Healthy Future:
A report on Child Health in Luxembourg

OBSERVATOIRE
NATIONAL DE LA SANTÉ

Healthy Future:

A report on Child Health in Luxembourg

Observatoire national de la santé, 2023

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Acknowledgments

This report consists of data, indicators and information that have been collected from several administrations and entities. The process of selecting the indicators and sources of suitable data would not have been possible without close collaboration with the administrations and bodies that produce these data, to whom we would like to express our sincere gratitude.

Overall, twenty different data sources were used, of which nearly half were supplied by the General Inspectorate of Social Security (IGSS) and a third by the Directorate of Health. Within the IGSS, our thanks go to the Etudes et analyses department and to the informatics department for their invaluable contribution. Within the Directorate of Health, the epidemiology and statistics unit made a major contribution, along with the Departments for innovation and support, Preventive medicine and population health, Healthcare, and Sanitary protection. The HBSC survey team provided essential data, as did the national registers (Perinat registry, national cancer registry, trauma and accident registry, national population registry), the eSanté Agency, Statec, Luxembourg Institute of Socio-Economic Research, and the Mobility Observatory.

Our analyses would not have been possible without the contribution of all the people who collect and process these data, without their expertise, and without their kind comments and advice throughout the preparation of this report. We cannot list them all here, but our warmest thanks go to them all.

We would also like to express our warmest thanks to Corinne Alberti, Armand Biver, Karine Chevreul and Silvana Masi for their participation in the panel of experts to select the indicators, to Philippe Van Kerm for his contribution to the analysis of inequalities in COVID-19 and vaccination against this disease, and to Laëtitia Huiart for her contribution on the effects of COVID-19 on children's health, and for her general review of the report.

Finally, this report would not have been possible without the contribution of the entire ObSanté team, who offered their continued assistance, talents and skills throughout the entire process, and the guidance, constructive comments and support provided by the Council of Observers.

Foreword

When I was asked to take up the reins of the National Health Observatory (ObSanté), it was with real enthusiasm that I approached this new challenge: setting up a structure whose mission is to make the most of available data to support evidence-based health policies and decisions - that's an inspiring mandate!

Indeed, all the data I've had the opportunity to work with throughout my career holds enormous potential, which all too often remains untapped. The pandemic has illustrated the importance of assembling data from multiple sources and putting it in the context of a country and healthcare system to support health policy making. ObSanté's legal framework now allows the secondary use of data from Luxembourg administrations, public entities and organizations, to assess the health status of the population and the performance of the health system.

Our ambition at ObSanté is to offer national expertise in health system performance assessment, based on a reference framework adapted to the Luxembourg context and on relevant indicators. Driven by our values of independence, integrity and transparency, we intend to become a trusted partner of the public, healthcare providers, patients, decision-makers and all stakeholders. We strive to produce reliable and usable information to support strategic orientations and policies fostering the health of the population and the sustainability of the healthcare system.

For ObSanté, 2023 represents its first full year of operation; twelve months that have proved to be intense for our small team, as we have had to carry out the foundation work required to start operating this very young administration, while already launching the first analyses and the production of indicators that would feed into the reports as required by law.

This report has a special significance, as it is the very first thematic analytic report prepared by ObSanté, and it is the first attempt to use reference frameworks to 'order' indicators relating to the health of the population and the response of the healthcare system to the needs of that population. The theme of Child Health, was chosen by the Council of Observers, following a selection process based on objective criteria. I can’t deny that, as a paediatrician, I was sensitive to this choice.

I am convinced—and there is ample evidence to support it—that public health policies should be guided by an assessment of children's health and its determinants, and that investing in health from the earliest age is the most effective strategy for achieving optimal health in adulthood. By devoting the first ObSanté analyses to these issues, the experts of the Council of Observers clearly expressed the importance they attach to children's health, now and in the future.

In line with ObSanté's mission, this report presents validated and robust data and indicators which decision-makers and stakeholders can use to develop their strategies for promoting, preventing and improving health from an early age. It can be a useful basis for measuring the results of health policies and, where necessary, adapting programmes. This report presents the most objective information available for an initial assessment, which may be enriched in the future. As for the reference frameworks used for this report, they will be adapted, and their use fine-tuned over the coming years to best reflect the specific characteristics of the Luxembourg healthcare system.

We hope that this report will provide a constructive contribution to the public debate and to decisions that will give every child the opportunity to grow up healthy in Luxembourg and achieve the best possible state of health and well-being.

Strassen, January 2024
Françoise Berthet
President

Executive Summary

Investing in child health in Luxembourg

Children from 0 to 12 years account for almost 14% of the current population living in Luxembourg. They represent Luxembourg's future, and over and above their fundamental right to good health, it should be in every country's own interests to provide them with every opportunity to grow up healthy and well. To achieve this, policy-makers need to know how children are doing in terms of health, where improvements are needed and where blind spots in data need to be addressed. This information lays the foundations for the design, implementation and monitoring of age-sensitive policies that best serve the needs of children to grow up healthy and develop their full potential later in life.

This first report by the Observatoire national de la santé (ObSanté) offers a comprehensive picture of child health in Luxembourg. It uses indicators, based on data available from various sources in Luxembourg, to look at the past and present of child health, health behaviours and the health system for children in Luxembourg, and to provide a baseline for future assessments.

The state of child health in Luxembourg

Health Status and Behaviours: Between 2014 and 2022, overweight and obesity increased from 15% to 22% among boys, and from 11% to 16% among girls. Healthy behaviours among 11 to 12 year olds have not improved or have even declined over the last decade. Children from poorer backgrounds are less likely to report behaviours that are good for their health. Daily fruit and vegetable consumption was reported by 39% of children from richer households compared with 18% for those from poorer households. In 2022, regular physical activity was reported by 49% of children from richer households compared with 37% from poorer households. Child mortality rates are low, yet two out of three deaths are from causes considered as largely treatable or preventable.

Self-rated and mental health: More than half of the 11 to 12 year olds rated their health as less than excellent in 2022. The incidence of psychosomatic health complaints has increased, particularly among girls: of whom 43% had experienced these problems several times a week or even daily over the previous six months. Economic disparities are also evident in this area. Compared with children from poorer households, children from wealthier ones are more than twice as likely to report excellent health (52% vs. 23%). Similarly, children from poorer households are almost twice as likely to report frequent multiple health complaints as their counterparts from wealthier households (63% vs 34%).

Maternal Health: The self-reported data on maternal health behaviours during pregnancy show low levels of smoking (6.7% in 2021) and alcohol use (1.9% in 2021).

COVID-19: The short-term impact of COVID-19 on children's physical health has been limited. However, more studies are needed to assess how the pandemic has affected children's mental health and overall wellbeing in Luxembourg, as well as the long-term effects on health, as current evidence is insufficient to conclude.

The health system for children

Paediatricians play a prominent role in the care for children in Luxembourg, including primary care: they provide between 97% (age < 1) and 63% (age 4 to 9) of all consultations for children during the first ten years of life. More than 40% of paediatricians are over the age of 50. Nevertheless, the number of paediatricians is increasing, and at 0.19 paediatricians per 1000 inhabitants, it is higher in Luxembourg than in Belgium, France and the Netherlands, and similar to that in Germany. Further analysis is needed to assess whether this is sufficient to meet the demand for paediatric services, as the number of paediatricians required to

effectively cover the needs of children depends on the specific organization of care within the health system. The staffing levels of obstetricians (0.18 per 1000 inhabitants) and midwives (34.3 per 1000 live births) are similar to those in neighbouring countries.

The health system reaches young children effectively through high rates of vaccination, health check-ups and screening participation. Over 90% of children before 2 years old engage in recommended health check-ups. However, this participation rate falls after the second birthday, with 40% of children attending a speech and language screening with hearing test at 30 months after birth, 42% of children attending both preventive medical visits at 3 years old and 19% attending a preventive dental visit at 4 years of age. The effectiveness of these health interventions in improving child health remains to be fully assessed.

Specialized hospital care for children is centralized at the CHL-Kannerklinik. The national density of hospital beds for paediatric care decreased over a 5 year period, to 3.9 beds per 10 000 children in 2021. The number of available maternity beds was 14.9 per 1000 live births in 2021, which is lower than the number available in France (20 beds per 1000 live births in 2020).

Socioeconomic differences

The report highlights significant socioeconomic differences in health behaviours and the health of children. Children from poorer families have worse health outcomes and engage in less healthy behaviours than children from richer families. The available data also suggests that this gap has increased over the last decade. For the health system, the very low levels of unmet medical and dental care needs among children in Luxembourg indicate equitable access to services.

Recommendations

There is an urgent need to counteract the increase in overweight and obesity, and to foster and support better health behaviours among children. This will not only improve children's current health, but will also lay the foundations for healthy adolescent and adult life, particularly (although not only) for economically disadvantaged children.

A national plan towards child health would allow the establishment of common goals for the promotion, protection and improvement of the health of all children. This can best be achieved by multisectoral efforts. Strategic alignment that goes beyond the health system is needed to address the different determinants of child health, including—but not limited to—socioeconomic, demographic, commercial and environmental factors, and to implement coordinated health interventions in homes, schools and municipalities. By recognizing the existence of inequities in child health, such a plan could include health policies and interventions aimed at reducing the disparities, while at the same time benefiting all children, whatever their background.

There is a need to address data gaps and foster research into child health in Luxembourg, in particular, concerning the health and health behaviours of children before the age of 11 years. As a first step, improved data quality and information systems would enable more systematic secondary use of data. In this regard, the health data collected by school medical services represents a very rich resource to monitor the health of school-aged children. Similarly, the collection and accessibility of data on screening outcomes, diagnoses and the reasons for consultations at the primary care level would be important. This would allow people to draw a richer and more accurate picture of the health outcomes for children, to evaluate the effectiveness of existing programmes and interventions to improve child health, and to answer questions regarding the efficient use of resources.

Overall, efforts to improve child health should be evidence-based and need to be evaluated using suitable data to ensure they achieve their stated goals and contribute to the reduction of health inequities. Importantly, these efforts should also aim to investigate and improve the health determinants that go beyond the health system.

Contents

List of acronyms

APGAR	*Aspect – Pouls – Grimaces – Activité – Respiration* (Appearance – Pulse – Grimaces – Activity – Respiration)
AMM	*Assurance maladie-maternité*
ATC	Anatomical Therapeutic Chemical Classification System
BE	Belgium
CAE	*Caisse pour l'avenir des enfants*
CH	Switzerland
CHdN	*Centre Hospitalier du Nord*
CHEM	*Centre Hospitalier Emile Mayrisch*
CHL	*Centre Hospitalier de Luxembourg*
CIRC	*Centre international de recherche sur le cancer*
CNS	*Caisse nationale de santé* (National health fund)
COVID-19	Coronavirus Disease 2019
CSMI	*Conseil supérieur des maladies infectieuses*
CUSS	*Couverture universelle des soins de santé*
CVE	*Carnet de vaccination électronique* (electronic vaccination record)
DCSH	*Documentation et classification des séjours hospitaliers*
DDD	Defined daily dose
DE	Germany
ALOS	Average length of stay
DPT	Diphteria, pertussis and tetanus
DSP	*Dossier de soins partagé* (electronic health record)
ECDC	European Centre for Disease Prevention and Control
ECHI	European Core Health Indicators
EHIS	European Health Interview Survey
ENCR	European Network of Cancer Registries
ERN	European Reference Networks
EU-SILC	EU statistics on income and living conditions
FR	France
GIMB	*Gesond iessen, méi bewegen*
HBSC	Health Behaviour in School-aged Children
HPV	Human papilloma virus
HSPA	Health System Performance Assessment
HRS	*Hôpitaux Robert Schuman*
ICD-10	International classification of diseases, tenth revision
IDB	*Injury database*
IGSS	*Inspction générale de la sécurité sociale*
BMI	Body mass index
KJT	*Kanner-Jugentelefon*
LIH	Luxembourg Institute of Health
LMDP	Luxembourg Microdata Platform on Labour and Social Protection

LNS	*Laboratoire national de santé*
MOCHA	Models of Child Health Appraised
NL	Netherlands
ObSanté	*Observatoire national de la santé*
OECD	Organisation for Economic Co-operation and Development
SDG	Sustainable development goals
OKaJu	*Ombudsman fir Kanner a Jugendlecher*
WHO	Wolrd Health Organisation
ORL	Otorhinolaryngology
PCR	Polymerase Chain Reaction
PERINAT	*Système de surveillance de la santé périnatale* (Perinatal Health Monitoring System)
PIMS	Pediatric Inflammatory Multisystem Syndrome
MHC	Multiple health complaints
AMR	Antimicrobial resistance
RETRACE	*REcueil d'informations sur les Traumatismes et Accidents* (Monitoring Injuries and Accidents in Luxembourg)
GDPR	General Data Protection Regulation
RNC	*Registre national du cancer*
MMRV	Measles-Mumps-Rubella-Varicella Vaccine
SARS-CoV-2	Severe Acute Respiratory Syndrom - Coronavirus
STATEC	*Institut national de la statistique et des études économiques*
ADHD	Attention deficit hyperactivity disorder
NIPT	Noninvasive prenatal testing
UNICEF	United Nations International Children's Emergency Fund
RSV	Respiratory Syncytial Virus

Introduction

As of 1 January 2023, approximately 14% of the population in Luxembourg were children younger than 13 years, corresponding to 90 862 individuals. The current report focuses on these children and their health.

Good health during childhood is a major component of proper physical and mental development. A healthy upbringing does not just affect a child's life during their younger years; it is also the foundation for a healthy life as they grow older.[1]

The health of children can be affected by many different factors. Some of these factors can be influenced by the child or their caregivers, while others may not. Healthy behaviours in nutrition, physical activity and preventative health care are all important for the maintenance of health. In addition, the environment children grow up in matters, including their exposure to dangers such as second-hand smoking, environmental pollution, physical and emotional violence at home and in school, and the suitability of the built environment for children.[1] Recent global changes and new threats are having a disproportionate effect on children, undermining the conditions necessary for their healthy growth and future. Children face distinct challenges from climate change, with their anatomy, physiology and metabolism making them more susceptible to health issues caused by environmental changes.[2,3] The COVID-19 pandemic is another recent example, disrupting children's daily lives and significantly affecting their well-being.[4,5] Economic crisis and uncertainty particularly affect the poorest families, widening further the existing gap in inequality of opportunity for all children.[6,7]

One important aim of initiatives to enhance children's wellbeing is to minimize disparities in health among them. Differences in health exist in every society, even in wealthier nations such as Luxembourg. Children who live in poverty, violence-affected environments or marginalized groups often face more significant health challenges compared with those growing up in stable and prosperous conditions. In 2021, some 28.6% of minors (under 18 years of age) in Luxembourg were at risk of poverty, which is a significantly higher proportion than for the general population. It was particularly high for those living in single-parent families or families with a migration background.[8,9] Some 8% of children face material deprivation in Luxembourg, lacking important material resources, such as access to appropriate clothing or leisure activities.[10,11] To improve children's health, policies must acknowledge the existence of these societal groups and should address their specific needs.

The aim of this first report from ObSanté is to provide a solid foundation of data that can help shape better policies for children's health in Luxembourg. The report focuses on important indicators related to child health and the health system that caters to children. We selected these indicators and gathered data from various sources in Luxembourg to describe the current state of health of Luxembourg children, as well as how the health system is serving them. The population we investigate spans from conception up to the age of 12 years. Where possible, we track the progress of these indicators over time and compare our results with those of other countries. A full assessment of all areas affecting child health is beyond the scope of this report. Nevertheless, the report aims to take the influence of outside factors into account by providing differences in the indicators by socioeconomic backgrounds.

This report should serve as a source of inspiration and support for the development of improved child health policies in Luxembourg. We want the report to be accessible and useful for all individuals and organizations involved in child health, and to empower stakeholders to hold decision-makers accountable and advocate positive changes to enhance the health of children.

The report is split into two parts. The first describes child health and health behaviours, as well as maternal health during pregnancy. The second part focuses on the health system serving children and pregnant mothers. At the end of the report we highlight important findings, discuss the limitations of the report, and provide some recommendations for the way forward.

Methodology

This report uses quantitative data and qualitative information to describe the health of children in Luxembourg, and the health system serving children.

Target population

The report focuses on children from the age of conception up to and including 12 years of age, limiting the scope of the report to younger children. Based on the latest population data, on 1 January 2023, some 90 862 children from 0 to 12 years old were registered residents of Luxembourg and represented about one in seven of its inhabitants. Of those children, 0–4 year olds made up 37.5%, 4–9 year olds 39.1% and 10–12 year olds 23.4%. In 2022, the number of births among the resident population was 6690.[12] Eurostat projections estimate the population of children from 0 to 12 years old will reach about 110 000 in 2050.[13]

Due to the particular situation of Luxembourg, with a considerable number of cross-border workers, the health system also serves people working in Luxembourg but not resident there. For the current report, this is of particular relevance regarding pregnant cross-border workers, who choose Luxembourg to deliver their baby or to use the system during pregnancy. Hence, the population of interest depends on the respective indicator. For health status and health behaviours, the focus tends to be on the resident population, while the health system should be designed to serve the entire insured population, including cross-border workers.

The period covered in this report is from 2011 up to the most recent year for which data was available. This ensures that trends over recent years were observable and could provide context for results based on the most recent year.

Child health

To identify and describe relevant areas for the health of children up to the age of 12, we used Section 4, 'Are Children Active and Physically Healthy?' of the report *Measuring What Matters for Child Well-Being and Policies*, published by the Organisation for Economic Co-operation and Development (OECD).[1] We follow the areas and measurements identified in this report to describe children's birth outcomes, physical development, health status and health behaviours as they grow up. The OECD report also includes the family and the home environment, as well as health policies as important determinants of child health. The family and home environment are covered by looking at maternal health and health behaviours during pregnancy, as well as the analysis by household income groups. Existing policies to improve child and maternal health are included in a description of the health system in Luxembourg.

The health system

An important contributor to child health is the ability of the health system to provide services that prevent and treat ill health among children. Many countries have developed a framework tailored to their specific health system context that specifies the relevant measurements to be included in a Health System Performance Assessment (HSPA). No HSPA framework yet exists for Luxembourg. For this report, measurements and indicators were selected to describe the health system in terms of its response to the health-related needs of children, based on the generic HSPA framework of the WHO.[14]

This framework only assesses actions within the health system, while acknowledging the impact of socioeconomic determinants that lie outside the boundaries of the system (Figure 1). The actions inside the framework are grouped into four interconnected functions of service delivery, governance, financing and resource generation.

Apart from the financing for child health, which does not differ fundamentally from the financing of any other health service provided in the country, the health system in Luxembourg is described along the lines of these functions. Service delivery—in other words, the health services that are available for children in Luxembourg—is separated into public health, primary care and specialized or hospital care. Service delivery in these different sectors of the health system is then evaluated through the lens of their effectiveness and accessibility, and—where possible—also considering potential systematic differences in the ways in which different population groups are served by the system. User experience and efficiency were not analysed in this report. For user experience, no suitable indicators could be identified. The efficiency of the health system was not analysed as it is not a topic specific to child health but should be assessed within the health system as a whole. It is not clear that a more efficient use of resources would result in better child health, as the freed-up resources might be used elsewhere in the health system.

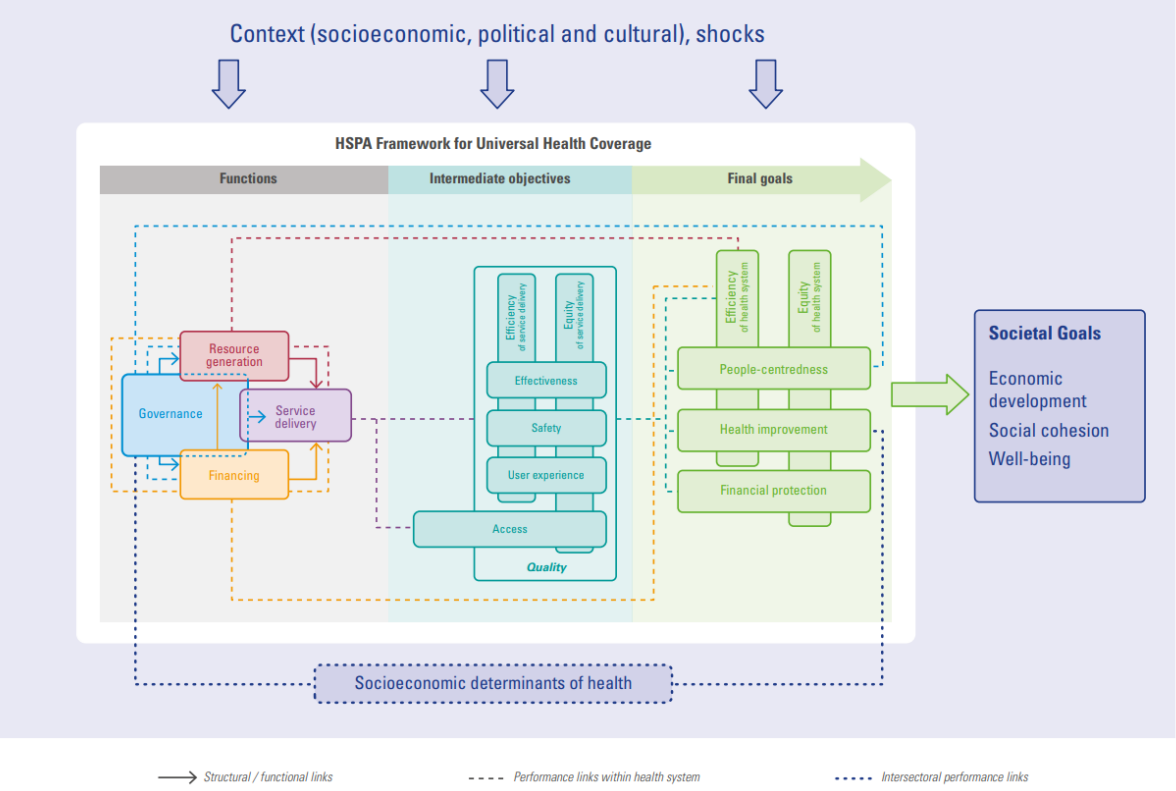


Figure 1: HSPA Framework for Universal Health Coverage.

Source: Health system performance assessment: a framework for policy analysis. WHO 2022.

Selection of indicators

In line with the identified areas of child health and the health system, a comprehensive selection of indicators was compiled, based on scientific literature and published reports. For international comparability, indicators used by international health institutions, such as the WHO, OECD and Eurostat, were also screened.

A panel consisting of four experts within the fields of public health, paediatric care and the Luxembourg health system were tasked with selecting indicators with the highest quality. Their role was to review and assess the indicators by scoring them from 1 (very low) to 10 (very high) on three criteria:

1. Validity: The indicators needed to measure the intended aspects of child health and wellbeing, and of the health system, providing reliable and meaningful information.
2. Feasibility: The selected indicators had to be practical and feasible to measure within the context of our research, ensuring obtainable data.
3. Actionability: The chosen indicators had to have the potential to drive actionable change, providing insights and information to support effective policies and interventions to improve child health in Luxembourg.

A cut-off of an average score of seven was then used to identify indicators of suitable quality to be used in the report. Using the criteria ensured a rigorous and relevant process of indicator evaluation. This systematic approach allowed us to select indicators that offer insights into various areas of child health and the health system.

A total of 89 indicators were accordingly selected and are presented in this report (see full list in the Appendix).

Data sources

The data for the indicators comes from existing data sources in Luxembourg, including administrative data and data collected through national or international surveys. No new data collection was undertaken. If possible, the data covers the years 2011 to the most recent year available. The sources we used are described in detail in the Appendix at the end of the report. The data source is specified for each indicator used throughout the report.

To make international comparisons, where relevant, we have used data from standardized surveys or collections. We chose to compare to several different countries. First, all three neighbouring countries, France, Belgium and Germany, where all cross-border workers come from that make up a large share of the countries labour force. Switzerland as a relatively affluent and small country, and the Netherlands, who are considered to have a very efficient and high-quality health system.

Analysis

The indicators we use were calculated directly by the data provider, or if we received the raw data, were calculated by the data team at ObSanté. Where necessary, we sought help from the original data provider and consulted with experts with regard to the interpretation of indicators.

Where it was possible and relevant, we stratified the indicator results by a measurement of age categories, gender, socioeconomic status and by migration status. Further details on the applied definitions for those categories can be read under the respective data source in the Appendix. To show trends over time, if the data allowed we tracked the indicator's development over approximately the previous 10 years.

The underlying population of each indicator depends on the available data source, as well as the goal of the indicator. As a rule of thumb, to assess the performance of the health system, which normally provides access to care for everybody insured in the national health insurance of Luxembourg, the population included affiliated residents and non-residents. In other cases, the population of interest was the resident population. This was the case, for example, for many health status and health behaviour indicators that can be influenced by public health efforts that mostly reach the resident population of children.

Health status and determinants

1. Health determinants

The behaviours and activities children engage in can affect their health. With increasing age, they become more autonomous and start making their own choices. This includes activities that can be beneficial or detrimental to their health. Early exposure to alcohol, tobacco, and a diet high in sugars and fats, but low in fruit and vegetables can have long-term detrimental effects on health. On the other hand, good nutrition and physical activity can be of benefit.[1]

This section relies, to a large extent, on data from the Health Behaviour in School-aged Children (HBSC) survey. The survey also provides results stratified by a measure of economic status of the household which we use to identify potential differences in the indicators between groups with different levels of wealth. The HBSC collected this information by asking pupils: “How well off do you think your family is?” with answers ranging from 1 “not at all well-off” to 5 “very well off”. Answers 1 to 2 were combined by the HBSC team to "not well off" and 4 to 5 to "well off". Answer 3 was labelled as "average".[15]

Main findings for children aged 11 to 12 years:

- Apart from fruit and vegetable consumption, most health behaviours have worsened over the last decade. While in 2010, some 68% of boys and 44% of girls reported vigorous physical activity at least four times per week, by 2022 it had decreased to 57% of boys and 36% of girls. Seven percent of boys and 4% of girls reported drinking alcohol in the past 30 days in 2022.
- Children from poorer families reported worse health behaviours than children from better-off ones. While 39% of children from well-off families reported daily fruit and vegetable consumption in 2022, only 18% of the children from less well-off families reported the same.
- In comparison with other European countries, Luxembourg is placed in the middle in terms of health behaviours, indicating potential for improvement.
- Data on health determinants for young children aged 0–10 years is lacking. Five of the six indicators presented are sourced from HBSC and assess behaviours and determinants of children 11 years old and above.

Main findings in terms of maternal health:

- In 2021, fewer than 2% of women reported having consumed alcohol while pregnant and fewer than 6% reported regular smoking during the third trimester.
- Anonymous surveys would be of added value to confidently monitor trends of smoking and alcohol behaviours during pregnancy.

1.1 Nutrition and eating behaviours

While infants, children and adolescents grow and their bodies develop, it is important that their dietary intake supplies the necessary micronutrients and macronutrients required for strong physical development. Early-life nutrition habits are often carried over to adulthood, meaning that children with a healthy diet also often eat more healthily during adulthood and vice versa.[1,16]

BREASTFEEDING

Breastfeeding has positive effects for the health of both the child and the mother. It contributes to the development of the child’s immune system and thereby reduces the risk of infections for newborns and very young children. Some scientific studies have also found long-term

benefits of breastfeeding, as it may help reduce the risk of obesity, diabetes and cardiovascular disease as an adult.[17,18] The first days and weeks after birth are of crucial importance to promote continued breastfeeding. Mothers who are exclusively breastfeeding as they leave the maternity ward of their hospital are much more likely to continue breastfeeding during the first six months of the child's life.[19]

For Luxembourg, we show the proportion of mothers who reported if they exclusively breastfed their child upon leaving the maternity ward, or if they gave their children baby formula or a mixture of formula and breastmilk.

Exclusive breastfeeding decreased between 2011 and 2021; from 80.9% to 73.3%. Exclusive formula use remained stable at around 11%, while the mixed use of both formula and breastfeeding increased from 8.1% to 15.2% between 2011 and 2021 (Figure 2).

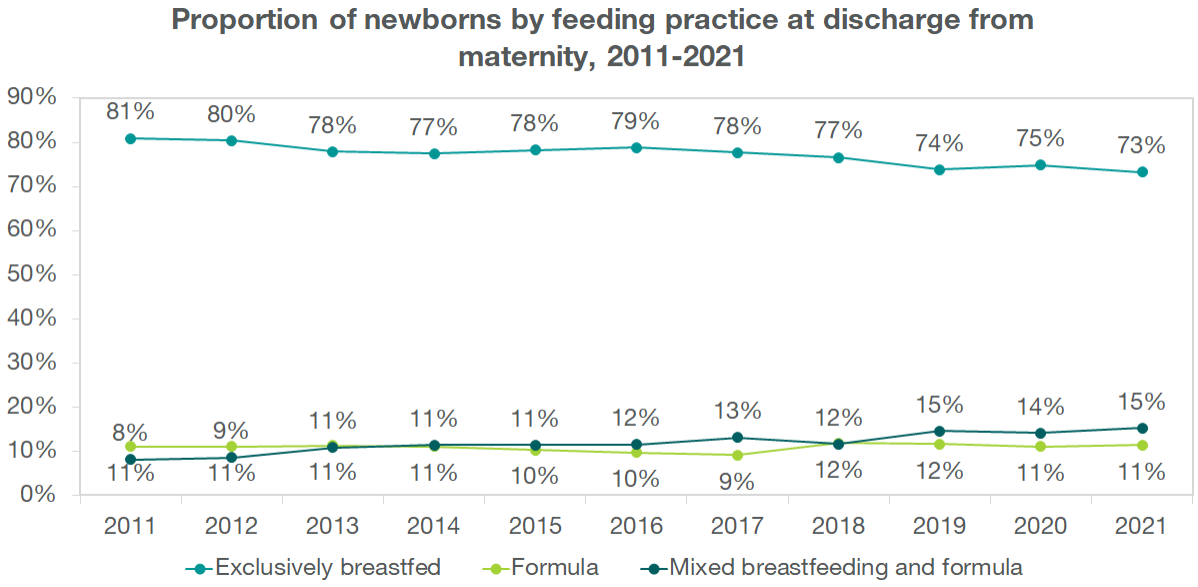


Figure 2: Proportion (%) of newborns by feeding practice at the time of discharge form maternity in Luxembourg, 2011–2021.

Source: PERINAT.

International comparisons are difficult, due to differences in data collection and the limited availability of recent data.[20] However, a recent study identified data from 11 European countries and concluded that 56% to 98% of infants in all observed countries were given some breastmilk.[i] They also found that breastfeeding decreased over time after birth, and that at six months, 13% to 39% of infants were exclusively breastfed.[20]

FRUIT AND VEGETABLE CONSUMPTION

Fruit and vegetable consumption is an important marker for healthy eating. Eating fruit and vegetables rather than foods high in sugar, salt and fat can protect against obesity and related diseases in childhood and in later life.[21]

In Luxembourg, the proportion of girls and boys 11 to 12 years old who reported consuming both fruits and vegetables at least once a day has increased during recent years. In particular,

[i] The countries included were Belgium, Croatia, Denmark, Germany, Ireland, Italy, The Netherlands, Norway, Spain, Sweden and Switzerland.

boys increased their consumption over recent years and caught up with the levels of girls in 2022 (Figure 3).

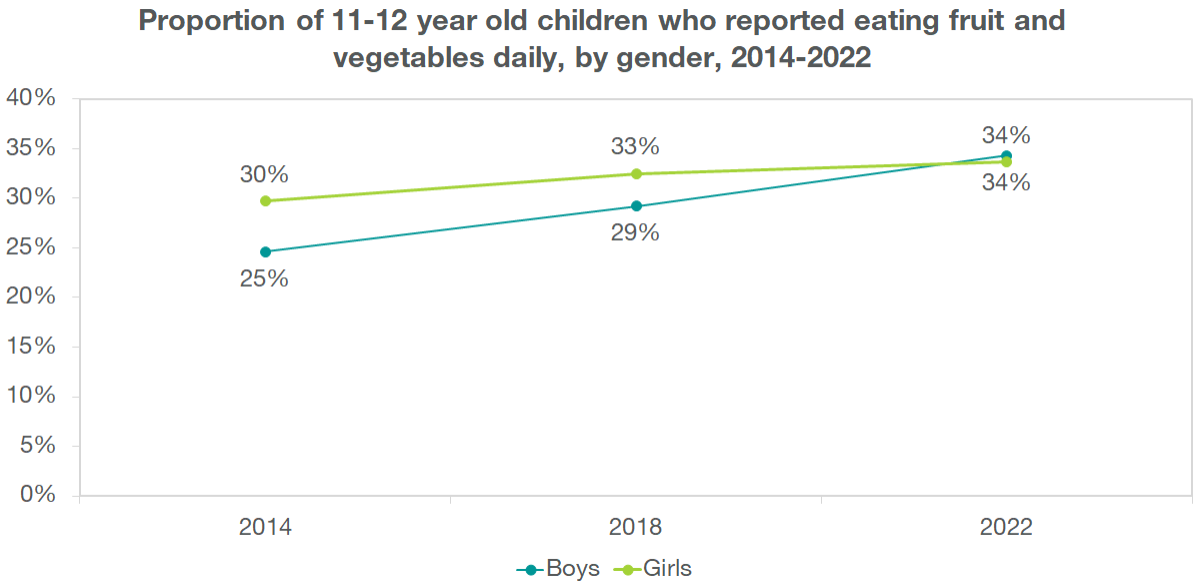


Figure 3: Proportion (%) of 11–12 year old schoolchildren who reported eating fruit and vegetables daily, by gender, 2014–2022, Luxembourg.

Source: HBSC.

There are apparent differences by socioeconomic status, as proxied by self-perceived household wealth. Children who perceived their family to be well-off reported the highest fruit and vegetable consumption in all years (Figure 4). Furthermore, daily consumption increased among well-off children and those from families with average wealth, while it decreased among children who are not well-off (financially poorer)over recent years.

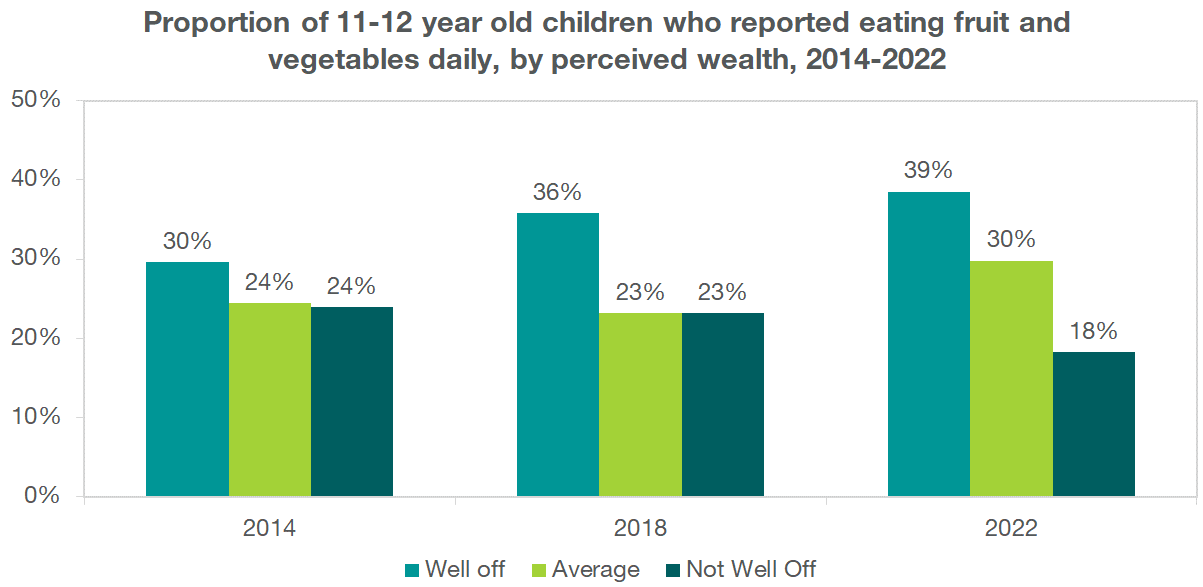


Figure 4: Proportion (%) of 11–12 year old schoolchildren who reported eating fruit and vegetables daily, by perceived wealth, 2014–2022, Luxembourg. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.

Source: HBSC.

No substantial differences were found linked to migration background or family composition (results not shown).

For comparisons of Luxembourg with other European countries, we had to use two separate indicators for the daily consumption of fruit and vegetables, respectively, as the international data does not provide a composite measurement.[ii] We found that in 2018, under half the children aged 11 in Luxembourg (48% for both boys and girls) reported consuming fruit daily. When we compared Luxembourg with the neighbouring countries, boys consumed more fruit than in Germany (41%) and the Netherlands (38%), and girls consumed more fruit than in France (42%). However, the proportion of girls and boys in Luxembourg who consumed fruit daily was lower than in the French speaking region of Belgium (56% and 57%). The pattern is similar for vegetables.[22]

DAILY BREAKFAST

Regular breakfast consumption is a marker for good diet quality in a household, and is associated with benefits, including healthy weight and generally good health behaviours, as well as better school performance and better health of children.[23]

In Luxembourg, 56% of girls and 59% of boys aged 11 to 12 years reported eating breakfast on every school day in 2022.[iii] Similar to the situation for fruit and vegetable consumption, socioeconomic status was associated with breakfast consumption, with children from poorer households (41%) being less likely to consume breakfast daily, compared with children from households perceived as well-off (61%) (Figure 5). Further stratifications also show that

[ii] International comparison – Proportion (%) of 11 year old schoolchildren who reported eating fruits daily, by country 2018. Source: HBSC.
International comparison – Proportion (%) of 11 year old schoolchildren who reported eating vegetables daily, by country 2018. Source: HBSC.
[iii] Proportion (%) of 11-12 year old schoolchildren who reported eating breakfast every school day, by gender 2022, Luxembourg. Source: HBSC.

children from families where both parents live in the household were more likely to eat breakfast (62%) than children from other family structures (46%) in 2022.[iv]

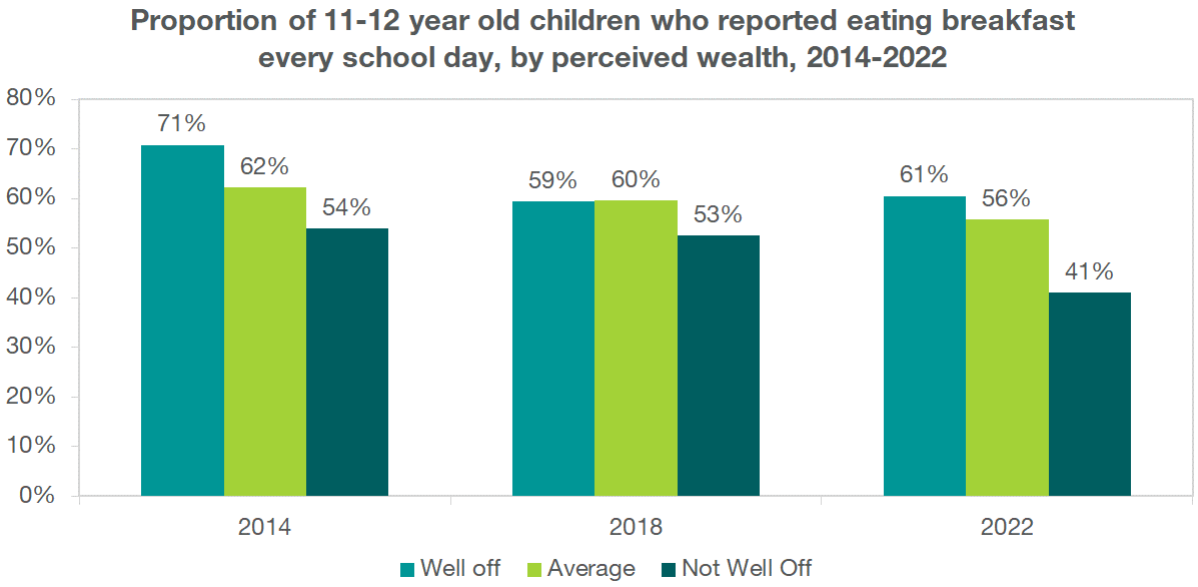


Figure 5: Proportion (%) of 11–12 year old schoolchildren who reported eating breakfast every school day, by perceived wealth, 2014–2022, Luxembourg.

Source: HBSC.

Compared with other European countries, in 2018 Luxembourg was at the lower end of daily breakfast consumption of 11 years old girls (61%) and boys (65%), Especially, compared to the Netherlands (girls 88% and boys 91%), but also compared to the Flemish speaking region of Belgium (girls 77% and boys 80%) and France (girls 72% and boys 75%) (Figure 6).[22]

[iv] Proportion (%) of 11-12 year old schoolchildren who reported eating breakfast every school day, by family structure 2022, Luxembourg. Family structure is categorized as family with two parents present in the household AND "other" family structure, that combines single parent household and living with other caretakers than parents.
Source: HBSC.

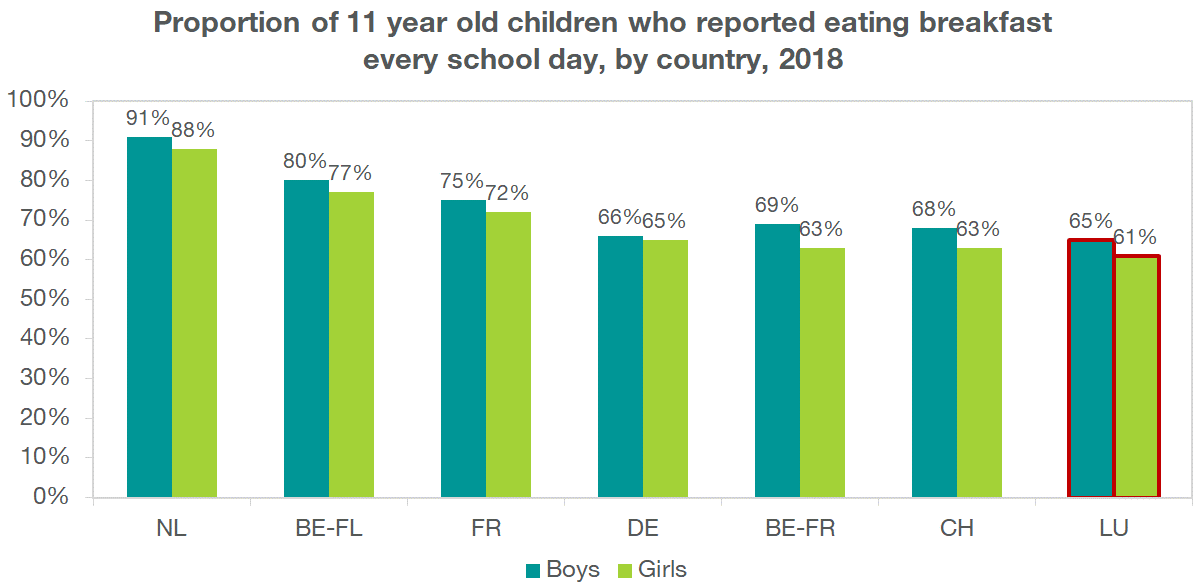


Figure 6: International comparison - Proportion (%) of schoolchildren aged 11 years who reported eating breakfast every school day, by country, 2018.

Source: HBSC.

1.2 Protective health behaviours

It is important for children to develop behaviours that are good for their health. They help to protect children from early health problems, such as tooth decay, allow them to develop motor skills, aid proper development of skeletal and bone health, and are often maintained throughout a person's life.[1]

DAILY TOOTH BRUSHING

Regular tooth brushing helps to prevent the development of dental caries, one of the most common preventable diseases among children. It can cause pain and infections that could affect eating, speaking, playing and learning.[24–26]

In Luxembourg, 78% of girls and 68% of boys aged 11 to 12 reported brushing their teeth twice a day in 2022,[v], in line with previous years.[27]

Children from less well-off families reported much lower levels of tooth brushing than children from better-off households (Figure 7). Further data show similar levels of tooth brushing by migration background (76% for no migration background to 74% for migrated children)[vi] and family composition (74% in families with both parents present and 70% in other families in 2022)[vii] (For more information on oral health see Sections 2.2 and 3.1).

[v] Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by gender, 2022, Luxembourg.
Source: HBSC.
[vi] Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by migration background, 2022, Luxembourg. Migration background is categorized as no migration background, the child migrated to Luxembourg and one or both of the parents immigrated to Luxembourg (the latter category is not displayed for this indicator)
Source: HBSC.
[vii] Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by family structure, 2022, Luxembourg.
Source: HBSC.

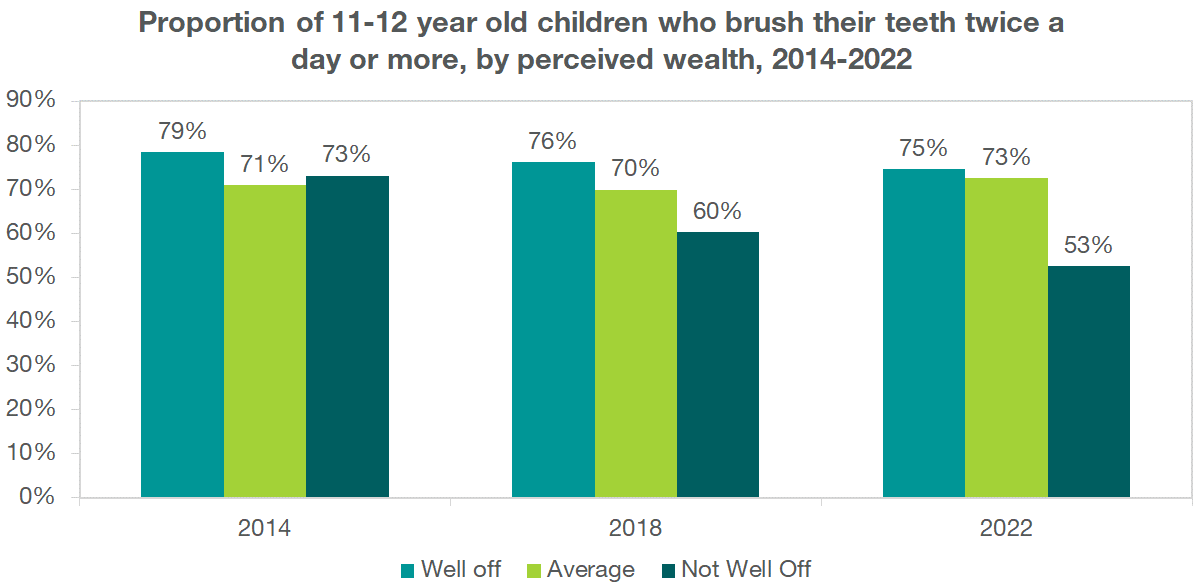


Figure 7: Proportion (%) of 11–12 year old schoolchildren who reported brushing their teeth twice a day or more, by perceived wealth, 2014–2022, Luxembourg.

Source: HBSC.

Compared with other European countries in 2018, children aged 11 years in Luxembourg (78% of girls and 71% of boys) had higher rates of daily tooth brushing (at least twice per day) than in Belgium (68% and 59% for, respectively, girls and boys in Flemish speaking Belgium and 67% and 59% in French speaking Belgium) and were similar to France (82% and 80%), but had slightly lower rates than Germany (86% and 79%), the Netherlands (82% and 80%) and Switzerland (91% and 84%)[viii].[22]

PHYSICAL ACTIVITY

Regular physical activity is important for the development of motor skills, a healthy cardiovascular system and maintaining normal weight. It is also good for mental tasks and can improve cognition, attention and performance in school.[28]

Conducting vigorous activity, defined as exercising enough to sweat or get out of breath, at least four times per week, declined over time in Luxembourg children aged 11 to 12 years. Girls reported less frequently being physically active than boys. In 2022, 36% of girls and 57% of boys reported engaging in vigorous physical activity at least four times per week (Figure 8).

[viii] International comparison – Proportion (%) of 11 year old schoolchildren who reported brushing their teeth twice a day or more, by country 2018.
Source: HBSC.

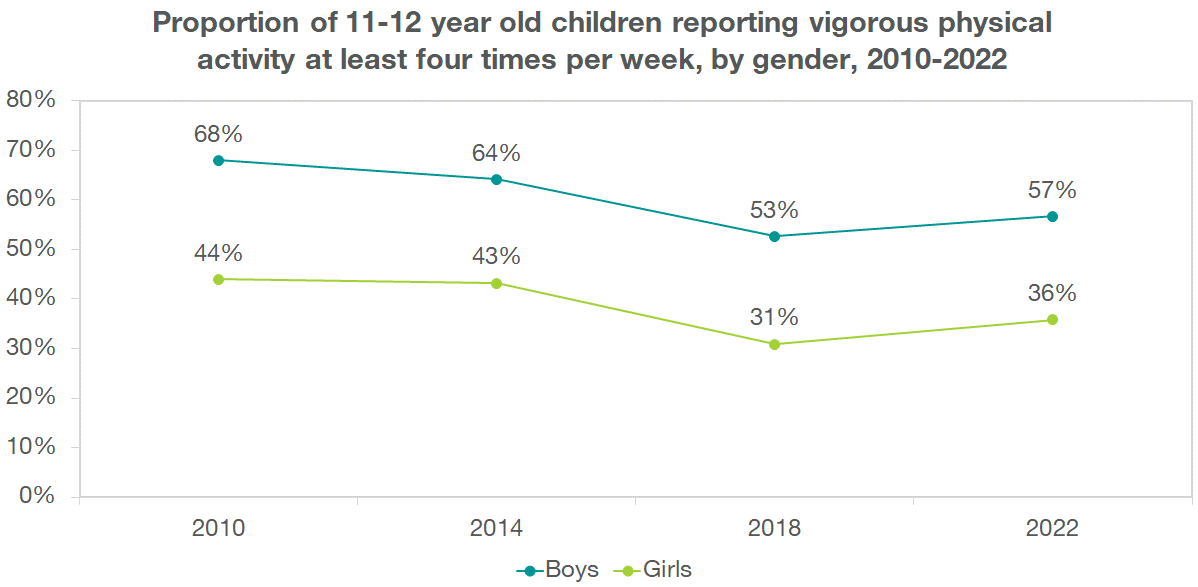


Figure 8: Proportion (%) of 11–12 year old schoolchildren reporting vigorous physical activity at least four times per week, by gender, 2010–2022, Luxembourg.

Source: HBSC.

Stratification by socioeconomic status again shows differences between well-off children and their less-well-off peers (Figure 9). Physical activity has decreased in all groups since 2014, but the decrease was greatest among children who reported being not well-off. This is the group that reported the lowest levels of physical activity. Differences by migration status also emerged: 41% of children who were born outside of Luxembourg and 46% of children with parents who migrated to Luxembourg reported exercising vigorously at least four times per week in 2022, compared with 50% of children without a migration background.[ix]

[ix] Proportion (%) of 11-12 year old schoolchildren who report vigorous physical activity at least four times per week , by migration background, 2022, Luxembourg.
Source: HBSC.

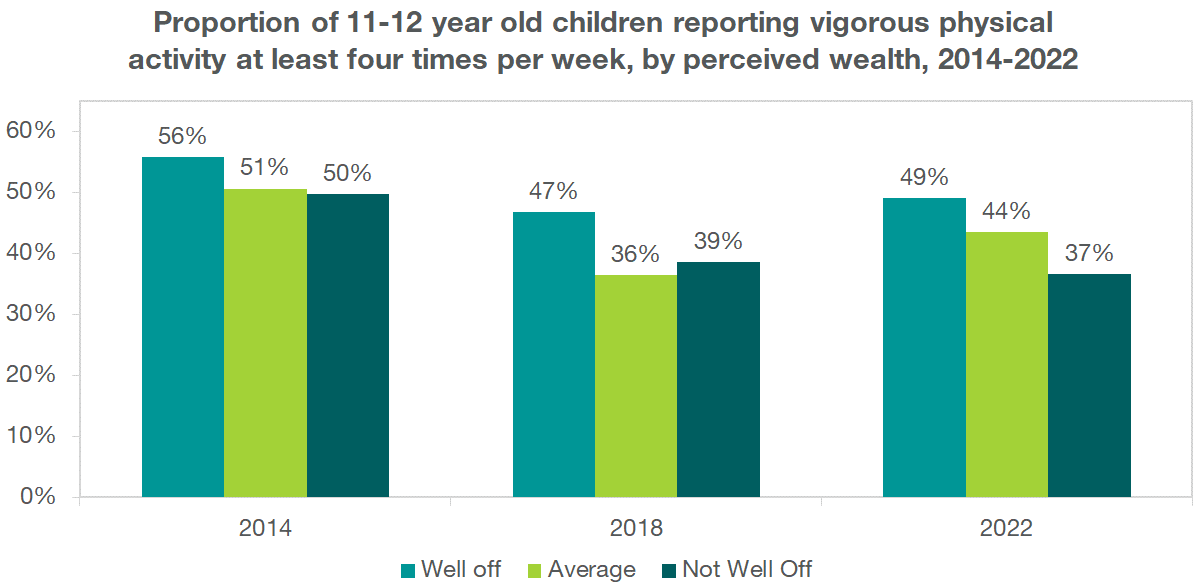


Figure 9: Proportion (%) of 11–12 year old schoolchildren reporting vigorous physical activity at least four times per week, by perceived wealth, 2014–2022, Luxembourg.

Source: HBSC.

Compared with other European countries in 2018, 11 year olds in Luxembourg reported lower levels of physical activity than in Germany and the Netherlands, and slightly higher than in France and French speaking Belgium (Figure 10).[22]

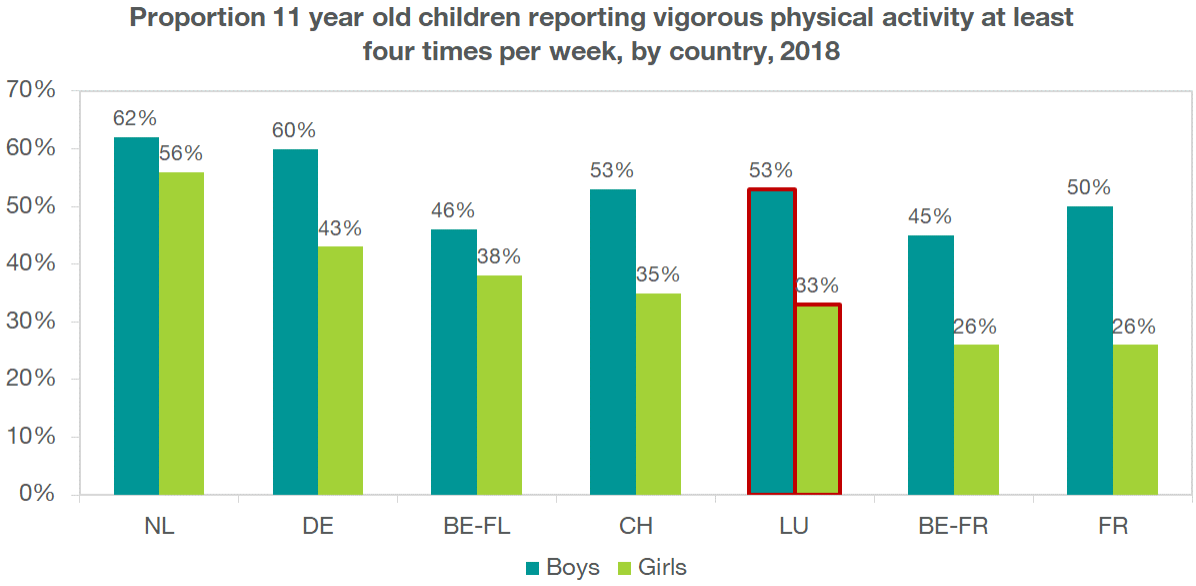


Figure 10: International comparison - Proportion (%) of schoolchildren aged 11 years reporting vigorous physical activity at least four times per week, by country, 2018.

Source: HBSC.

1.3 Risky health behaviours

As children become older and enter puberty, they become more independent, giving them the opportunity to partake in risky activities. In terms of health behaviours, they may start experimenting with drugs, including alcohol, cigarettes or cannabis. Even at low doses and with irregular use, these substances can be dangerous for their health and their development.[29,30]

ALCOHOL CONSUMPTION

Alcohol is one of the most common drugs consumed by adults in Luxembourg. Similarly, for children and adolescents, it is often the first substance to be consumed.[31] Early regular consumption can have negative consequences for the psychological development of children and their cognitive skills, and also increases the risk of accidents and violence.[29,30] Here, we used the proportion of children aged 11–12 who reported drinking alcohol in the previous 30 days to illustrate alcohol consumption in this age group.

Alcohol consumption among 11–12 year olds decreased from 2010 to 2022: from 8% to 4% for girls, and 10% to 7% for boys (Figure 11).

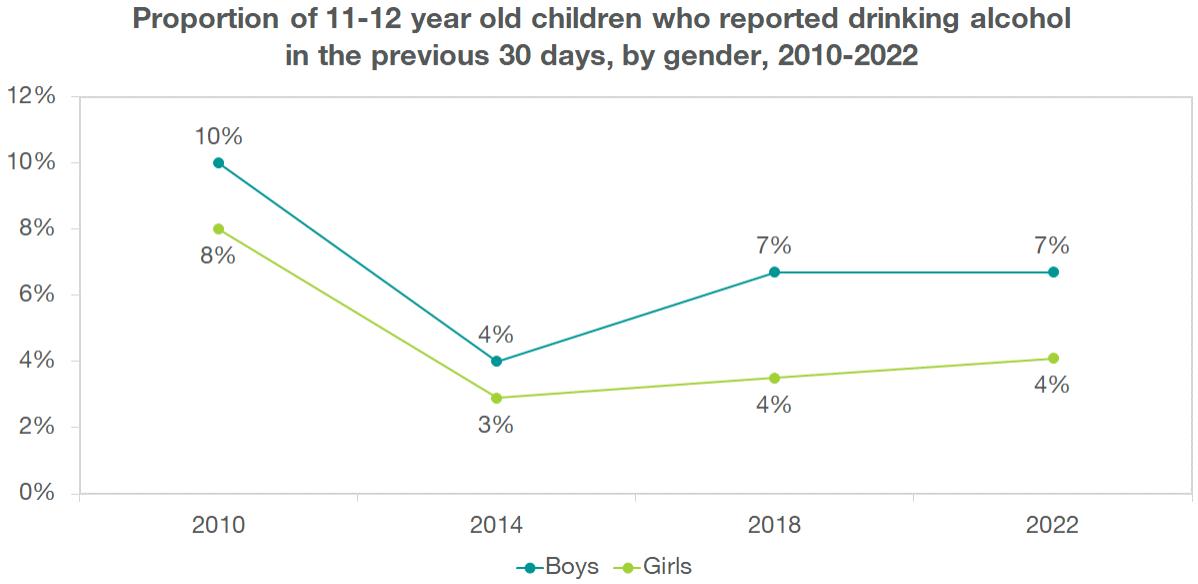


Figure 11: Proportion (%) of 11–12 year old schoolchildren who reported drinking alcohol in the previous 30 days, by gender, 2010–2022, Luxembourg.

Source: HBSC.

Due to the small number of children who reported alcohol consumption, we do not present differences by household wealth or household composition.

Compared with other European countries in 2018, for 11 year old children Luxembourg had lower rates of alcohol consumption for girls and boys than France, but higher rates than Germany, the Netherlands and Flemish speaking Belgium (Figure 12). In Luxembourg, as in all other countries used for comparison, boys were more likely to report drinking alcohol than girls. [22]

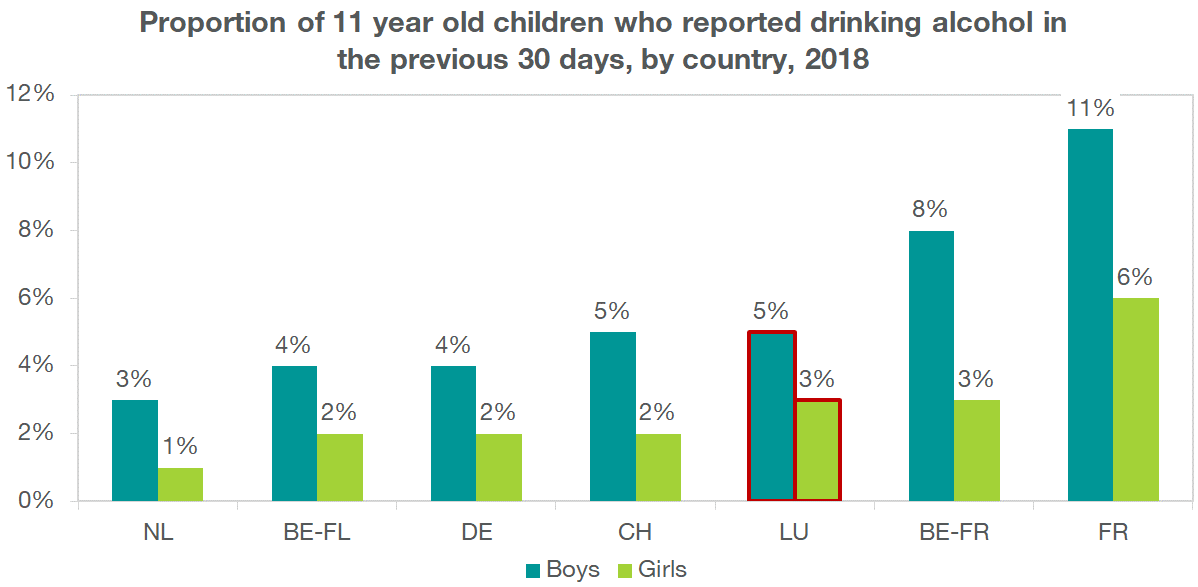


Figure 12: International comparison - Proportion (%) of schoolchildren aged 11 who reported drinking alcohol in the previous 30 days, by country, 2018.

Source: HBSC.

ADOLESCENT PREGNANCIES

Pregnancy during adolescence is a significant interruption to this important period of development for teenage girls. It can lead to major health consequences since adolescent girls may not yet be physically and biologically ready for pregnancy or childbirth.[32] Together with the number of abortions, it also provides evidence for the extent of early unprotected sex, which carries with it not only the risk of pregnancy, but also of sexually transmitted diseases.[33]

The data from the PERINAT registry shows only very few cases of delivery by mothers below the age of 15. Between 2011-2019, PERINAT registered less than 5 resident mothers below age 15.[x] Overall, birth in this age group is very rare and comparison with other countries difficult. In terms of abortions, a recent report showed that in 2022, some 0.8% of all 706 abortion requests in Luxembourg were for adolescent girls younger than 16, and that 31 minors had an abortion.[34]

1.4 Maternal health and behaviours

Pregnancy is a formative period for both the mother and the unborn child. Good maternal health and an environment with little exposure to harmful substances and stress reduce the risk of complications and increase the likelihood of the child living a long and healthy life.[35] Typical and well-known risks for mothers and children during pregnancy include exposure to tobacco smoke, alcohol consumption, chronic stress and poor nutrition, as well as obesity and high blood glucose levels as a result of diabetes.[35] This section uses several indicators to provide a picture over the last decade of the prenatal health of mothers and the exposure of unborn children to harmful substances.

[x] Number of resident adolescent mothers, below 15 years of age, within the years 2011-2019, Luxembourg
Source: PERINAT

ACTIVE AND PASSIVE SMOKING DURING PREGNANCY

Smoking increases the risk of complications during pregnancy.[36] The exposure of unborn children to maternal smoking increases the risk of birth defects, stillbirths, preterm births, low birth weight and infant deaths. It has further been associated with long-term health risks, including type 2 diabetes and hypertension, as well as behavioural problems.[36,37] Similar associations have been identified for passive exposure through second-hand smoking.[37–39]

The percentage of women who gave birth in a hospital and reported having smoked during the third trimester of their pregnancy has decreased over the last decade in Luxembourg.[40–42] Specifically, daily smoking rates during the third trimester decreased by almost half from 11.3% in 2011 to 5.6% in 2021 (Figure 13). As the rate of women occasionally smoking also decreased, in 2021, some 93.3% of women reported not having smoked, which is more than six percentage points higher than in 2011.

A recent worldwide study in 2015 estimated the percentage of women who had smoked at least one cigarette at any time during pregnancy. Compared with its neighbouring countries, which had smoking rates from 14.7% in Belgium to 19.7% in France, Luxembourg's smoking rate was relatively low at 10.0%; similar to the 8.0% estimated for Switzerland.[43]

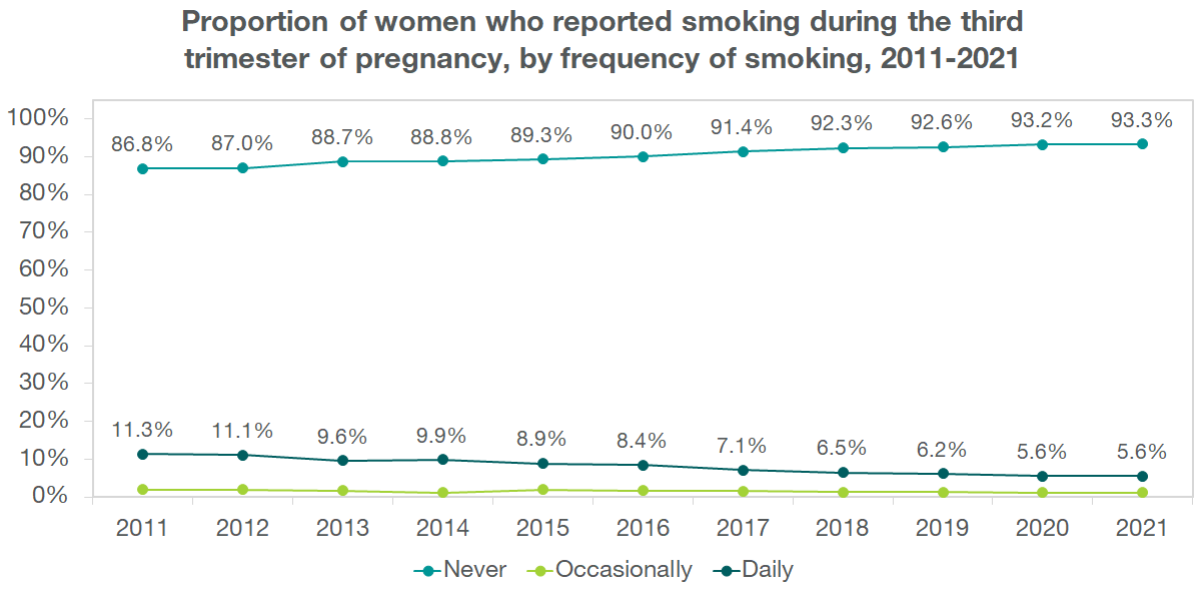


Figure 13: Proportion (%) of women who reported smoking during the third trimester of pregnancy among all women with live or stillbirths in Luxembourg, 2011–2021.

Source: PERINAT.

A similar trend can be seen for passive smoking, where occasional exposure decreased somewhat from 13.3% in 2011 to 11.9% in 2019, while daily exposure was reduced by almost half from 11.6% in 2011 to 5.6% in 2019 (Figure 14).

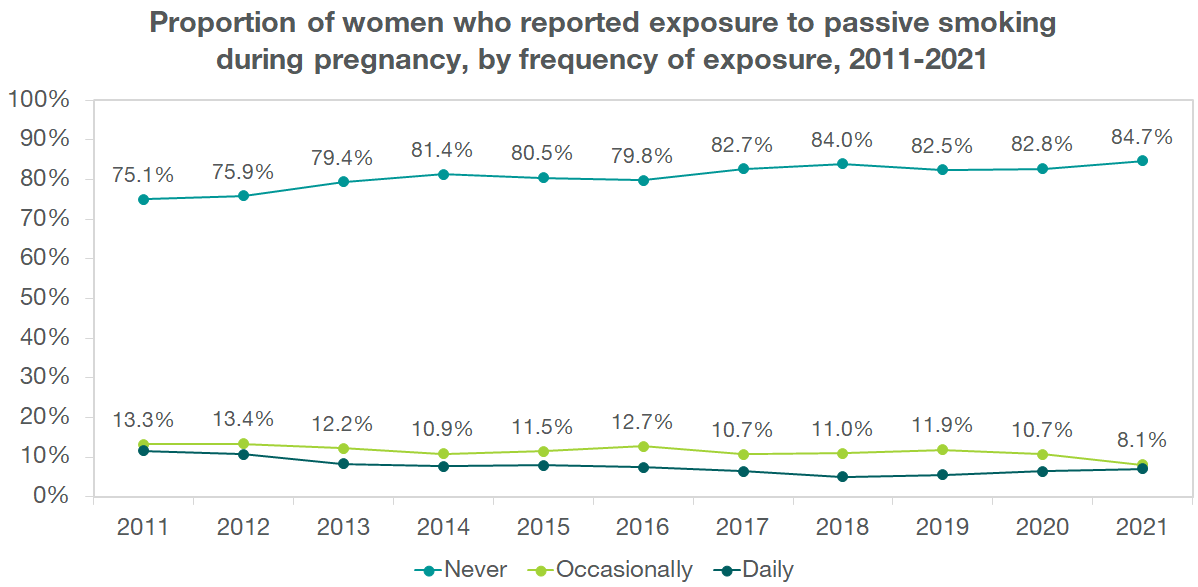


Figure 14: Proportion (%) of women who reported exposure to passive smoking during pregnancy among all women with live or stillbirths in Luxembourg, 2011–2021.

Source: PERINAT.

ALCOHOL CONSUMPTION DURING PREGNANCY

Alcohol consumption during pregnancy is still very common across the world, yet scientific evidence shows that any amount of alcohol can be harmful to an unborn child. Alcohol use during pregnancy increases the risk of stillbirth, premature birth and low birth weight. It can lead to birth defects and developmental disabilities with life-long consequences.[44] Only zero alcohol consumption during pregnancy is safe, and it is therefore recommended to abstain from alcohol use during pregnancy.

Data for Luxembourg shows that over the last decade, fewer and fewer women who gave birth reported alcohol consumption during their pregnancy (Figure 15). While in 2011, 8.6% reported having occasionally or regularly consumed alcohol, in 2021, only 1.9% reported having done so. This decrease is due to reported reductions in occasional drinking, as reports of daily drinking were already close to zero in 2011.

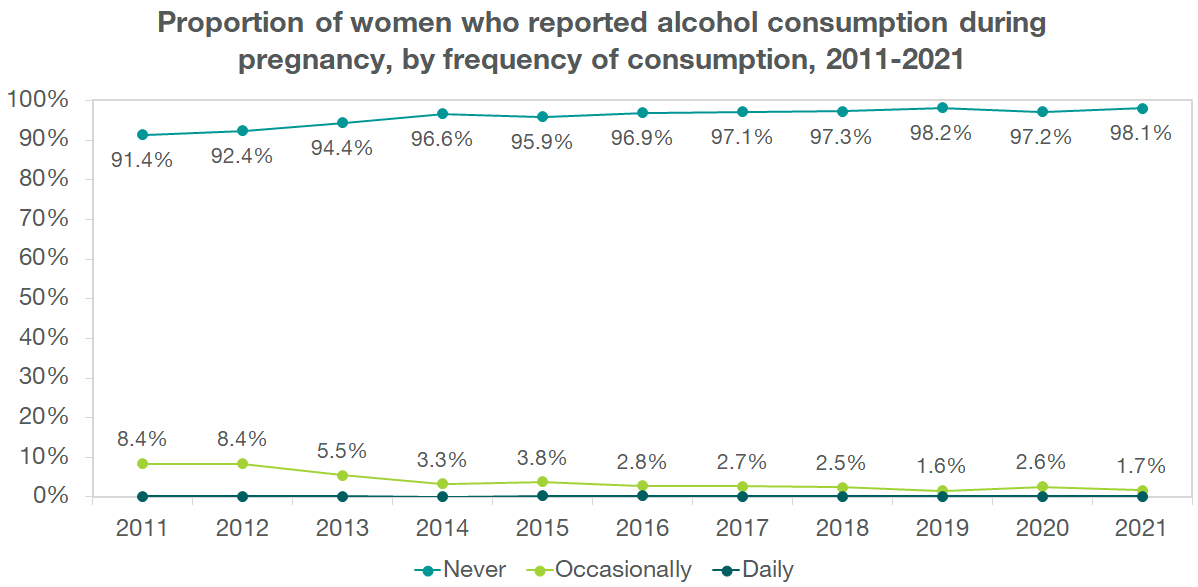


Figure 15: Proportion (%) of women who reported alcohol consumption during pregnancy among all women with live or stillbirth in Luxembourg, 2011–2021.

Source: PERINAT.

These numbers place Luxembourg at the low end of the scale of European countries, among which the frequency of alcohol consumption appears to be much higher. The latest study to estimate the prevalence of alcohol consumption in pregnant women for every country in the world reported rates of 14.9% for Belgium, 25% for Germany, 27% for France, 18% for the Netherlands and 32.7% for Switzerland.[45] Given the significantly higher numbers in other countries, it is likely that the data for Luxembourg underestimates the issue. One likely cause is that in Luxembourg, the care provider directly asks the women whether they consumed alcohol, and also collects the data.[46,47] As a result, some women may decide not to report their true alcohol consumption, as they know that it is not a desirable behaviour.

GESTATIONAL DIABETES

Gestational diabetes is a form of diabetes characterized by elevated blood glucose levels during pregnancy for women who have had no prior diabetes diagnosis.[48] Children of mothers with gestational diabetes have a higher risk of congenital malformations or perinatal mortality and of high birth weight. They also have an increased risk of developing type 2 diabetes later in life.[49] In Luxembourg, screening for gestational diabetes is recommended for women who are at higher risk (being overweight or obese with a body mass index equal to or above 25, being 35 years of age or above, having a history of diabetes or risk factor for familial diabetes, or a history of gestational diabetes or macrosomia).[40]

The data shows an increase in diagnosed gestational diabetes from 5.2% to 8.3% between 2014 and 2021 (Figure 16).

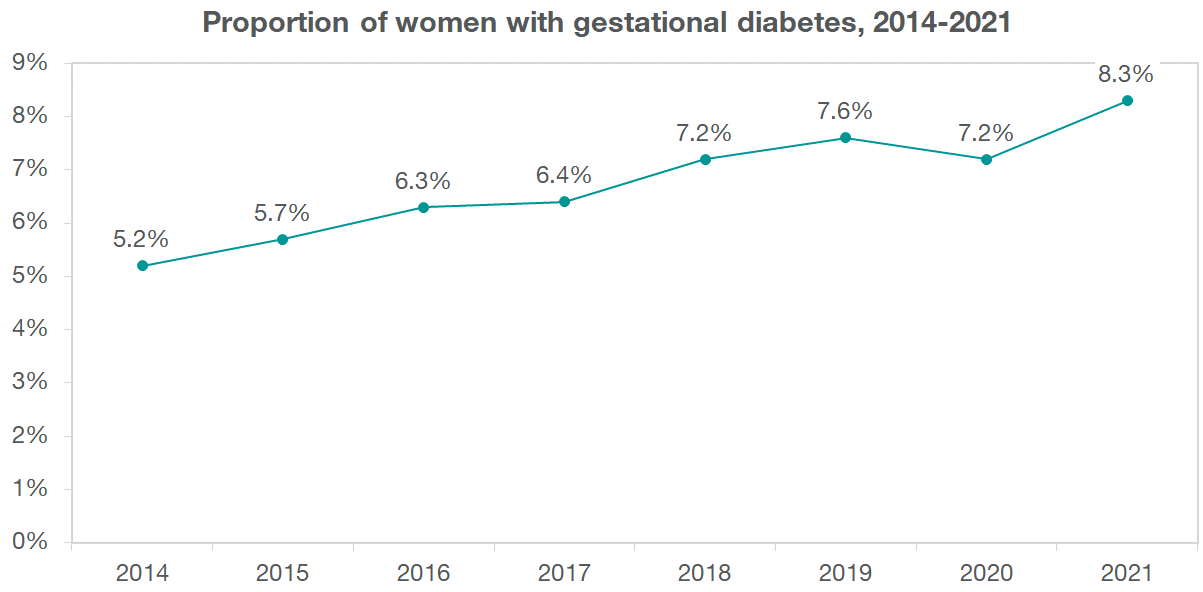


Figure 16: Proportion (%) of women with gestational diabetes among all women who gave birth in Luxembourg, 2014 to 2021.

Source: PERINAT.

International studies on the prevalence of gestational diabetes show wide variations between countries that are likely, at least partly, due to differences in diagnostic criteria. Therefore, comparisons with other countries are difficult. For Western Europe, the two most recent studies estimate a prevalence of 7.3% to 10.7%.[50,51] Luxembourg has similar rates to France (8%) and Germany (7.3%), and much lower rates than Switzerland (17%) and the Netherlands (13.9%). The lowest rates are found in Belgium, at 3.9%.[51]

Conclusions on health determinants

This section presents a mixed picture. Exclusive breastfeeding has decreased over time and has been partly replaced by mixed feeding of infants. There have been improvements over the last decade, in terms of increased fruit and vegetable consumption, and decreased alcohol consumption. This positive trend is contrasted by decreases in physical activity and breakfast eating among children aged 11 to 12, and by the levels of tooth brushing, which have remained mostly unchanged.

There are differences between boys and girls. Girls aged 11 to 12 are less physically active but consume less alcohol than boys and brush their teeth more. Pregnancies among girls before the age of 15 are rare.

A clear socioeconomic gradient is visible in almost all behaviours. Children from poorer families, and sometimes also from migrant backgrounds or living in family structures where not both parents are present, consistently report worse health behaviours than children from more-privileged groups. Moreover, the gap between children from richer families and those from poorer families widened between 2014 and 2022 for physical activity, breakfast eating, fruit and vegetables consumption and tooth brushing.

Overall, compared with other countries, Luxembourg neither excels nor is far behind. However, there is certainly room for improvement, given that for any given indicator, at least one other country is performing better than Luxembourg.

For many indicators, the available data for Luxembourg currently only covers the ages of 11 and 12, and there is a lack of information for younger children. This section only shows a selection of indicators available to assess health behaviours among children 11 and 12 years old. For more information on health behaviours among children in this age group and older, the HBSC study is the most exhaustive source currently available in Luxembourg.

For maternal health, self-reports on smoking and alcohol consumption during pregnancy show a decrease in these behaviours over the last decade. For both, Luxembourg reports lower levels than its neighbouring countries. The source of maternal health behaviour data in Luxembourg is self-reports, which could potentially result in under-estimating alcohol consumption and smoking rates in pregnant women.

2. Key physical health outcomes

Children's physical health is a major component of child wellbeing and sets the foundations for health in later life.

This chapter assesses the health status of children living in Luxembourg. The chapter starts by detailing changes in the rate of child mortality over the last decade. Mortality rates during early life are considered a good barometer for overall health during pregnancy and childhood, and increasing rates or comparably high levels of child mortality would point to serious problems in the health system. The United Nations Sustainable Development Goals (SDG) Target 3.2 sets out to 'End preventable deaths of newborns and children under 5 years of age' by the year 2030.[52]

The chapter then looks at indicators reflecting the development of children's physical health as they grow older, as well as chronic diseases typically appearing among young children. Where possible, the chapter aims to also identify differences by gender and socioeconomic environments.

Main findings:

- Overall, child mortality is low in Luxembourg. Compared with other European countries (BE, DE, FR, NL and CH), under-five mortality is lower in Luxembourg (2.7 deaths per 1000 live births in 2021).
- In 2022, about one in five 11–12 year olds were overweight (including obesity) in Luxembourg, which is higher than in any of the other European countries we compared (BE, FR, DE, NL and CH).
- One out of two children 11–12 years of age and from a household perceived as well-off rated their health as excellent in 2022. On the other hand, only one out of five children from a household perceived as not well-off rated their health as excellent.
- Almost a third of schoolchildren aged about 5–7 years had untreated caries in 2022–2023.
- Diseases of the respiratory system (Chapter X of the International Statistical Classification of Diseases and Related Health Problems, 10th revision, ICD-10) were responsible for the highest rate of hospitalizations among children under 1 and over 1 year old. Among children over 1 year of age, the second highest rates of hospitalizations were linked to injury, poisoning and results of external causes.
- About one in seven children a year sought emergency care for injuries between 2013 and 2020.
- The incidence of childhood cancer between 2014 and 2022 was in the same range as observed in other European countries (annual age-standardized incidence rate of 164.6 cases per 1 million children).

2.1 Mortality

Western Europe records the lowest child mortality rates in the world. As in its neighbouring countries, Luxembourg has observed a major decline in perinatal and child mortality rates, though the last decade was marked by a slowdown in the reduction of mortality.[53–55] Stillbirth remain a major health burden, with rates almost twice as high as for infant mortality.[54]

Changes in mortality indicators need to be interpreted with caution, as they involve small numbers and are sensitive to random fluctuations. To facilitate the analysis of trends since 2011, we apply 3-year centred moving averages for some of the mortality indicators.

Mortality indicators are based on two different sources, namely the national register of causes of death and the population register, with divergent inclusion and exclusion criteria for the analysis. Perinatal and neonatal mortality, as well as avoidable mortality are based on data from the national register of deaths and include child deaths that occur on the territory of the country, independent of residency of the child or its parents (de facto deaths). Resident children that die outside the country (for instance after a transfer or stillbirth outside the country) are not included (Figure 17). Infant, under 5 and 5-9 years mortality data are sourced from population registers. Those indicators only reflect the situation of resident children (de juro deaths) and exclude the number of deaths of non-residents that occur in Luxembourg and are a measure of the risk respectively the probability of dying in a given age range.

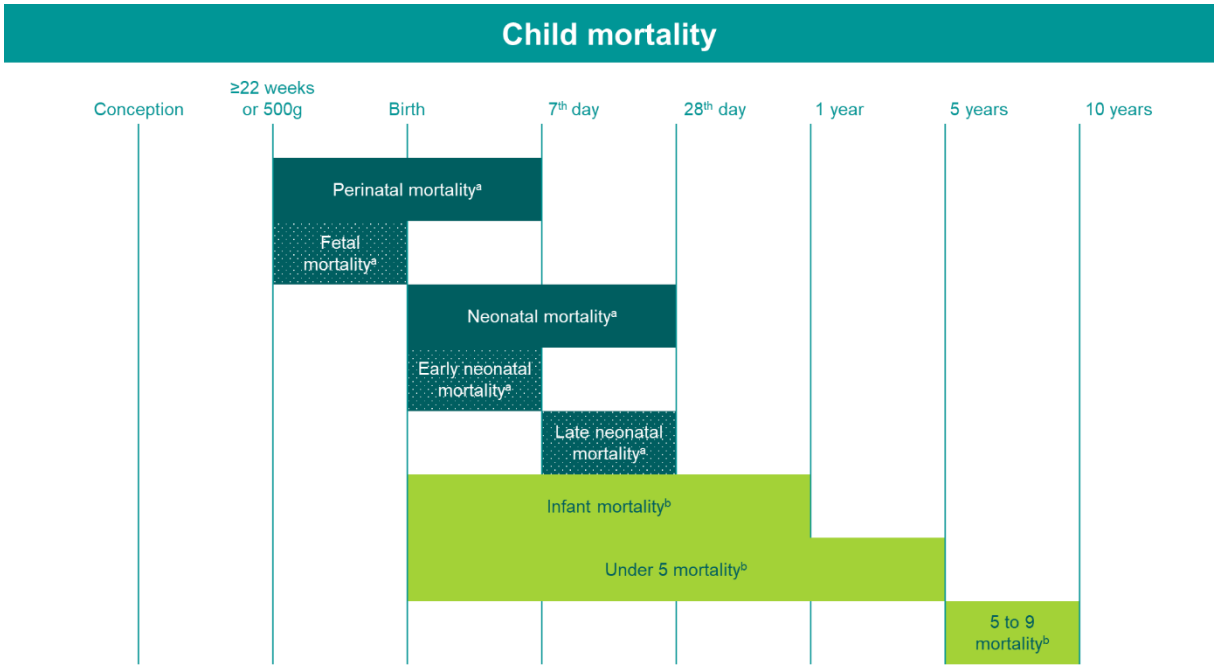


Figure 17: The different parts of child mortality as used in the report. Perinatal mortality: Death at or over 22 weeks of gestation (or at a birthweight of 500g or above) up to 6 completed days of life. Fetal mortality: Stillbirth at or over 22 weeks of gestation (or at a birthweight of 500g or above) until birth. Neonatal mortality: Death between birth and until 27 completed days of life. Early neonatal mortality: Death at birth and until 6 completed days of life. Late neonatal mortality: Death at 7 days of life up to 27 completed days of live. Infant mortality: Death between birth and 364 completed days of life (less than 1 year). Under 5 year mortality: Death between birth and 4 completed years of age. 5 to 9 years old mortality: Death between 5 and 9 completed years of age. Sources: a (dark green) national cause of death registry. The data covers deaths that occur in the territory of Luxembourg, independent of residency of the deceased; b (light green) population registers. The data covers mortality rates among resident children.

FETAL MORTALITY RATE (OR RATE OF STILLBIRTH)

Fetal mortality is a marker of women's health, as well as the quality of care around pregnancy and birth. Apart from congenital and maternal causes, many stillbirths remain unexplained. There is also some variation in stillbirth rates across high-income countries and across socioeconomic groups. Obesity, overweight, alcohol consumption and smoking are identified among the main modifiable risk factors for fetal mortality.[54,56] In Luxembourg between 2011 and 2021, 60.0% of fetal deaths (gestational age >= 22 weeks) occurred at 28 weeks of gestation or later (late fetal mortality).

Overall, the 3-year centred moving average for fetal mortality between 2012 and 2020 shows a stable trend over the last decade. The individual year values (not averaged over three years)

of fetal mortality rate ranged between 4.8 deaths per 1000 still and live births in 2014 and 2018, and 8.1 in 2019. [xi]

PERINATAL MORTALITY RATE

Perinatal mortality reflects and measures the likelihood of a fatal outcome from prenatal, intrapartum and newborn care up to six completed days after birth. Perinatal mortality is an important indicator for the access to and quality of preventive care during pregnancy, as well as of perinatal health care.[57]

As in most countries in Western Europe, fetal deaths (also termed stillbirths), contribute to nearly 80% of perinatal deaths in Luxembourg. For the period 2011–2021, 409 out of 516 perinatal deaths in Luxembourg were fetal deaths. The 3-year moving average shows a stable trend for perinatal mortality over the last decade (Figure 18). Individual year values (not averaged over three years) range from 6.2 to 9.6 deaths per 1000 still and live births in 2014 and 2015, respectively.

[xi] Fetal mortality rate in Luxembourg: number of fetal deaths, per 1 000 live and stillbirths, 2012 – 2020 (2011–2021 data presented as a 3-year centred moving average). The numerator includes fetal deaths with a gestational age of 22 weeks or more, or if gestational age is unknown with a birth weight of 500 g or above. The denominator includes all live births and stillbirths, independent of their gestational age and weight. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on all resident newborns.
Source: National register of causes of death; STATEC. Indicator computed by ObSanté.

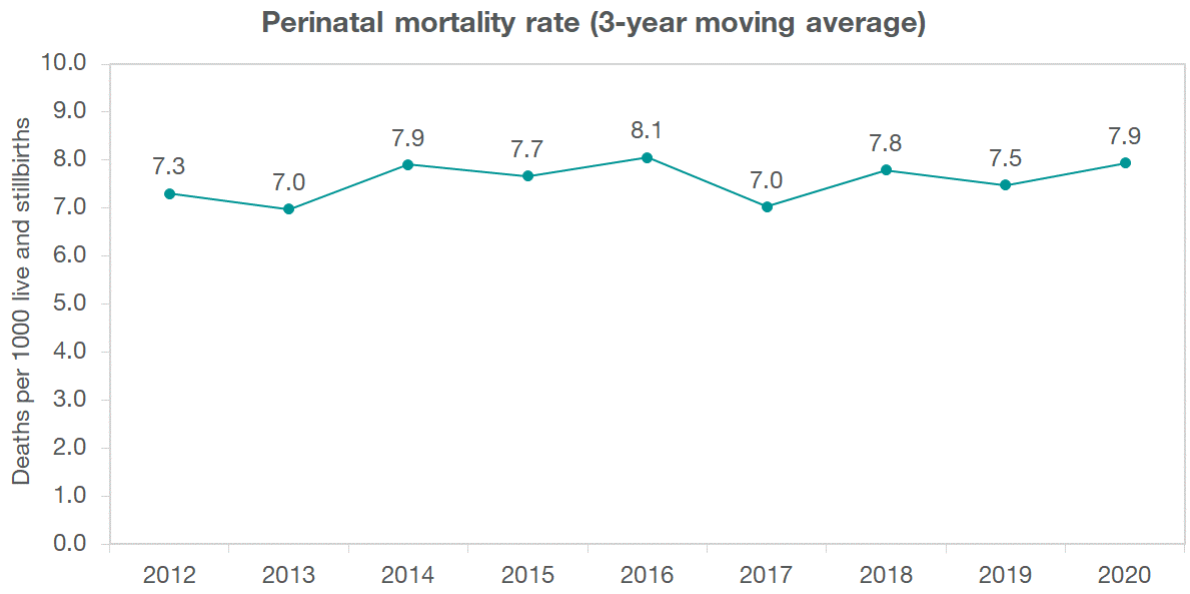


Figure 18: Perinatal mortality rate in Luxembourg: number of fetal and early neonatal deaths (up to six completed days after birth), per 1000 live and stillbirths, 2012 – 2020 (2011-2021 data presented as a 3-year centred moving average). [xii]

Sources: National register of causes of death; STATEC. Indicator computed by ObSanté.

NEONATAL MORTALITY RATE: EARLY (0–6 DAYS) AND LATE (7–27 DAYS) NEONATAL MORTALITY

Apart from its function as an indicator of child health, neonatal mortality is an indicator of the quality of care given during pregnancy and intrapartum. The main causes of death during the first month were recorded as congenital anomalies and prematurity.

Neonatal mortality rate is defined as the number of deaths during the first 27 completed days of life per 1000 live births in the same year. Early neonatal deaths are those that occur during the first 6 days of life, and late neonatal deaths are those that occur between the 7th and 27th completed day of life.

Neonatal mortality had decreased steadily for several decades and stabilized at about 2 deaths per 1000 live births per year.[55] In 2021, the annual rate was 2.2 deaths per 1000 live births. Neonatal mortality was mostly due to early neonatal deaths, which were about five times higher than the rate of late neonatal deaths (Figure 19).

[xii] The perinatal mortality rate is defined as the number of fetal and early neonatal deaths, per 1000 live and stillbirths in the same year. Early neonatal deaths are defined as deaths that occurred up to 6 completed days of life after birth. The numerator includes fetal and early neonatal deaths with a gestational age of 22 weeks or more, or if gestational age is unknown with a birth weight of 500 g or above. The denominator includes all live births and stillbirths, independent of their gestational age and weight. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.

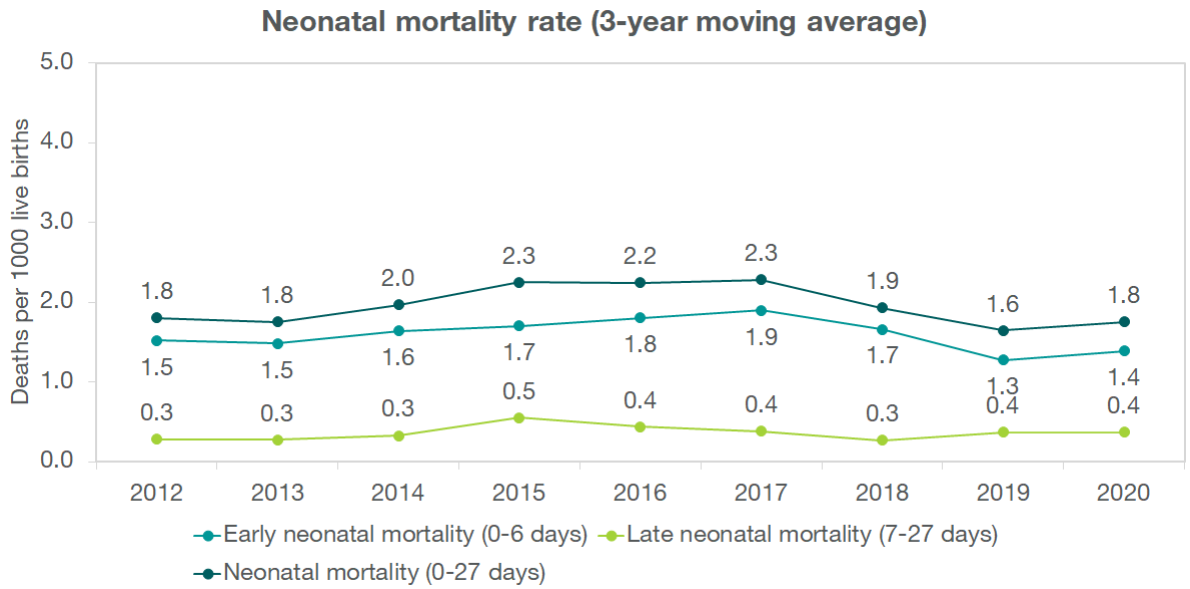


Figure 19: Neonatal mortality rate in Luxembourg: number of neonatal deaths, per 1000 live births, by early and late neonatal deaths, 2012 – 2020 (3-years centred moving average based on data 2011-2021).[xiii]

Sources: National register of causes of death; STATEC. Indicator computed by ObSanté.

[xiii] Neonatal deaths are defined as deaths that occurred during the first 27 completed days. Early neonatal deaths occur during the first 6 days of life, and late neonatal deaths occur between the 7th and 27th completed day of life. Early neonatal deaths are restricted to a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. The number of neonatal deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.

Approximately half (53.3%) of the early neonatal deaths were babies who were born extremely preterm (

Figure 20).

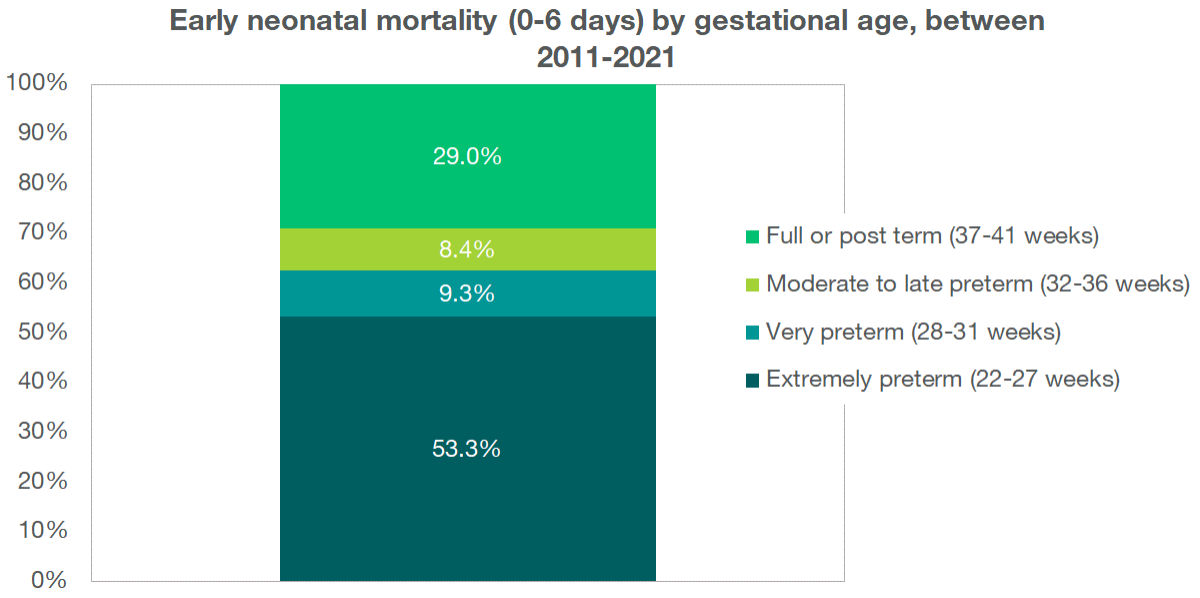


Figure 20: Distribution (%) of early neonatal mortality rate per 1000 live births, by gestational age at delivery, 2011–2021, Luxembourg.[xiv]

Sources: National register of causes of death; STATEC. Indicator computed by ObSanté.

In 2019, Luxembourg and Switzerland reported the same neonatal mortality rate (1.4 neonatal deaths per 1000 live births). The rate reported by Belgium and the Netherlands was higher (each at 2.1 neonatal deaths per 1000 live births).[58] However, as registration practices differ by countries, international comparisons should be treated with caution. [xv] [58]

INFANT MORTALITY RATE

Infant mortality is defined as death before a child's first birthday. Infant mortality is a standard indicator for assessing population health and the access to high-quality health services.

The infant mortality rate is the number of deaths of children under 1 year old per 1000 live births in the same year. The indicator is calculated using population registration data, and thus includes all births and deaths among residents.

The 3-year average rates of infant mortality in the years 2017 to 2020 were slightly higher than those observed from 2012 to 2016. The 3-year average increase from 2017 to 2019 was reversed in 2020, with a decrease in infant mortality to 4.1 deaths per 1000 live births (Figure 21). The individual year rate for 2021 was 3.1 deaths per 1 000 live births (not displayed).

[xiv] Early neonatal deaths occur during the first 6 days of life, are limited to those with a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. Only deaths that occurred on the territory of Luxembourg are included (resident and non-resident). The number of live births is based on resident newborns.
[xv] Differences in recording deaths that occur very soon after birth may have an impact on this indicator, if recorded as stillbirth rather than neonatal death.

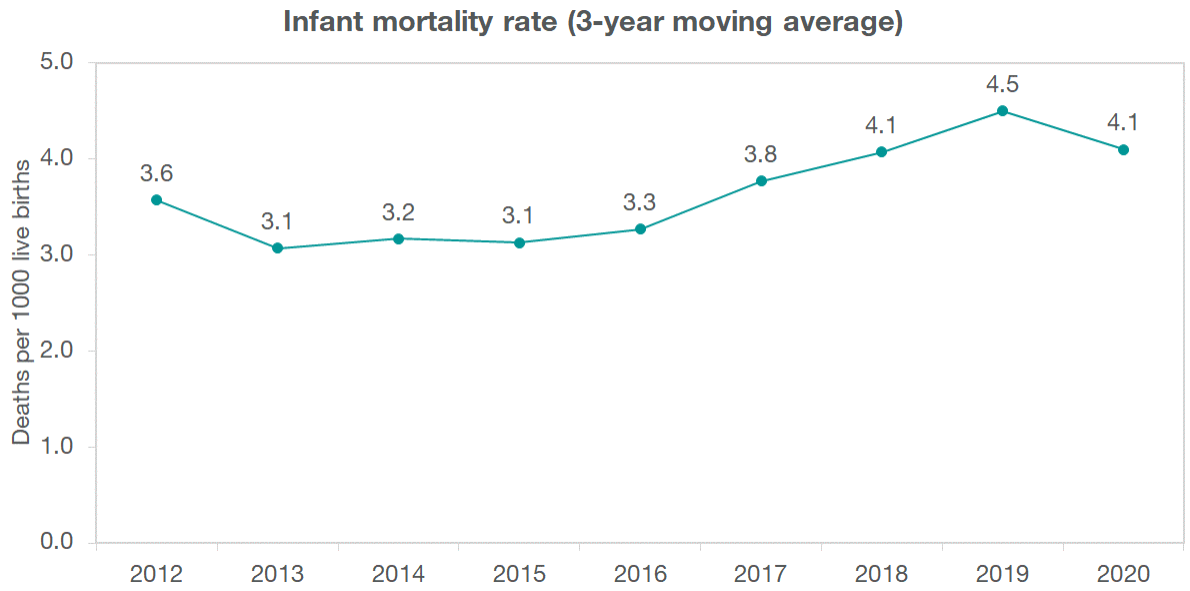


Figure 21: Infant mortality rate in Luxembourg: Number of deaths among children under 1 year of age, per 1000 live births, 2012–2020, (2011–2021 data presented as a 3-year centred moving average).

Source: Eurostat.

Comparing Luxembourg with other countries, the 3-year annual average infant mortality rate for 2020 (based on population register data for 2019, 2020 and 2021) was higher than the annual rates for 2021 reported by other European countries (Belgium 2.9 and France 3.7 per 1000 live births) (Figure 22).[59] On the other hand, the infant mortality rate reported by EuroPeristat, based on the number of deaths and births on the territory of Luxembourg, is lower than that reported using the population register and lower than that for other reporting countries such as Belgium and Switzerland.[58]

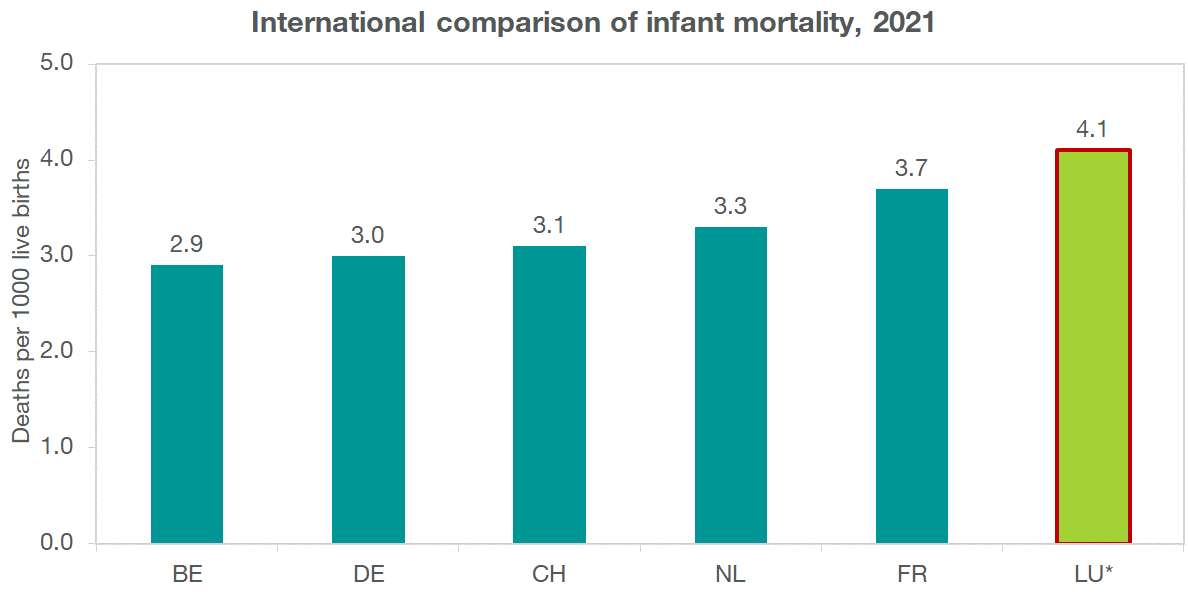


Figure 22: International comparison - Infant mortality rate: Number of deaths among children under 1 year of age, per 1000 live births, by country, 2021. *LU: 3-year moving average for 2020 based on data from 2019 to 2021.

Source: Eurostat.

MORTALITY RATE AMONG CHILDREN UNDER 5 YEARS OF AGE

The under-five mortality rate measures the likelihood of dying before the age of 5 for a child born in a specific year. Here, it is expressed as the probability per 1000 live births that a newborn will die before reaching 5 years of age. High under-five mortality rates point to poor social, economic and environmental conditions in which children live, including their health care.[60]

Out of all the WHO regions, Europe has the lowest under-five mortality (7.5 per 1000 live births in 2020).[61] In Luxembourg, under-five mortality has decreased significantly in the previous decades and has stabilized at low levels.[55]

Compared with its neighbouring countries, Luxembourg is among those with the lowest probability of dying before the age of 5 (Figure 23). In 2021, under-five mortality was 2.7 deaths per 1000 live births.[61]

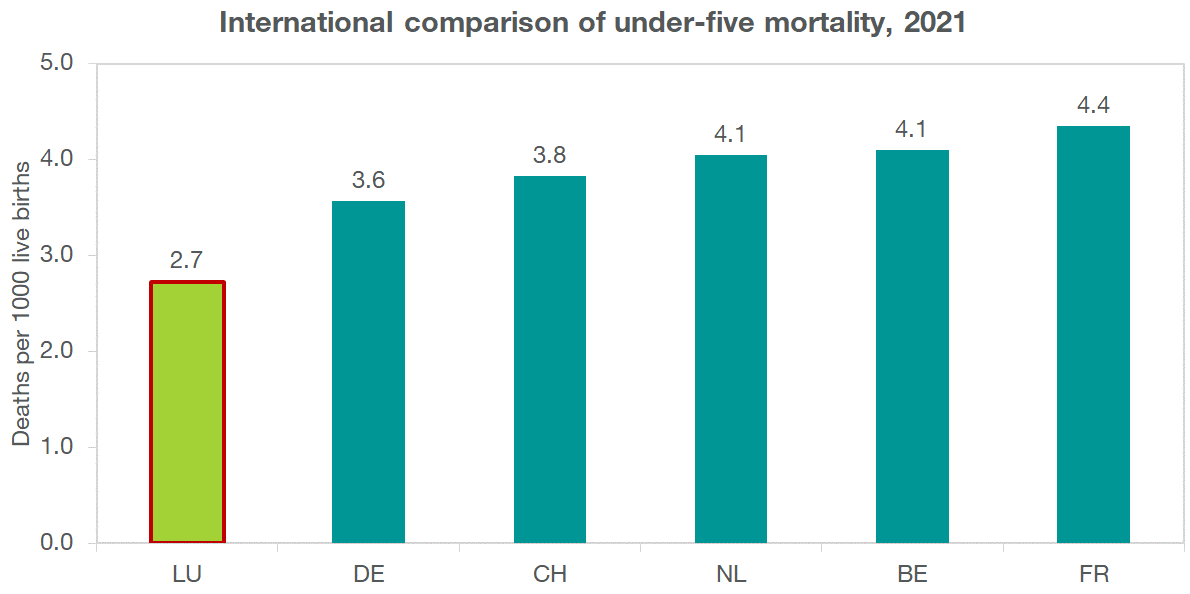


Figure 23: International comparison - Under-five mortality rate. Probability of dying by the age of 5 years per 1000 live births, by country, 2021.

Source: WHO - Global Health Observatory.

MORTALITY RATE AMONG CHILDREN 5 TO 9 YEARS OF AGE

The 5 to 9 year old mortality rate measures the probability of a 5 year old child dying before reaching the age of 10. In this age group, the risk of death from external causes, such as injuries, increases, as children become more mobile and independent.[62]

In Luxembourg, the 5 to 9 year old mortality rate has decreased over the last decade. In 2021, 0.17 deaths per 1000 children were registered, or 1 out of 5740 children aged 5 years or older dying before turning 10 years old (Figure 24).[62] Compared with the younger age categories, the mortality rate among children aged 5 to 9 years is lower.

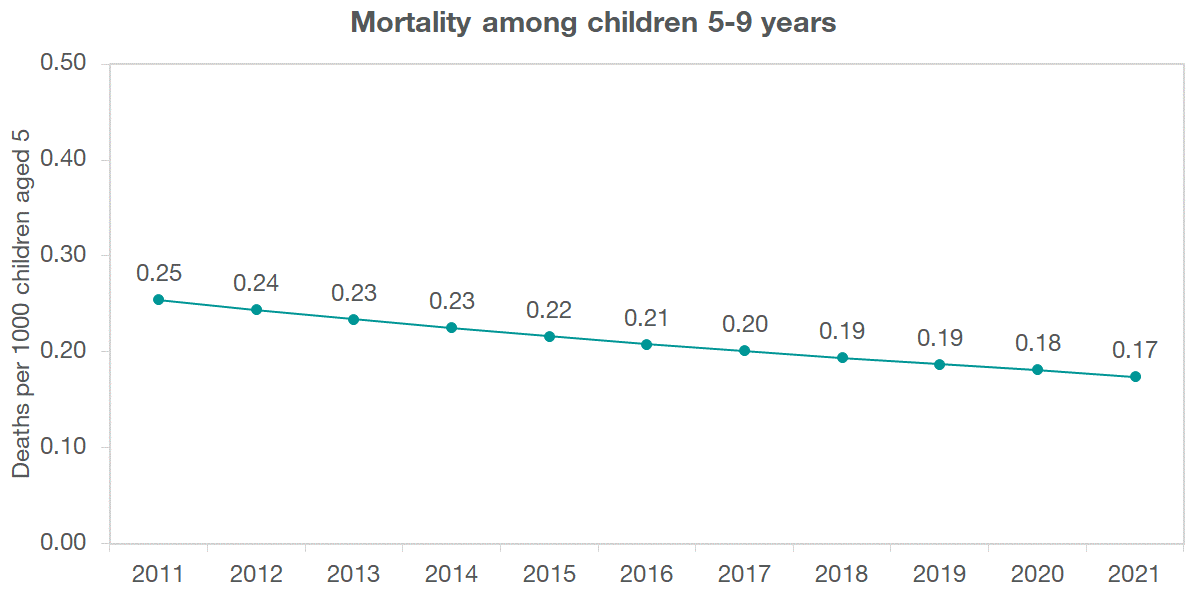


Figure 24: Mortality rate among children aged 5–9 in Luxembourg. Probability of children at least 5 years old dying before reaching the age of 10, per 1000 children aged 5 years, 2021.

Source: WHO - Global Health Observatory.

AVOIDABLE MORTALITY AMONG CHILDREN 0–12 YEARS OLD: PREVENTABLE MORTALITY AND TREATABLE MORTALITY

Avoidable mortality measures deaths due to causes considered avoidable because they can be largely treated or prevented given timely and effective health care or public health interventions. The OECD and Eurostat have adopted a harmonized definition and a list attributing avoidable causes of death to a preventable or a treatable mortality category.[63]

The two categories of avoidable deaths are defined as:

1. Preventable mortality: Causes of death that can be mainly avoided through effective public health and primary prevention interventions (that is, before the onset of diseases or occurrence of injuries, to reduce incidence).
2. Treatable mortality: Causes of death that can mainly be avoided through timely and effective health care interventions, including secondary prevention and treatment (that is, after the onset of diseases, to reduce case fatality).[64]

We found that about two-thirds of all deaths (157 out of 234 deaths) among children aged 0-12 from 2011 to 2021 in Luxembourg were considered avoidable.[xvi] The highest proportion of avoidable deaths (80%) was among children less than 1 year old, and due to conditions originating in the perinatal period that are considered as largely treatable.

Overall, the trend for both preventable and treatable mortality was stable during the observed period. The total avoidable mortality rate was higher for boys than for girls. For the period from 2011 to 2021, see Table 1, the preventable mortality rate among boys was 2.6 times higher

[xvi] For the analysis, we considered children who died between birth and 12 years of age, inclusive, and where the primary cause of death was included in the corresponding OCED/Eurostat list (January 2022 version).[64] Neonates who died at less than 7 days following live birth were considered if the gestational age was equal to or above 22 weeks, or if the gestational age was not available, where birth weight was equal to or above 500 g. We used data from the national register of causes of death, and included residents and non-residents. To calculate the rate, we extracted the population of the same age group for the corresponding year from national population statistics.

(boys 4.6 deaths per 100 000 children and girls 1.8) and the treatable mortality rate 1.4 times higher (boys 16.3 deaths per 100 000 children and girls 11.8). Differences in avoidable mortality between sexes are commonly observed in other European countries. In addition, crude child mortality rates show the same pattern. [65–67]

Table 1: Avoidable mortality rate in Luxembourg, stratified by preventable and treatable and preventable mortality and by gender: number of deaths per 100,000 children aged 0–12, 2011–2021.

Source: National register of causes of deaths; STATEC. Indicator computed by ObSanté.

Gender	Treatable	Preventable	Total avoidable
Female	11.8	1.8	13.6
Male	16.3	4.6	20.9
All	14.1	3.3	17.3

The leading causes of avoidable deaths[xvii] among children 0-11 months old, were conditions originating in the perinatal period (88.7%), such as respiratory and cardiovascular disorders and those related to the length of gestation and fetal growth. Congenital cardiovascular malformations were the second most important contributor to avoidable mortality (5.6%). Both belong to the category of treatable mortality. The ranking of treatable mortality in OECD countries shows very similar results.[68]

For children 1 to 12 years old, the main causes of avoidable mortality were categorized as preventable mortality, mainly due to accidental injuries, for instance falls, (36.4%) and transport injuries (24.2%). In general, accidents and transport injuries are the main causes of death in Europe among children aged 5 to 12.[69]

[xvii] Proportional distribution (%) of causes of avoidable deaths by age group, within the years 2011 -2021, Luxembourg. Age was categorized as 0-11 months and 1-12 years old.
Source: National register of causes of deaths. Computed by ObSanté.

2.2 Physical health status

This chapter presents and assesses indicators reflecting different aspects of children's health status as they grow older.

SELF-RATED HEALTH STATUS

Through self-appraising, children provide us with an overall picture of their health. In addition to physical health, this also includes the dimension of emotional wellbeing (for further information on this topic, see the chapter: Mental health), socio-environmental and behavioural factors. Thus, self-rated health provides relevant information on the overall health and wellbeing of children.[70,71]

This indicator presents the proportion of 11–12 year old schoolchildren in Luxembourg who rated their health as excellent. Fewer than half of the girls and boys in Luxembourg considered their health to be excellent in 2022. Over time, the indicator has remained relatively stable, with a small increase in excellent health for both boys and girls from 2018 to 2022 (boys 43.4% to 47.2%, girls 38.7% to 40.6 %) (Figure 25). It is common for boys to report better health status than girls.[22,72] The international HBSC study group suggests that those differences may be linked to gender differences in expectations for daily life or that the HBSC question tends to centre more on how girls articulate or show their difficulties.[72]

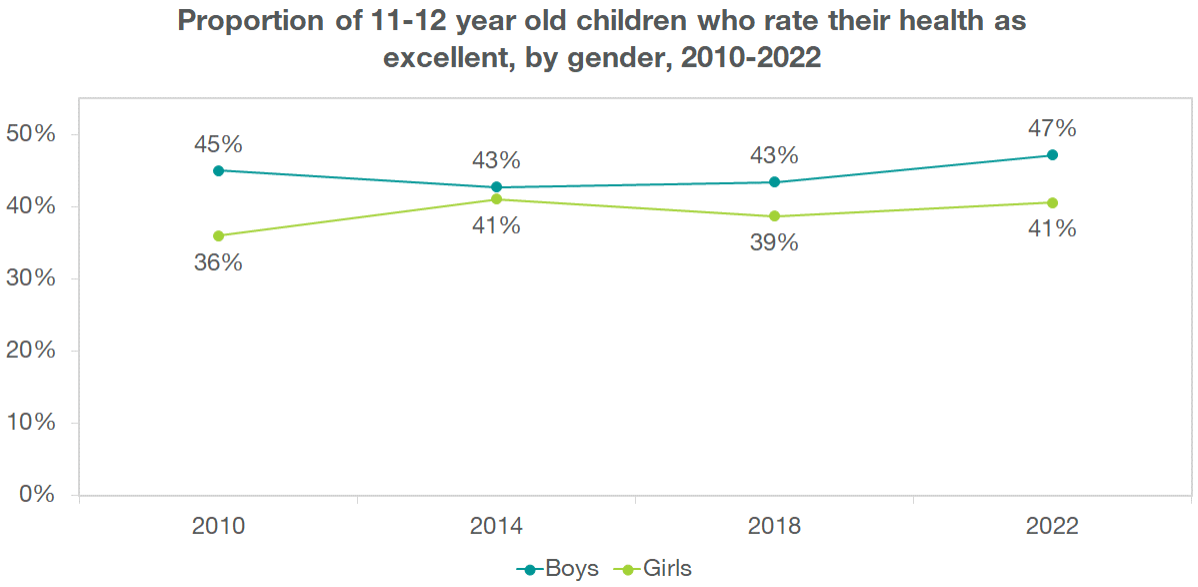


Figure 25: Proportion (%) of schoolchildren aged 11–12 who rated their health as excellent, by gender, 2010–2022, Luxembourg.

Source: HBSC.

Stratifying by self-reported wealth, a clear gradient is apparent, which has steepened over recent years. Children who perceive their family to be economically well-off are much more likely to report excellent health compared with children who perceive their family as economically average or not well-off (Figure 26).

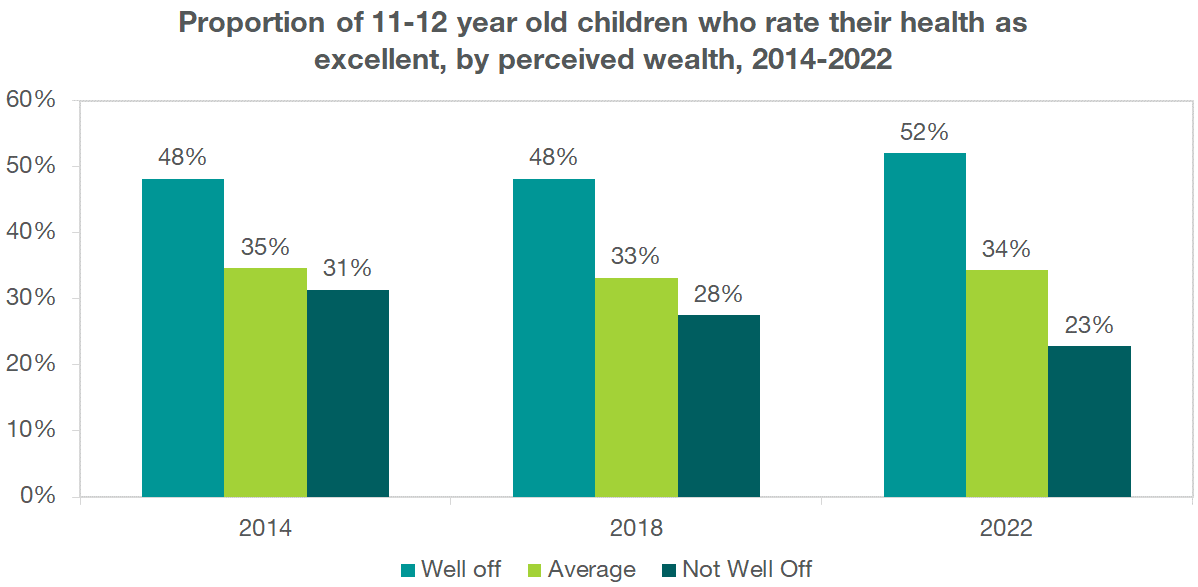


Figure 26: Proportion (%) of schoolchildren aged 11–12 who rated their health as excellent, by perceived wealth, 2014–2022, Luxembourg.

Source: HBSC.

For migration, the differences are less pronounced. Nevertheless, children with no migration background did report better health.

For the international comparison, data for 11 year old children from 2022 is used.[73] Among the girls, 43% reported being in excellent health and 47% among the boys. Compared to other European countries, Luxembourg has similar levels as Switzerland and higher levels than all neighbouring countries and the Netherlands. (Figure 27). Generally, the proportion of children rating their health as excellent is slightly lower in girls than in boys (between 3 and 6 percentage points) except for the Netherlands, where there is a difference of 13 percentage points (girls 28%, boys 41%).

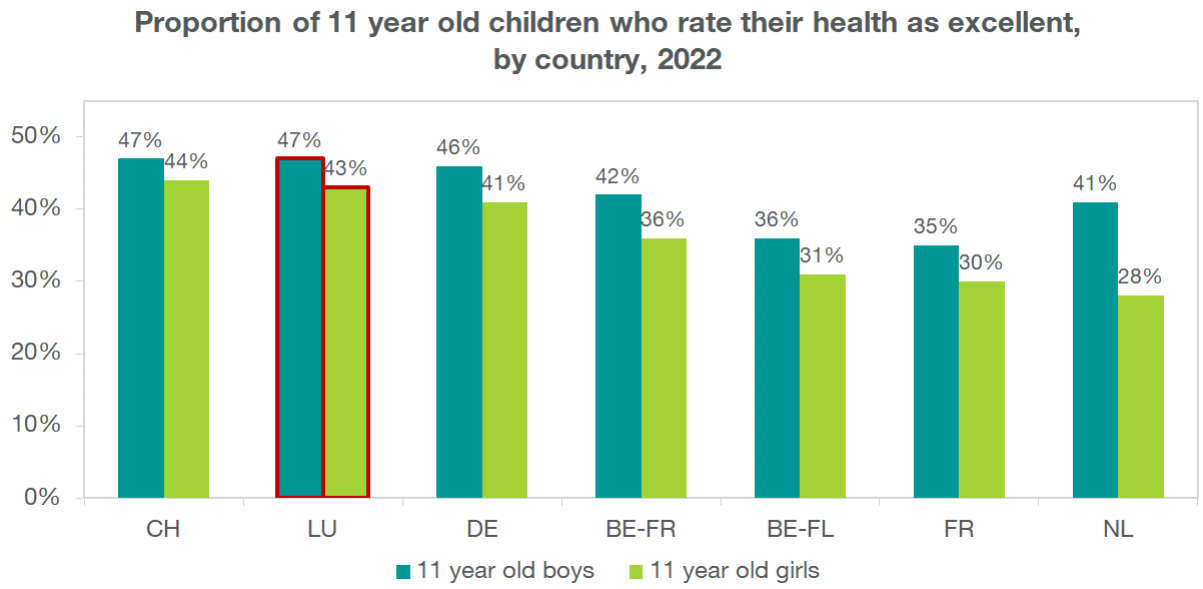


Figure 27: International comparison – Proportion (%) of 11-year-old schoolchildren who rated their health as excellent, by country, 2022.

Source: HBSC.

OVERWEIGHT AND OBESITY

The increase in the number of overweight and obese children poses a public health challenge for modern society.[74] Obesity is the most common disorder among children in wealthy countries.[6,7] Monitoring overweight and obesity is important, given their serious immediate and later-life impacts on health.[77,78] For more than half of children, obesity endures from childhood into adulthood and carries risks of serious immediate and long-term consequences for health, such as hypertension and diabetes.[74,79] In addition to harmful physical consequences, deviations from optimal weight can affect children's mental wellbeing and social outcomes.[80–82]

Overweight and obesity are assessed in the HBSC survey.[27,83,84] Pupils report their weight and height, which are used to calculate their Body Mass Index (BMI).[85] The BMI is an easy way to screen for weight categories that may lead to health problems at the population level.

The data presented shows the proportion of 11–12 year old pupils who reported anthropometric measurements categorized as overweight or obese, based on the International Obesity Taskforce recommendations.[85,86] Here, the results are presented as a measurement that combines overweight and obese children into one group.

In 2022, one in five 11 to 12 year olds were affected by being overweight or obese, with a higher prevalence among boys. In addition, the increase since 2010 was more pronounced among boys than girls: for the latter, the prevalence marginally decreased between 2018 and 2022 (from 16.9% in 2018 to 15.9% in 2022) (Figure 28).

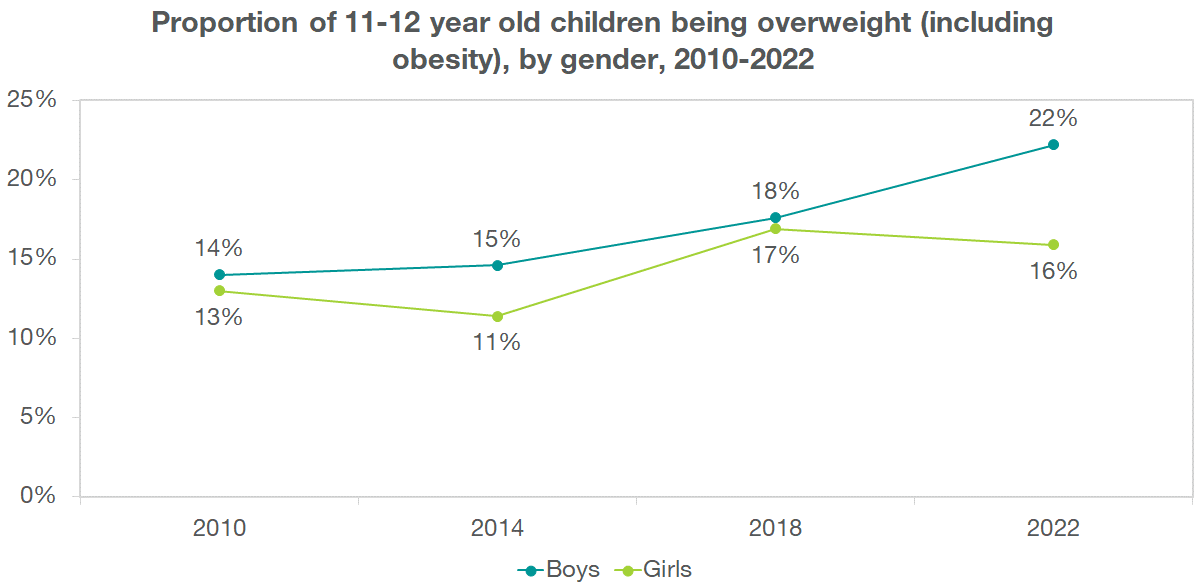


Figure 28: Proportion (%) of schoolchildren aged 11–12 who were overweight (including obesity), by gender, 2010–2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce were used.[85]

Source: HBSC.

In Luxembourg, as in most high-income countries, children from families that are economically less well-off are more likely to be affected by overweight or obesity, compared with those from more affluent families.[22,84,87] Over time, the prevalence of being overweight among children who perceived their family as not well-off remained stable at the highest level, around 24%, whereas the prevalence among children living in economically average and well-off families increased steadily between 2014 and 2022 (Figure 29).

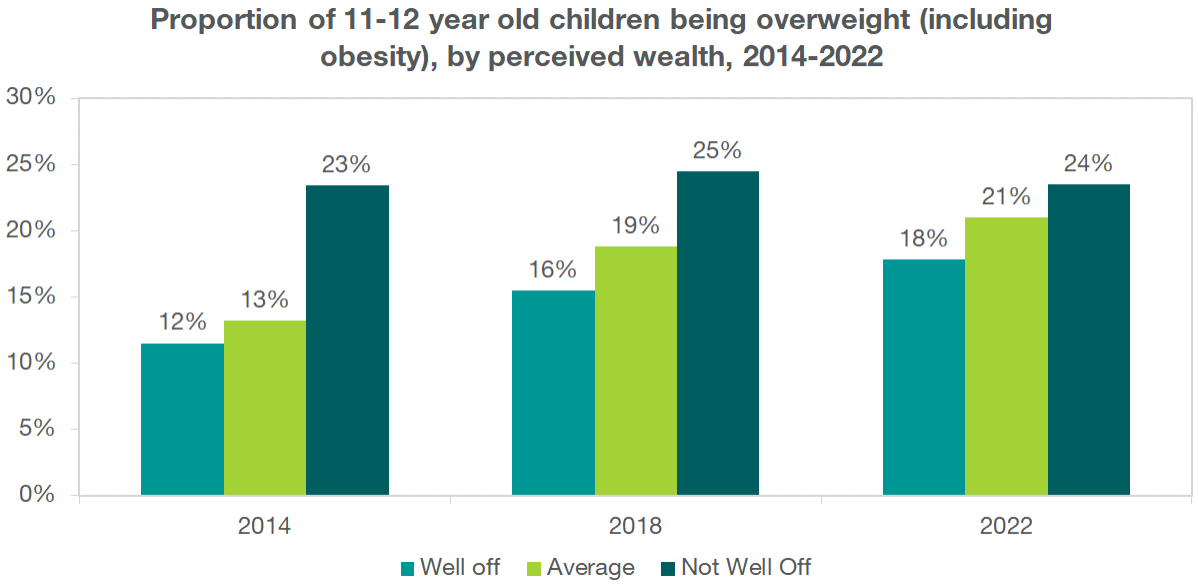


Figure 29: Proportion (%) of schoolchildren aged 11–12 years who were overweight (including obesity), by perceived wealth, 2014–2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce were used.[85]

Source: HBSC.

To look at differences by migration background in being overweight, the population was categorized as having 'no migration background', 'children migrated' or 'parents migrated'. The latter category applies when one or both parents have a migration background.

Figure 30 shows that in 2022, children with no migration background had a lower prevalence (15.8%) of overweight or obesity than children who had migrated (20.6%) and those whose parents had migrated (20.5%).

Compared with the results for 2014, in 2022 the prevalence of overweight or obesity increased by a factor of 1.6 among the group of children without a migration background, 1.4 among children whose parents had migrated and 1.2 among children who had migrated.

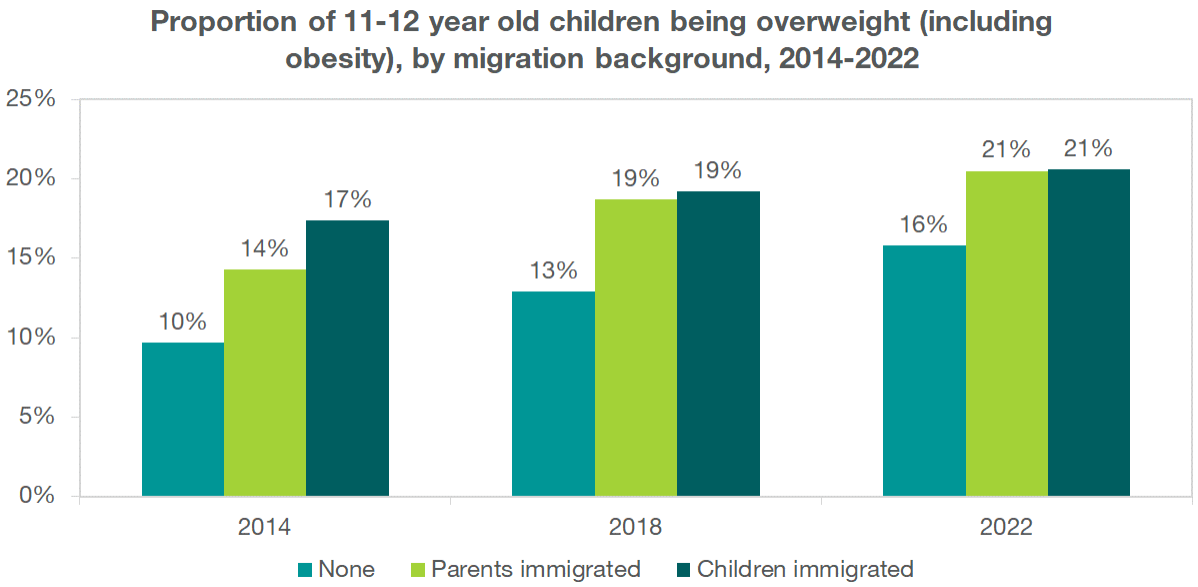


Figure 30: Proportion (%) of schoolchildren aged 11–12 who were overweight (including obesity), by migration background, 2014–2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce were used.[85]

Source: HBSC.

In terms of international comparisons using HBSC data from 2018 for 11 year old children, Luxembourg shows a considerably higher prevalence of overweight or obesity (girls 21%, boys 31%) than its neighbouring countries. In contrast to Luxembourg, only 9% of girls and 17% of boys were overweight in the Netherlands. In most countries, a gender gap exists, in terms of a higher prevalence among boys (Figure 31).[22]

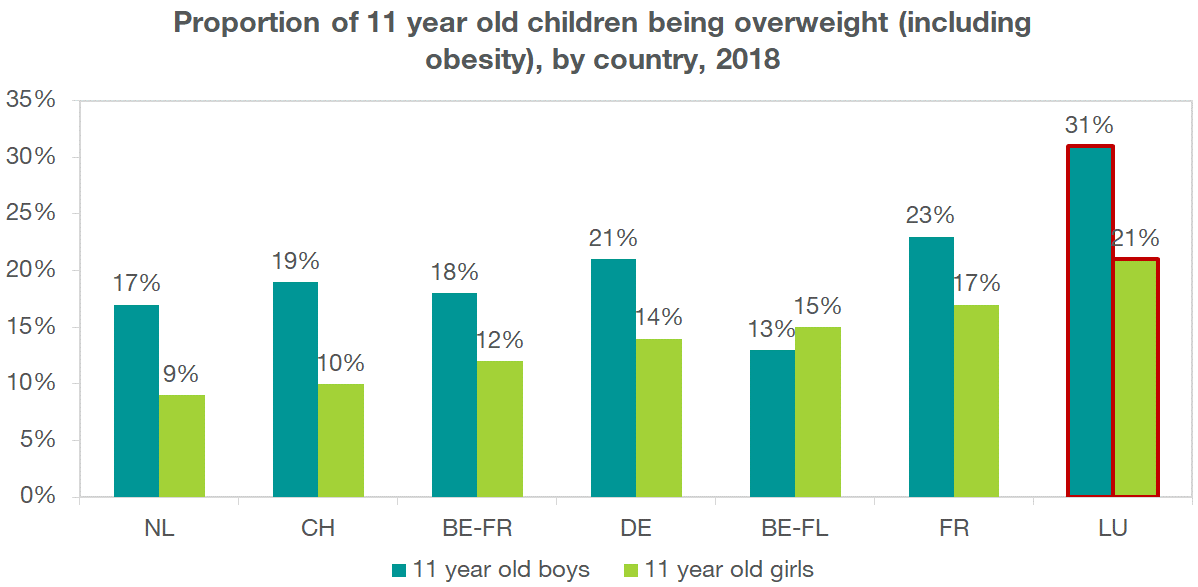


Figure 31: International comparison - Proportion (%) of schoolchildren aged 11 who were overweight (including obesity), by country, 2018. BMI cut-off values as defined by the WHO were used.[88]

Source: HBSC.

UNTREATED CARIES

Untreated caries frequently causes acute infection, dental pain and discomfort, affecting children's ability to eat, speak, learn and sleep.[89] Further, untreated caries during childhood can lead to oral health problems in later life.[90]

Oral health check-ups are given to schoolchildren in four different years during primary school in Luxembourg. We used data from the School Medicine Service for the 2022–2023 schoolyear. This data includes the proportion of schoolchildren examined who presented with untreated caries in either milk (primary) and/or permanent teeth in cycle 1.2 (pupils aged 5 to 6 years) and cycle 2.1 (pupils aged 6 to 7 years).

Almost one out of three (27.9%) children in cycle 1.2 and 2.1 had untreated caries. This proportion was slightly higher for children in cycle 2.1 (29.6%) compared with their peers one school grade below (26.2%). The prevalence of caries among children in cycle 1.2 and 2.1 varies across regional education directorates, and ranged from 20.3% to 45.9%.[xviii]

The WHO European regional office provides country estimates of the prevalence of children aged 1 to 9 years with caries of milk (primary) teeth. The WHO estimate for children in Luxembourg (29.2%) is as high as those for neighbouring countries (Belgium 30.2%, France 29.2% and Germany 29.1%).[91] Studies conducted in Belgium and the Netherlands show that underlying socioeconomic inequalities are drivers of poor oral health among underprivileged children.[92,93]

[xviii] Proportion (%) of schoolchildren in cycle 1.2 and 2.1, with untreated caries on either milk (primary) and/or permanent teeth, overall, by school classes and by regional directorate of primary education (n=14), schoolyear 2022–2023, Luxembourg.
Source: Health Directorate.

INCIDENCE AND PREVALENCE OF TYPE 1 DIABETES

Type 1 diabetes is a chronic disease caused by autoimmune destruction of pancreatic beta cells. Individuals with type 1 diabetes are reliant on insulin for survival, as without insulin, blood sugar cannot be processed by cells and builds up in the bloodstream.[94] High blood sugar levels are damaging to the body and cause many of the symptoms and complications of diabetes. Type 1 diabetes often manifests during childhood and is one of the most common chronic diseases among children.[95,96] Diabetes has a profound impact on the life of children with the condition, as they need close monitoring of their blood sugar levels throughout the day and require the constant use of insulin. This can be very stressful for both the children and their caregivers.

Insured resident children with type 1 diabetes were identified using reimbursement information for insulin or insulin analogues by the National Health Fund. The incidence of type 1 diabetes was measured by the number of children that received a first reimbursement for insulin or insulin analogues within a given year. For determining the prevalence, all children were considered that were reimbursed for insulin within the given year, irrespective of reimbursements in previous years.[xix] [xx]

Between 2012 and 2022, the incidence of type 1 diabetes fluctuated at around 3 cases per 10 000 children (Figure 32). In 2022, 41 children began insulin treatment, translating into an incidence of 4.3 cases per 10 000 children aged 0–14 years. However, no recent increase in newly diagnosed cases was observed by the Diabetes & Endocrine Care Clinique Pédiatrique of Luxembourg for 2022. Therefore, the 2022 increase observed here may be due to the immigration of children previously diagnosed with type 1 diabetes.

[xix] As immigrant children with insulin dependent diabetes are not 'new cases' per se, but are included on their first prescription in Luxembourg, the true value may be slightly lower. Also, other conditions may require short-term treatment with insulin. Therefore, we excluded cases with fewer than 60 days of consecutive treatment.

[xx] For Luxembourg, a previous analysis of new cases between 1989 and 2013 demonstrated an increasing trend since 1989.[97]

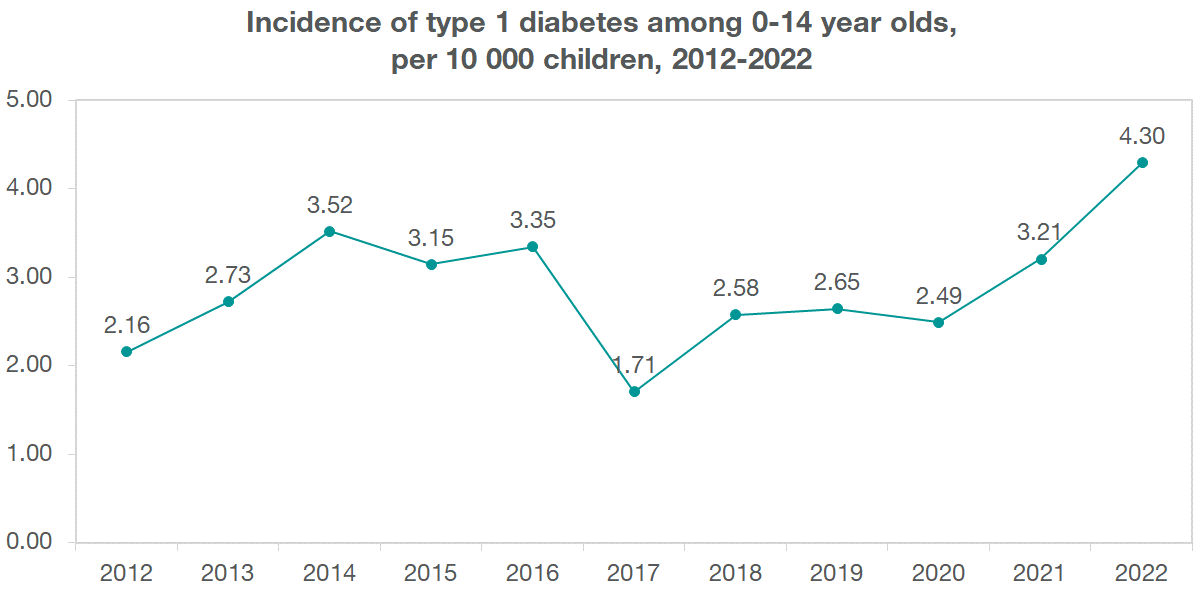


Figure 32: Incidence of Type 1 diabetes in 0–14 year old insured resident children, per 10,000 children, 2012–2022, Luxembourg, based on reimbursement data from the National Health Fund for insulin and analogues for injection. The first prescription were taken into account, with a minimum DDD of 60 per prescription.[xxi]

Source: Social security database.

In 2022, a total of 155 children aged 0–14 years were on insulin or insulin-analogue treatment, translating into a prevalence rate of 16.2 per 10 000 children. Boys and girls were affected to a similar extent.[xxii]

CHILD HOSPITALIZATION RATE AMONG RESIDENT CHILDREN

Child hospitalization is described using the rate of hospitalization for resident children aged 0–12 years, according to the main diagnosis causing the hospital admission, using ICD-10 codes.[xxiii]

The indicator presented shows the number of hospitalizations by ICD-10 diagnostic chapter per 1000 resident children per year. Three years are taken into consideration for the analysis: 2019, 2021 and 2022. We excluded the year 2020, due to incomplete data resulting from the COVID-19 pandemic. All admissions in acute and mid-term care hospitals in Luxembourg are included in the analysis, based on billing data from the national health insurance.

Among children under the age of 1 year, the main causes of hospitalization were diseases of the respiratory system and conditions originating in the perinatal period, being responsible for, respectively, 58.2 and 45.7 hospitalizations per 1000 children per year (Figure 33). In addition, among children 1–12 years old, respiratory diseases were responsible for the highest hospitalization rate (12.5 hospitalizations per 1000 children). The second largest cause of hospitalizations among children 1–12 years old were injuries (6.0 hospitalizations per 1000 children).

[xxi] DDD : Defined Daily Dose. The assumed average maintenance dose per day for a drug used for its main indication in adults.
[xxii] Prevalence of Type 1 diabetes in 0–14 year old insured resident children, by gender, per 10,000 children, 2022, Luxembourg. Based on reimbursement data from the National Health Fund for insulin and analogues for injection. Prescription with a minimum DDD of 60 per prescription were taken into account.
Source: Social security database.
[xxiii] International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10 version 2019).[98]

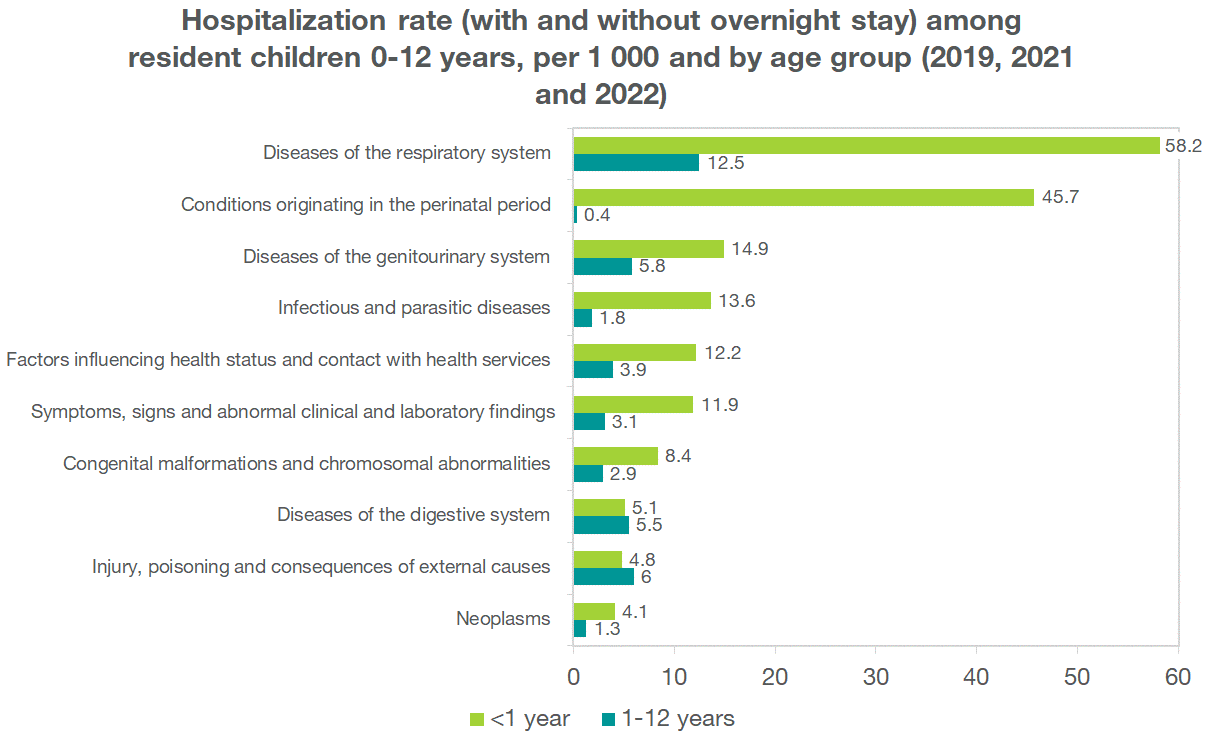


Figure 33: Annual hospitalization rate (with and without overnight stay) among resident insured children 0–12 years of age, per 1000 children by main diagnostic groups (ICD-10 chapters) and by age group, 2019, 2021 and 2022, Luxembourg. Only the 10 most frequent diagnostic categories are illustrated. See appendix for the complete data table (

Table 13).

Source: Social security database, computed by ObSanté.

CHILDHOOD CANCER

Very few childhood cancers are currently preventable, and the causes of their development are not well understood.[99] The impact of cancer on the lives of children and their families is profound, as the malignancy puts patients in a critical situation. Further, the treatment of childhood cancer is of very high intensity.[99,100] Survivors need long-term follow-up and care to mitigate physical effects, such as suboptimal growth, cardiovascular effects, neurocognitive dysfunction, fertility issues and secondary cancers.[100]

In Europe, survival rates after childhood cancer have improved over recent decades, to an 81% survival probability after 5 years. Nevertheless, the types of childhood cancer are very diverse, resulting in varying prognoses.[101]

Based on data from the national population-based cancer registry (RNC)[xxiv], 147 new childhood cancer cases were diagnosed in Luxembourg among resident children 0–14 years old over the past nine years (2014–2022). This equates to an annual age-standardized (European Standard Population) incidence rate of 164.6 cases per 1 000 000 children for the years 2014 to 2022.[102,103] Within the years 2014 to 2022, the age group of children 0–4 years had the highest incidence (232.0 per 1 000 000 per year), followed by the 10–14 years age group (150.2 per 1 000 000 per year). Childhood cancer occurred twice as frequently among

[xxiv] For more details see Appendix: Data sources.

children 0–4 years old than those 5 to 9 years old, who had the lowest incidence (117.8 per 1 000 000 children per year). [102,103]

The standardized (Standard World Population) annual childhood cancer incidence in Luxembourg (171.4 per 1 million), from 2014 to 2022, is similar to the rates in other European countries (Figure 34). France (161.2), Switzerland (165.6) and the Netherlands (169.6) showed slightly lower, and Belgium (186.8) slightly higher incidence rates than Luxembourg.

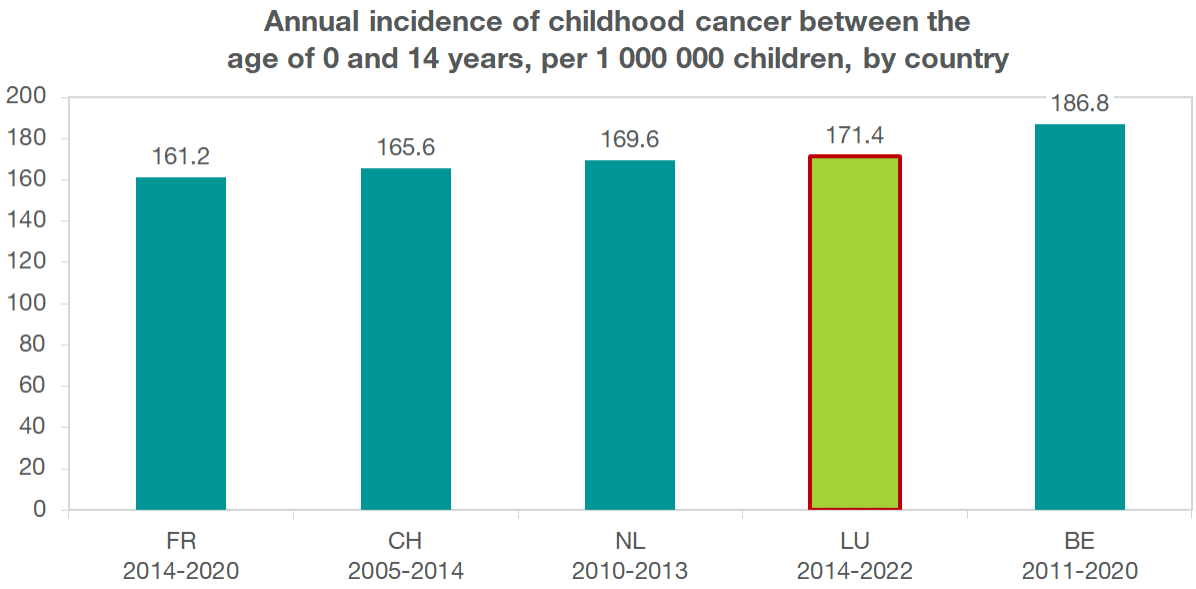


Figure 34: International comparison - Age standardized (World Standard Population) annual incidence of childhood cancer between the age of 0 and 14 years, per 1,000,000 children, by country.

Sources: LU: Incidence des cancers de l'enfant au Luxembourg: Données du Registre National du Cancer, 2014-2022 (www.rnc.lu); FR: Registre National des Cancers de L'Enfant (rnce.inserm.fr); BE: Cancer in children and adolescents in Belgium 2004-2020, Belgian Cancer Registry, Brussels, 2023 (https://kankerregister.org/); NL: https://ecis.jrc.ec.europa.eu; CH: Temporal trends in incidence of childhood cancer in Switzerland, 1985–2014. Sommer et al.[103]

Table 2 shows that from 2014 to 2022, haematological malignancies and tumours of the central nervous system were the most frequent cancers among children aged 0–14 years. They represented about two thirds of all diagnosed cancers. This is in line with distributions reported by neighbouring countries.[104,105]

Table 2: Distribution of the main diagnostic groups for childhood cancers among children aged 0–14 years at the time of diagnosis, 2014–2022, Luxembourg.

Source: National Cancer Registry.[103]

		Number of new cases	Relative distribution (%)
All cancers		147	100
Diagnostic groups (ICCC-3 2017)			
	I. Leukaemia	39	26.5
	II. Lymphomas	16	10.9
	III. Central Nervous System (CNS)*	46	31.3
	IV. Neuroblastoma	10	6.8
	V. Retinoblastoma	0	0.0
	VI. Renal tumours	< 5[#]	< 3.4

	VII. Hepatic tumours	< 5[#]	< 3.4
	VIII. Malignant bone tumours	5	3.4
	IX. Soft tissue sarcomas	9	6.1
	X. Germ cell tumours	< 5[#]	< 3.4
	XI. Malignant epithelial neoplasms and melanomas	12	8.2
	XII. Other and unspecified malignant neoplasms	0	0.0

* Non-invasive tumours are grouped together with invasive tumours.

[#] Number between 1 and 4.

ICCC-3 2017: International Classification of Childhood Cancer, 3rd edition, updated 2017.

INJURIES AMONG CHILDREN

While children go through different developmental stages, they are particularly vulnerable to injuries. Injuries are one of the leading causes of death and disability among European children, and their consequences may endure into adulthood.[106,107] Injuries often are preventable by ensuring safe social and physical environments where children can live, learn and play.[106,107]

Injuries treated at hospital emergency departments are reported based on established injury definitions to the REcueil d'informations sur les TRaumatismes et ACcidEnts" (RETRACE).[108] [xxv] As for some of the years hospital participation in the Registry was incomplete, estimated annual incidence rates for injuries are calculated and presented.

In each of the recent years in Luxembourg, about one in seven children has required medical treatment in a hospital due to an injury (Figure 35). The highest estimated incidence (155 injury cases per 1000 children) was observed in 2019, subsequently decreasing to 123 injury cases per 1000 children in 2020. Overall, estimated incidence of injury has remained stable over recent years, apart from 2020, potentially due to effects of the COVID-19 pandemic.[109–112]

[xxv] For more details see Appendix: Data sources.

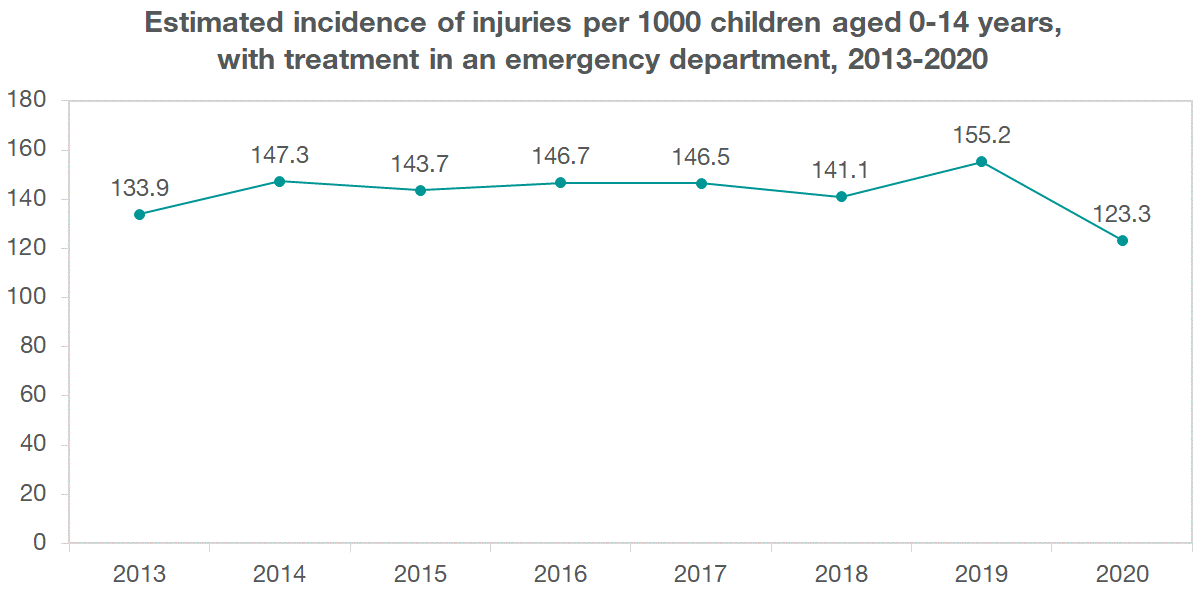


Figure 35: Estimated incidence of injuries per 1000 children aged 0–14 years, requiring treatment in a hospital emergency department, 2013–2020, Luxembourg.

Source: RETRACE; STATEC.

To assess differences by age and sex, we used the most recent data from 2018 to 2020. The highest incidence is observed in the age group of 10–14 years (boys 171.5 injuries per 1000 children, girls 138.7 injuries per 1000 children). Across all age groups, boys had a higher risk of injury requiring hospital treatment than girls (Figure 36).

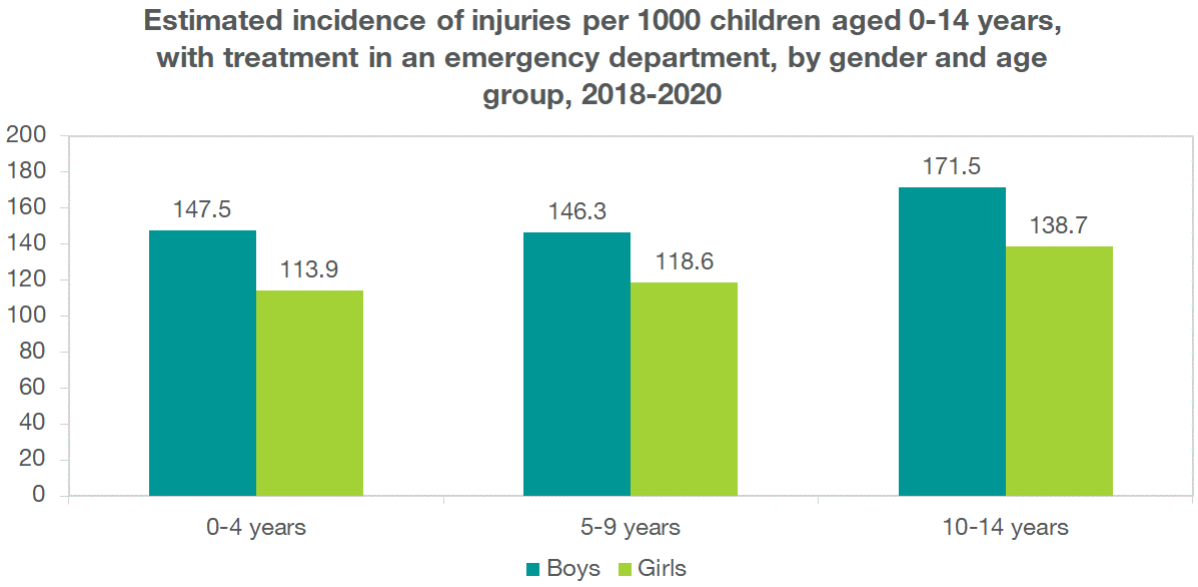


Figure 36: Estimated incidence of injuries per 1000 children aged 0–14 years, requiring treatment in a hospital emergency department, by gender and age group, 2018–2020, Luxembourg. Only resident children are included

Source: RETRACE; STATEC.

From 2018 to 2020, falls represented the most frequent mechanism of injuries, in particular among children 0–4 years of age (56.0%) compared with their older peers (42.6%). Cuts and puncture wounds were the second most reported cause among both age groups (0–4 years 7.7%, 5–14 years 6.2%). Injuries due to road traffic accidents were responsible for 1.4% of

injuries among the children aged 0–4 years and 3.5% of injuries among children 5–14 years old. In contrast to road traffic accidents, burns or scalds (2.7%) and poisoning (2.5%) represented a notable cause of injuries among children 0–4 years old.[xxvi]

Lastly, we looked at the rate of injuries among children in Luxembourg at their home or at school, and/or during leisure activities. This indicator is based on the European Union Injury Database (IDB) and part of the published European Core Health Indicators (ECHI) (indicator 29_b). [113] [xxvii]

For 2018, Luxembourg reported 109.1 injuries resulting from accidents at home or at school and/or during leisure activities per 1000 children aged 0–14 years. This was slightly higher than in Austria (92.6 per 1000 children) and Denmark (104.3 per 1000 children). A large gap can be observed with the Netherlands (41.0 per 1000 children), where the incidence was only half of that in Luxembourg. However, country specific differences in the organization of the health system strongly determine the number of visits to emergency services, which is a limitation when making country comparisons. As shown for example in the Netherlands where 20.5% of all age injury cases were reported as being hospitalised compared to only 7.6% of cases in Luxembourg (EU-IDB data 2020).[110] This suggests that emergency visits may involve more-severe injuries in the Netherlands than in Luxembourg.

[xxvi] Proportional distribution (%) of estimated number of injury cases in resident children 0-14 years old, by mechanism of injury and by age group, 2018-2019, Luxembourg. The mechanism of injury is the process by which an injury occurs. Road traffic injury: all accidents involving means of transport (car, bicycle, lorry, etc) and that take place on a public street; Falls; Cuts/puncture wounds: cuts by sharp objects and puncture wounds by objects under the skin; Poisoning: intoxication by alcohol, drugs or chemical substances; Burn/scald: includes burns by hot substances or objects as well as chemical products. Age is categorized as 0-4 years and 5-14 years. Source: RETRACE.

[xxvii] Number of accidents at home or at school and/or during leisure activities during the past 12 months, resulting in an injury that required treatment in a hospital, expressed per 100,000, in the age group 0–14 years.
Source: European Core Heath Indicators (indicator 29_b).[113]

Conclusions on physical health status

This chapter has covered a broad range of indicators to describe the health status of children in Luxembourg, based on several different data sources. The measurements we used to assess the physical health and development of these children highlight that many of them are affected by more behaviour-related outcomes, such as dental caries and being overweight. The latter is more prevalent among children from less well-off households, and it is more common than in neighbouring countries. Most injuries are considered to be preventable and the result of unsafe environments in which children live. Nevertheless, the rate of children seeking medical care in an emergency department because of an injury has remained unchanged since 2013.

We found that fewer than half of the children rate their overall health as excellent. Further, health and wellbeing of a child growing up in Luxembourg differs substantially according to the socioeconomic environment it is born into. The last HBSC survey shows that this inequity was even more pronounced in 2022 than in 2018.

Currently, little is known about how to prevent childhood cancer and type 1 diabetes. Both profoundly impact the lives of children and their families. About one in every 400 children will be affected by cancer during their early years, and type 1 diabetes among children is on the upsurge across Europe. In Luxembourg, the number of children affected by type 1 diabetes increased in 2021 and 2022.

Luxembourg observed a decline in perinatal and child mortality rates over the previous century, and they have remained stable at low levels during the last decade. The likelihood of a child dying before reaching 5 years of age is lower than that observed in neighbouring countries. The likelihood of dying before reaching the age of 10 is also low and shows a slightly decreasing trend. Two thirds of all deaths among children aged 0–12 years were categorized as potentially avoidable, and most were linked to conditions occurring in the perinatal period; that is, around birth. As in other European countries, boys were more affected than girls. Also, as in Europe in general, the main causes of death among older children were accidental and transport injuries, indicating that this is an area that should be further investigated to help prevent avoidable deaths among children.

The most frequent causes for hospital admission across all age groups were diseases of the respiratory system. Among children 1–12 years old, the second most frequent causes for hospitalization were injuries, poisoning and other external factors, followed by diseases of the genitourinary system and diseases of the digestive system. In infants, after conditions originating in the perinatal period, diseases of the genitourinary system and infectious diseases were the most frequent causes for admission.

Overall, the section shows that overweight and obesity among children is increasing and that relatively large social inequalities exist in child health in Luxembourg.

3. Mental health

Mental health is a central element of individual and collective health and wellbeing. Childhood and adolescence are critical stages of life for mental health, as this is a period during which rapid growth and development takes place in the brain. The skills and competencies formed at a young age directly influence mental health throughout a person's lifetime. [114,115]

Mental health conditions such as anxiety are very prevalent among children in Europe and constitute a major source of distress. In the Global Burden of Disease Study, anxiety ranks among the top five most significant morbidities among children aged 5–9 years living in OECD countries.[1,116,117] Among children 10–14 years of age, anxiety and conduct disorders are among the five most significant conditions.[1,116,117] A report on the Luxembourg HBSC survey from 2022 specifically focused on mental health and well-being of children, showed that one out of four (26.6%) schoolchildren aged 11-12 years experienced moderate to high anxiety symptoms, and every tenth child was at risk for depression.[118]

This chapter looks at three measurements of mental health: self-reported prevalence of multiple health complaints, hospitalization due to mental and behavioural disorders, and the proportion of children having treatment for attention deficit hyperactivity disorder (ADHD).

Main findings:

- In 2018, multiple health complaints (psychosomatic complaints) were more prevalent among children 11 years of age in Luxembourg, compared with children in DE, NL, CH and BE-FL. Furthermore, children from less well-off households (63.3%) were affected almost twice as frequently as their peers from well-off families (33.8%).
- Child hospitalizations due to mental health and behavioural disorders were mainly among children 10–12 years old. Around a third of those hospitalizations were due to 'behavioural and emotional disorders' and another third were due to 'neurotic, stress-related and somatoform disorders'.
- In 2022, 12.1 per 1000 children were taking medication for ADHD.

PSYCHOSOMATIC COMPLAINTS AMONG CHILDREN

The occurrence of psychosomatic complaints is an important indicator for mental health in young people.[119–121] Adolescents with frequent multiple health complaints (MHC) are more likely to report a lower quality of life and increased feelings of loneliness, as well as being more likely to experience negative school experiences, such as bullying and low school satisfaction.[119–121] Furthermore, psychosomatic health complaints during early life may persist and evolve into serious mental health symptoms later in adulthood.[122]

We used data for self-reported measurements of eight common psychosomatic complaints: headache, stomach ache, backache, feeling low, irritability or bad temper, feeling nervous, difficulties in getting to sleep and feeling dizzy. [xxviii] The indicator is based on the proportion of children 11 to 12 years of age who reported frequent MHC, defined as experiencing two or more complaints several times a week or even daily over the previous six months.

MHC among children have been rising over time. In 2022, 29.4% of boys and 43.0% of girls reported frequent MHC (Figure 37). The higher proportion of girls than boys is in line with findings that biological and psychosocial differences contribute to girls reporting MHC more often than boys.[15,119xxix]

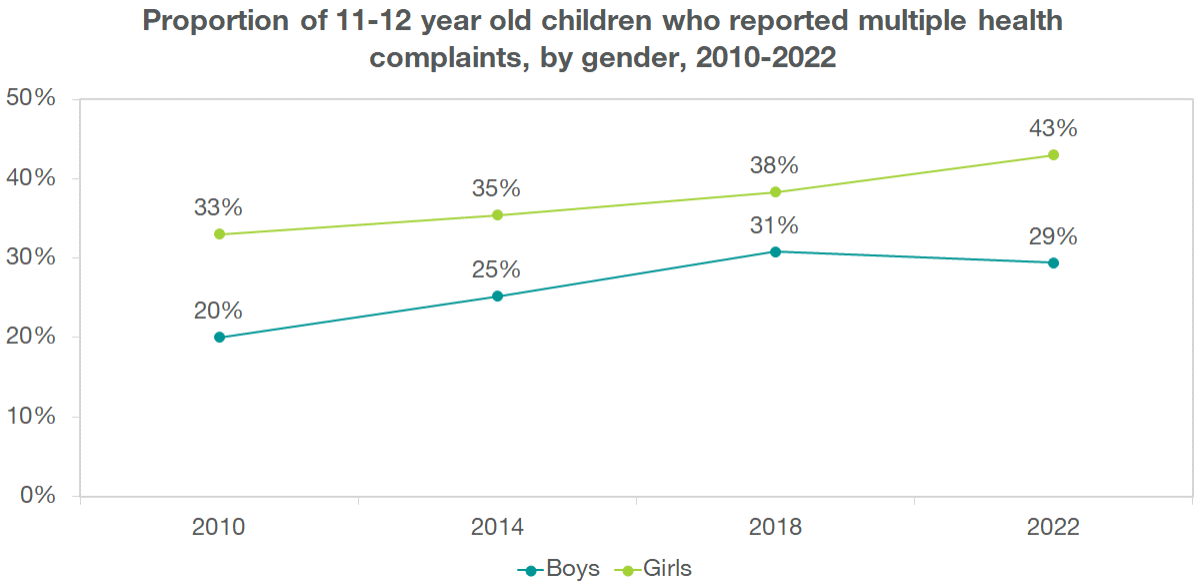


Figure 37: Proportion (%) of 11–12 year old schoolchildren who reported multiple health complaints, by gender, 2010–2022, Luxembourg.

Source: HBSC.

Differences by socioeconomic status also emerged. In 2022, a higher proportion of children who perceived their family as not being well-off reported experiencing MHC (63.3%), compared with children who perceived their family as well-off (33.8%) (Figure 38).

[xxviii] In the Health Behaviour in School-Aged Children (HBSC) study, children were asked to answer a symptom checklist (HBSC-SCL), comprising a validated non-clinical measurement of eight common psychosomatic complaints: headache, stomach ache, backache, feeling low, irritability or bad temper, feeling nervous, difficulties in getting to sleep and feeling dizzy. The answers ranged from having complaints rarely or never, to about every day.[83,123–125]

[xxix] A recent report on mental health among schoolchildren in Luxembourg showed that lower life satisfaction among girls compared to boys was mainly driven by psychological distress and social relationships.[118]

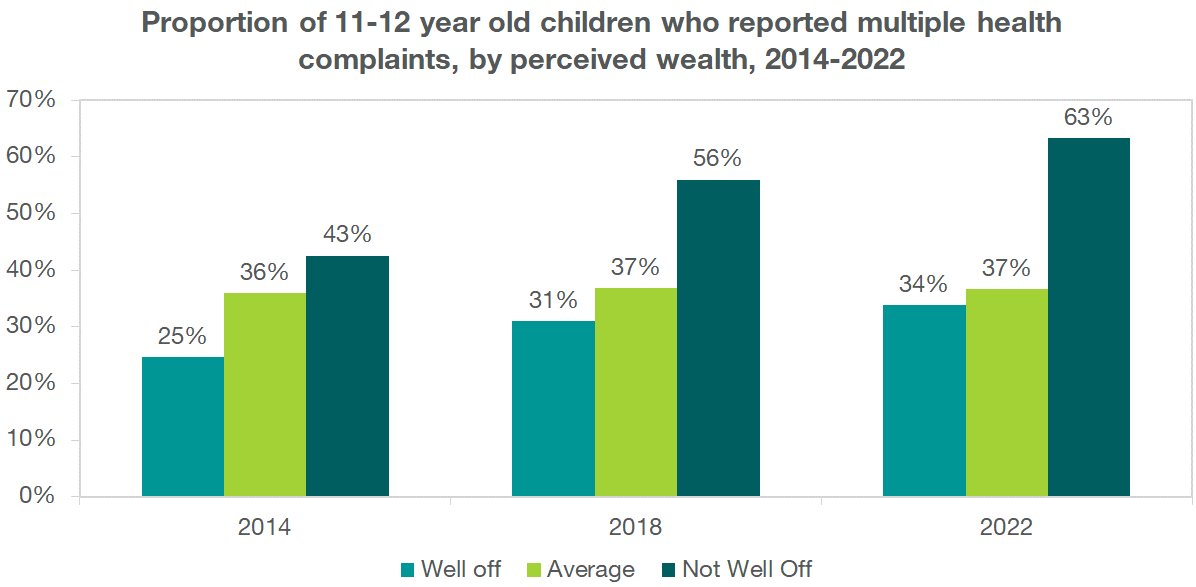


Figure 38: Proportion (%) of 11–12 year old schoolchildren who reported multiple health complaints, by perceived wealth, 2014–2022, Luxembourg.

Source: HBSC.

The results for 2022 also show MHC as being more prevalent among children living in family compositions in which not both parents were present in the household (42.9%), compared with households with two parents (33.2%). Similarly, children who did not have a migration background had a lower prevalence (31.8%) of MHC than children who had migrated (38.4%) or whose parents had migrated (37.8%).

In an international comparison using data from the 2022 HBSC study, 11 year old girls and boys from Luxembourg (girls 39%, boys 29%) reported having MHC with a similar rate to their peers from the Netherlands (girls 39%, boys 26%), Germany (girls 34% , boys 26%), Switzerland (girls 37%, boys 27%) and the Flemish-speaking region of Belgium (girls 37%, boys 28%). France (girls 47%, boys 37%) and the French-speaking region of Belgium (girls 53%, boys 38%) had higher levels of frequent MHC reported by children than in the previously mentioned countries. Generally speaking, girls report higher rates of MHC than boys (Figure 39).

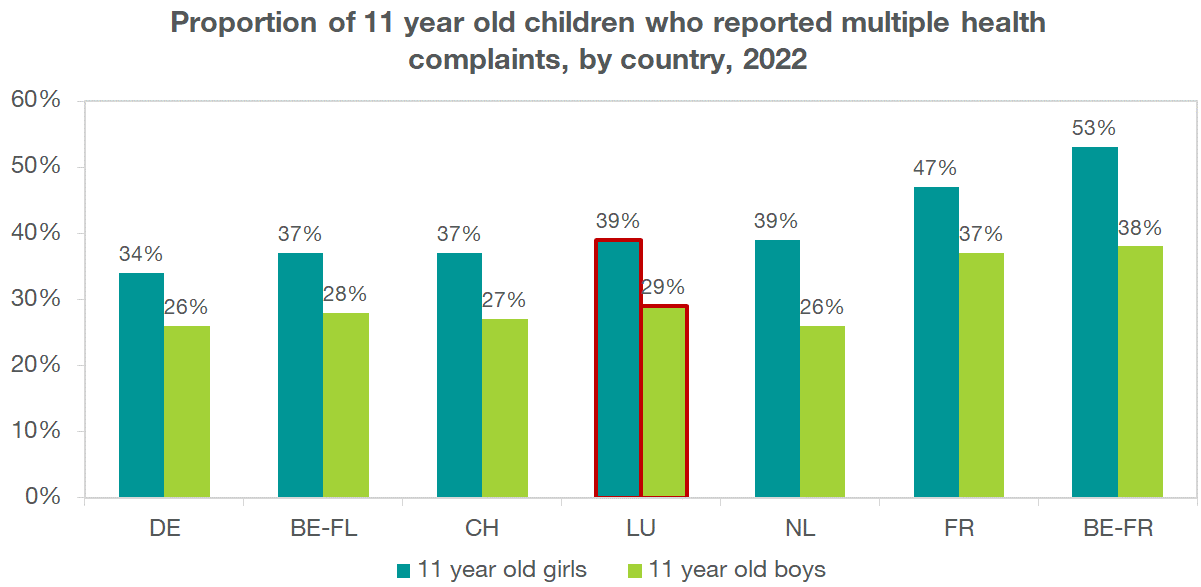


Figure 39: International comparison – Proportion (%) of 11 year old children who reported multiple health complaints, by country, 2022.

Source: HBSC.

CHILD HOSPITALIZATIONS DUE TO MENTAL AND BEHAVIOURAL DISORDERS

The second indicator for mental health concerns hospitalization with an overnight stay due to mental or behavioural disorders among resident children, indicating severe episodes of mental health problems. Ideally, children should be given care and support for their mental health before their condition escalates to the point of requiring hospitalization.

The presented indicator is based on data from the national health insurance and shows the proportion of each diagnostic group, among all hospitalizations for mental and behavioural disorders (ICD-10 chapter V). Within the years 2019, 2021 and 2022,[xxx] 0.7% (175 out of 23 819) of hospitalizations with overnight stays among children aged 0–12 years were attributable to mental or behavioural disorders. In line with the commonly reported increase of mental health disorders with age, around two-thirds (62.9%) of hospitalizations were among children aged 10–12 years.[117] Hospitalizations due to mental or behavioural disorders among children below 4 years of age were rare.

Further, recurrent hospitalizations due to mental or behavioural disorders were frequent. In 2019, 2021 and 2022, approximately one in four (27.0%) children hospitalized with mental or behavioural disorders experienced multiple hospitalizations.

The most common mental and behavioural disorders leading to hospitalization were under the international categorization of ‘Behavioural and emotional disorders with onset usually occurring in childhood and adolescence’. These were followed by ‘Neurotic, stress-related and somatoform disorders’ (mostly reaction to severe stress and adjustment disorders (F43)), ‘Disorders of psychological development’ and ‘Behavioural syndromes associated with

[xxx] We excluded the year 2020, due to incomplete data resulting from the COVID-19 epidemic.

physiological disturbances and physical factors'. These accounted for 34.4%, 32.8%, 11.1% and 10.6%, respectively (Table 3).

Table 3: Relative distribution (%) of hospitalizations with overnight stay among children 0–12 years, due to mental and behavioural disorders, by ICD-10 sub-chapters, 2019, 2021 and 2022, Luxembourg. Only resident insured children were included.

Source: Social security database, computed by ObSanté.

Description	Percentage
Behavioural and emotional disorders with onset usually occurring in childhood and adolescence (F90-F98)	34.4%
Neurotic, stress-related and somatoform disorders (F40-F48)	32.8%
Behavioural syndromes associated with physiological disturbances and physical factors (F50-F59)	11.1%
Disorders of psychological development (F80-F89)	10.6%
Schizophrenia, schizotypal and delusional disorders (F20-F29)	3.9%
Mood [affective] disorders (F30-F39)	2.2%
Mental and behavioural disorders due to psychoactive substance use (F10-F19)	2.2%
Mental retardation (F70-F79)	1.7%
Disorders of adult personality and behaviour (F60-F69)	1.1%

Overall, in 2022, some 0.8 hospitalizations per 1000 children were recorded as being due to mental and behavioural disorders (ICD-10 chapter V) (Figure 40).

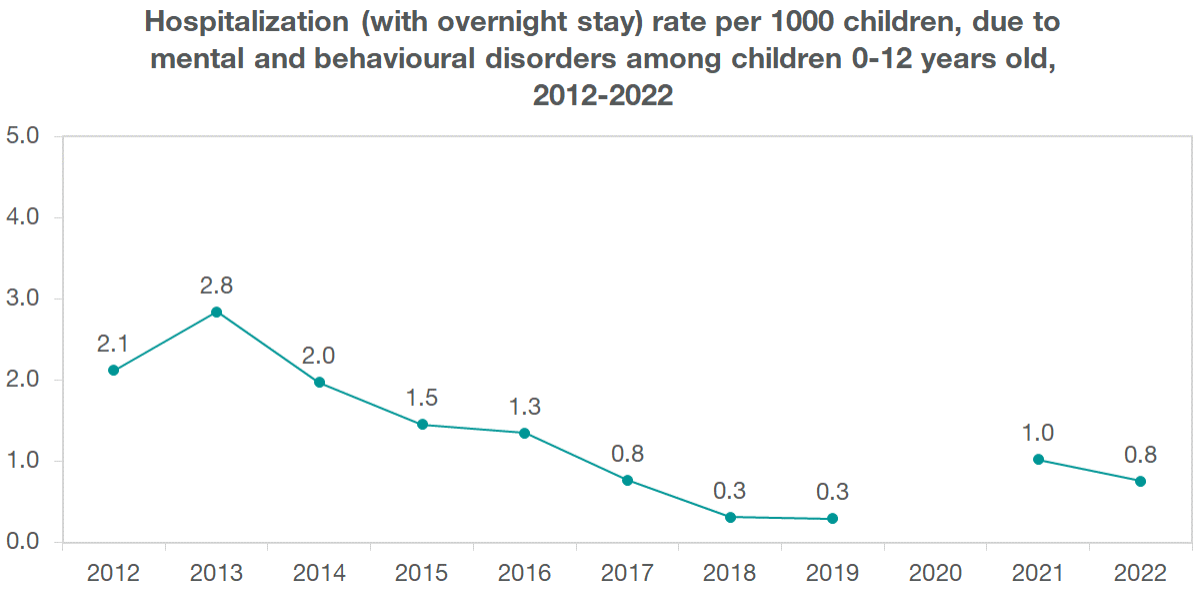


Figure 40: Rates of hospitalization with overnight stay due to mental and behavioural disorders among resident children 0–12 years old per 1000 children, 2012–2022, Luxembourg. Only diagnosis within the chapter V of mental and behavioural disorders of the ICD-10 (version 2019) were considered in the analysis. Resident insured children were included.

Source: Social security database. Computed by ObSanté.

ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

The third indicator for mental health is the incidence and prevalence of treatment for attention deficit hyperactivity disorder (ADHD) (prescribed methylphenidate), among resident children 5-14 years of age.

ADHD is one of the most diagnosed behavioural disorders in childhood. It is estimated that ADHD accounts for 19.5% of all mental disorders among adolescents aged 10–19 years in Europe.[126,127] Early detection and intervention can help reduce the severity of symptoms, decrease the impact on school performance, enhance the child's psychosocial development, and improve the overall quality of life.[117,127]

To identify children receiving medical treatment for ADHD, we counted those who had a reimbursement by the National Health Fund for at least 60 days of treatment (60 DDD)[xxxi] with methylphenidate. Methylphenidate is a psychostimulant that is licensed in the European Union for the treatment of children aged 6 years and over with ADHD, as part of comprehensive treatment programmes.[129] According to international recommendations, methylphenidate is the first choice pharmacological treatment option for ADHD among children aged 6 years and above.[130]

Between 2012 and 2017, the yearly incidence of children starting treatment with methylphenidate has decreased and has stabilized in recent years at around 4 per 1000 children (Figure 41Figure).

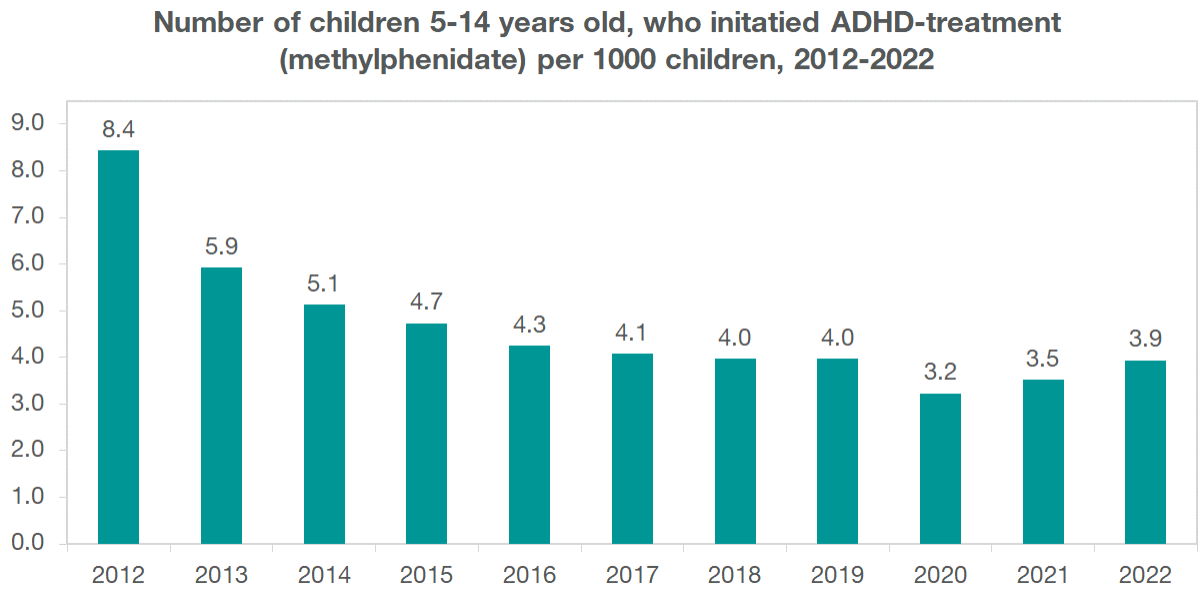


Figure 41: Incidence of attention deficit hyperactivity disorder (ADHD)-treatment among children 5-14 years old, per 1000 children, 2012–2022. Resident insured children were included.

Source: Social security database.

The prevalence of methylphenidate treatment in 2022 was 12.1 per 1000 children aged 5–14 years, and was higher in the 10–14 years age group (18.8 per 1000 children) than among 5–

[xxxi] The Defined Daily Dose (DDD) is the assumed average maintenance dose per day for a drug used for its main indication in adults and is a gold standard measuring unit for international drug utilisation research.[128]

9 year olds (5.6 per 1000 children).[xxxii] The use of ADHD medication, as part of a comprehensive treatment plan that should include interventions focusing on different therapeutic areas (psycho-education, and management of school tasks and daily life), varies between countries. One study reported that in 2010, the prevalence of ADHD medication use was 7 per 1000 children 3–18 years old in Western Europe and 19.5 per 1000 children in Northern Europe.[131] A recent French study reported a steady increase in the prevalence of methylphenidate prescription among 3–17 year olds, reaching an estimated 6.1 to 7.5 per 1000 children in 2019.[132]

Conclusions on mental health

The mental health of children in Luxembourg has been worsening over the 10 years examined, irrespective of family situations or wealth. There has been a consistent increase in the number of children affected by multiple health complaints. In addition, children living in less favourable socioeconomic contexts were disproportionally affected by MHC.

We nevertheless observed a decrease in hospitalizations due to mental health problems over the last decade. There could be several reasons for this, and it deserves further study, as it may indicate that severe mental distress has become less frequent or that the outpatient treatment of mental health conditions has improved. Between 2012 and 2021, around two-thirds of hospitalizations due to mental and behavioural disorders were attributed to 'Behavioural and emotional disorders with onset usually occurring in childhood and adolescence' and 'Neurotic, stress-related and somatoform disorders'.

ADHD prevalence treated by methylphenidate has remained stable over recent years. It has increased in line with children's age and was at the highest level among children 10–14 years old.

Monitoring indicators related to the mental health of children and adolescents is important to follow the health of young people over time, identify at-risk groups and facilitate international comparison benchmarking. The results are important sources of information for those involved in designing environments and policies to support the optimal development and self-realization of children and adolescents. However, representative data for the mental health situation of children below the age of 11 is almost completely absent in Luxembourg, apart from the use of health insurance data.

[xxxii] Prevalence of attention-deficit/hyperactivity disorder (ADHD)-treatment) among children 5-14 years old, per 1 000 children, 2022, Luxembourg. Resident insured children are included.
Source: Social security database.

4. The effects of COVID-19 among children in Luxembourg

The COVID-19 pandemic affected population health through different mechanisms. First, it caused a large number of infections throughout the entire pandemic and thereby placed additional pressure on the healthcare system. A second major effect was due to the containment measures to limit viral transmission, with lockdown periods, school closures, physical distancing and reductions of cultural, social and leisure activities, as well as potentially more limited access to health care.

While children mostly suffered less-severe illness from SARS-CoV-2 infection than adults did, they were particularly exposed to the restrictions implemented to mitigate viral transmission.[133] These restrictions had several potential negative effects for children. The uncertainty surrounding the situation, the fear of becoming infected or transmitting the virus, or worries for family members were likely to have adversely affected mental health and emotional wellbeing, while stress within families increased due to economic uncertainty and greater caregiving responsibilities. Child protection was also impaired, as school closures and restrictions on movement hampered the detection and management of child abuse and neglect. The greater use of remote learning and online resources may have further exacerbated educational inequalities, as many children from poorer families could not readily access computers or the internet from home.

Throughout the pandemic, various measures and support systems were put in place to address the health and wellbeing issues of children in different domains. The goal was to ensure continued access to essential healthcare services and to education. Mental health support was offered to vulnerable families, and efforts to reinforce child protection were implemented. One important aspect was support for research and data collection to inform targeted interventions and policies, and to monitor the long-term effects of the pandemic on children. To date, these effects nevertheless remain largely unknown.

This chapter aims to provide insights into both the direct effects of SARS-CoV-2 infection and the wider indirect effects of containment measures on children's health.

A short history of COVID-19 in Luxembourg

The first case of COVID-19 in Luxembourg was reported on 1 March 2020, immediately followed by the mobilization of a crisis unit. A crisis situation was announced by the government on 16 March 2020, leading to a lockdown of the population, travel restrictions and the closure of schools, childcare facilities and other activities. Over the entire period of the pandemic, elementary schools were closed for a total of 48 days in 2020 and 2021. This was shorter than in many other European countries. School closures were split into three time periods: the first was for eight weeks, starting on 16 March 2020, the second in January 2021 for one week and the third in February 2021 also for one week. During the school year 2020–2021, some 1350 classes of primary schools were quarantined.

In the meantime, several support schemes for young people were set up to limit the impact of the crisis. For example, dedicated health crisis lines were opened to provide educational and psychological support.[i] In addition, remote teaching was developed in order to ensure learning continuity for all. Two online web platforms were available from 20 March 2020 to facilitate remote learning and provide support to students (with dedicated tools for children aged 1–4 and 4–12 years), and to parents and teachers during lockdowns. The return to primary school and associated childcare facilities was gradual from 25 May 2020, with classes divided in half, and with alternating weeks of attendance. Classes were reunited and attendance brought back to normal with face-to-face teaching as of 29 June 2020.

Starting from September 2020, children attended classes in person. However, social distancing was mandatory and every child over the age of six had to wear a mask. Large-scale testing was implemented in schools to mitigate transmission. A second wave of COVID-19 occurred during Autumn 2020, leading to the interruption of extracurricular sports activities at the end of October and the closure of cinemas, swimming pools and sports halls at the end of November. In 2021, schools had very high COVID-19 incidence rates, which led the government to reinforce measures (increased contact tracing, closure of schools for short periods in January and February, etc.). Restrictions on extracurricular activities were gradually relaxed during the first half of 2021.

Main findings:

- The direct health effects of the COVID-19 pandemic on children were small with few hospitalizations and no deaths due to COVID-19
- The pandemic likely affected children's mental health, health behaviours and weight, but more research is needed to determine the exact impact in Luxembourg

The direct effects of COVID-19 on children

The impact of COVID-19 on children was different to the effects for adults and adolescents in several ways. The immediate health risk from infection was generally deemed to be lower for children.[134] On the other hand, children had fewer options to protect themselves against infection once schools and childcare started functioning normally again, and were also the last population group to be offered vaccinations.[135] As a result, many children were exposed to the virus prior to being vaccinated.

For this section, we analysed data from the Directorate of Health (Direction de la santé) and the social security database, focusing on COVID-19 infections, hospitalizations and vaccinations for children 0–12 years old.[xxxiii] We also investigated differences in infection and vaccination rates by the demographic and socioeconomic characteristics of children (see Van Kerm et al., 2022, for details on the general methodology).[136]

[xxxiii] Note that children of parents not covered by the national social security system (e.g., international civil servants) or who were not residents in Luxembourg and aged between 0-12 in March 2020 are not covered by the statistics on vaccination and infections.

SARS-CoV-2 infections among children 0 to 12 years old

Over the 27-month period from March 2020 to May 2022, the SARS-CoV-2 incidence rate of insured resident children varied between age groups (Figure 42). The majority of infections came with the onset of the highly transmissible Omicron variant at the end of 2021. In January 2022, the incidence rate reached over 6500 per 100 000 children aged 0–12 years; notably 8400 per 100 000 specifically among children 6–8 years old. No sex differences in incidence rates were found at any point during the observed period. Looking at the results by age groups, 9–12 year old children showed higher rates of incidence in the wave during 2020 and 6–8 year olds had the highest infection rate in 2022, when Omicron was the main circulating variant. For the youngest children, many infections might have remained undetected due to a lack of symptoms or difficulties differentiating COVID-19 infections from other infectious diseases among children.[137] This likely resulted in fewer PCR tests among this group, leading to fewer detected cases than in other age groups. Geographically, the proportion of children infected over the entire observed time was greatest in Esch-sur-Alzette (58%) and lowest in Echternach (51%).[xxxiv]

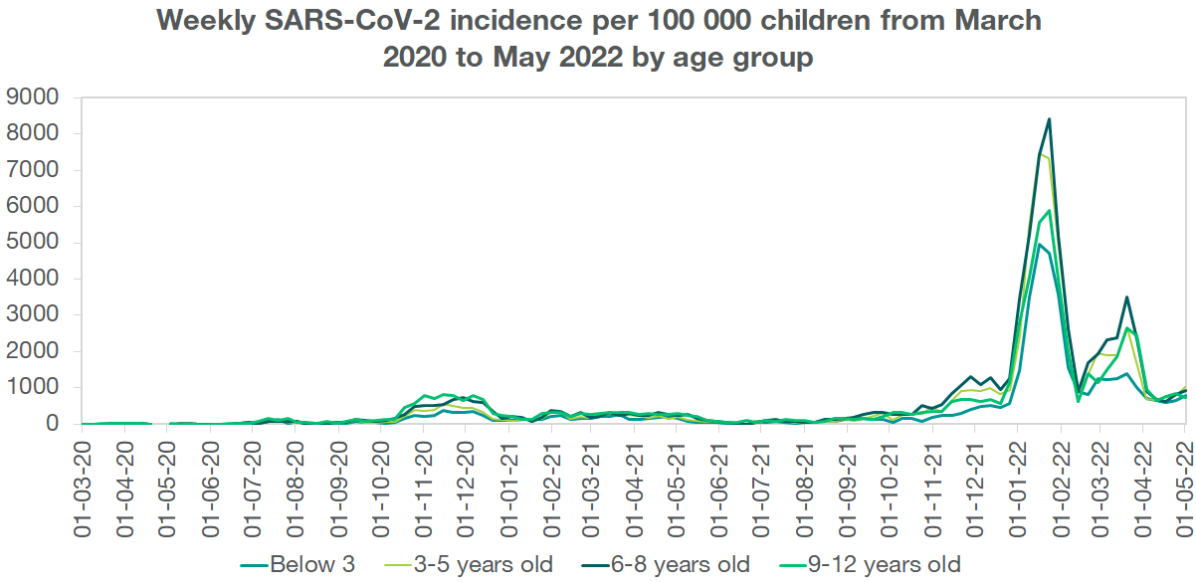


Figure 42: Weekly SARS-CoV-2 incidence per 100 000 children, from March 2020 to May 2022 by age group, Luxembourg..

Source: Direction de la Santé ; Social security database.

Incidence rates were somewhat higher in larger families during the Omicron wave. At the peak of the epidemic wave in January 2022, households with at least two children had a higher incidence rate than households with only one child. A likely reason for this is that once one child had been infected, the infection spread within the family. However, this observation does not seem to hold true for previous waves. Also, unlike what has been reported for adults (prior

[xxxiv] The analysis was conducted in partnership with the project “Santé Pour Tous” of the Luxembourg Ministry of Health in the context of which data were compiled by the Luxembourg Directorate of Health (Direction de la santé) and the Inspection générale de la sécurité sociale (IGSS). The extractions are made available through the IGSS’s Luxembourg Microdata Platform on Labour and Social Protection. See Van Kerm et al. (2022) for details on the data sources, variable definitions and general methodology.[136]

to the onset of the Omicron variant), our analysis did not detect large socioeconomic differences in terms of infections according to household income.

SEVERE FORMS OF COVID-19 INFECTIONS

Despite the high incidence of SARS-CoV-2 infections, very few children required a hospital stay due to the pandemic. Between March 2020 and December 2021, some 61 children and adolescents under 20 years of age were hospitalized, out of whom 51 were under 10 years of age. This means that 0.08% of all resident children under 10 years old and 0.01% of children and adolescents aged 10–19 years were hospitalized due to COVID-19.[138] These results are in line with a recent study, which found that between 1 July 2020 and 17 February 2022, 0.9% of children and adolescents aged 0–17 residing in England and who had a recorded first SARS-CoV-2 infection during this period were admitted to a hospital.[139]

Although severe COVID-19 is less common among children than adults, Paediatric Inflammatory Multi-system Syndrome (PIMS) and post-COVID syndromes (or 'long COVID') are of concern.[137] PIMS (or multisystem inflammatory syndrome in children (MIS-C)) represents a rare and severe form of inflammatory syndrome that can affect multiple organs. It occurs in a very limited number of children in the weeks following a SARS-CoV-2 infection. The cumulative incidence has varied between countries, with 7.5 per 100 000 recorded in France (7.3 among age 0–2, 8.8 among age 3–5 and 10.6 among age 6–10); 7.4 per 100 000 in Germany and 6.8 per 100 000 in Sweden.[140–142] In Luxembourg, between March 2020 and February 2022, among 0 to 15 years old, 18 children were diagnosed with MIS-C at the national specialized paediatric department out of a total of 5200 reported infections. The incidence rate of MIS-C was 7.2 per 1 000 000 person-months.[143]

Post-COVID syndrome or 'long COVID' is a heterogeneous multi-systemic condition and includes signs and symptoms that persist after a SARS-CoV-2 infection. Estimating the prevalence of post COVID-19 conditions is challenging, because of variations in awareness, case definitions, methods and populations surveyed. In October 2021, the WHO proposed a clinical definition, stating it generally occurs three months from the onset of COVID-19, with symptoms lasting at least two months and not able to be explained by an alternative diagnosis.[144] A recent study estimated a prevalence of long COVID of 25% among children and adolescents who had a SARS-CoV-2 infection, and identified an increase in risk with age.[145] However, precise data is lacking to enable differentiation between children under 12 and adolescents. The high prevalence observed is in line with data for adults, showing that the proportion of post-COVID syndrome was higher among those infected in the early phase of the pandemic. Further studies targeting children under 12 years old are required to establish the burden of post-COVID syndrome in this population.

No deaths due COVID-19 were reported for children in Luxembourg.[xxxv]

COVID-19 vaccinations for children 0–12 years old

The Conseil Supérieur des Maladies Infectieuses (CSMI) recommends vaccination against COVID-19 for adolescents aged 12 years old and above, as well as for children 5-11 years old with severe COVID-19 risk factors or those living in the same household as people vulnerable to the disease. Vaccination against COVID-19 for children 5-11 years old in good health with a history of COVID-19 infection is not recommended, given the current knowledge

[xxxv] Number of death due COVID-19 among children 0-12 years old, in Luxembourg, 2020-2021. Source: National register of causes of death. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident) Source: National register of causes of death.

about the limited severity of the disease for children. Below the age of five, vaccination against COVID-19 is only recommended in children with severe risk factors.[146,147]

By 30 April 2023, close to 19% of all children between 5 and 9 years old, and over 62% of those aged 10–14 years had been given at least one vaccine dose against COVID-19 (Table 4).[148] Older children are by far the group with the highest vaccine coverage. This may be explained by the universal vaccination recommendation for children aged 12 and over, the later availability of vaccines for younger children, as well as greater reluctance to vaccinate very young children, for whom the health benefits from vaccination are less clear.[149]

Table 4: Coverage (%) of SARS-CoV-2 vaccination among children 0-14 years old in Luxembourg, by dose administered and age group, by April 2023.

Source: Directorate of Health, Rapport sur l'effectivité vaccinale contre la COVID-19 au Luxembourg - Mise à jour du rapport - 31.03.2023[148]

Age group	Vaccination coverage 1st dose	Vaccination coverage 2nd dose	Vaccination coverage 1st booster	Vaccination coverage 2nd booster
0 to 4 years	0.0 %	0.0 %	0.0 %	0.0 %
5 to 9 years	18.9 %	16.0 %	0.0 %	0.0 %
10 to 14 years	62.2 %	58.4 %	23.6 %	0.2 %

Based on information from the national registry for vaccination data we also investigated differences in the vaccination rates for various social groups (see Appendix and Van Kerm et al., 2022).[136] In contrast to the situation for infections, a strong socioeconomic gradient emerged in vaccination rates among children. These strong differences remained whether we focused on all children or those in the 9 to 12 years age group. Across all ages, children in households with an annual income greater than 60 000 euros had a vaccination rate more than 50% higher than children from households with an annual income under 25 000 euros. Geographically, the cantons of Grevenmacher and Echternach had the highest proportions of vaccinated children, while those of Esch-sur-Alzette and Luxembourg-Ville had the lowest (see Table 14 in the appendix).

Overall, socioeconomic characteristics had a limited effect on infection rates among the 0–12 year old group, but substantial differences in vaccination rates were observed across socioeconomic groups. Campaigns have not been able to reach or convince societal groups with lower resources, and often with a migratory history, to vaccinate their children. Irrespective of any added health benefit of vaccinating children against COVID-19 the emergence of such large socioeconomic differences in vaccination rates highlights the difficulties of effectively reaching parts of the Luxembourg child population. [149]

The indirect effects of COVID-19 on children's health

During the successive waves of the pandemic, not only the infection itself was impacting people's health, but the pandemic also heavily disrupted daily routines, especially through non-pharmaceutical interventions implemented to contain the spread of the disease.

For this section, we analysed these more indirect effects of the pandemic by looking at the evidence for the impact of the crisis on access to health care, on mental health and on lifestyle behaviour. We have included the perceived state of wellbeing in the analysis of mental health, in line with the WHO definition that mental health is not limited to the absence of mental disorders. This is complementary to what is presented in the previous chapter on mental health.

The results here are, unless otherwise specified, described in four national reports concerning children in Luxembourg: Le bien-être des enfants au Luxembourg (2022)[150], COVID-Kids (2020 and 2022)[151,152], COVID-19 et les droits de l'enfant (OKAJU)[153] and HBSC study 2022.[27]

Access to health care

In 2020 as a whole, paediatricians saw their activity reduced by 10% compared with 2019.[154] The number of consultations fell sharply during the months corresponding to the first period of confinement. Similar trends have been reported for adults' appointments. However, unlike other specialities, paediatric activity also fell during the second lockdown, with 27% fewer consultations. The impact on the population as a result of the decline in paediatric appointments has not yet been determined.[155]

Regarding the quality of prenatal and infant care, and how these were affected by the pandemic, there is no precise pre-COVID and post-COVID comparison available. Prenatal workshops were discontinued in 2020 and 2021. Nonetheless, a recent study shows that Luxembourg maintained a significantly higher Quality of Maternal and Newborn Care Index than other European countries, suggesting that the quality of prenatal care remained high in Luxembourg throughout the crisis.[156]

General wellbeing

A deterioration in children's mental health has emerged as the main indirect consequence of the health crisis for young people, and is a concern in many countries. However, in Luxembourg, studies into the mental health and general wellbeing of 0–12 year old children provide contrasting results.

The 2022 national report on child wellbeing in Luxembourg shows a longitudinal evolution of wellbeing indicators for children aged 8, 10 and 12 between 2019 and 2021, with an initial representative sample.[150] Overall, the level of wellbeing of 10 and 12 year old children, measured on a 0-100 scale, was stable at relatively high levels between 2019 and 2021. Global subjective wellbeing also remained stable for 10 year olds (from 89 in 2019 to 88 in 2021, on a scale from 0 to 100) and decreased slightly for 12 year olds (from 87 in 2019 to 82 in 2021). Negative emotional wellbeing increased substantially between 2019 and 2021 for 12 year olds (23 in 2019 to 33 in 2021, on a scale from 0 to 100) and modestly for 10 year olds (28 to 31). Being satisfied about their own life and family relationships had a substantial impact on children's wellbeing indicators.[150] These results should nevertheless be interpreted with caution, as only 30% of respondents in the first wave participated in the second wave.

The first survey of COVID-Kids was conducted during the first wave of the COVID-19 pandemic in 2020. It shows a decrease in life satisfaction, with 96% of children stating that they were satisfied or very satisfied with their life before the pandemic, whereas the figure was 67% in May to July 2020.[151] Similarly, in 'Covid-Kids II', a survey conducted between June and October 2021, although the results are not directly comparable, 31% of children aged 6 to 11 years declared that they were less satisfied in 2021 than before the pandemic.[152] One in six children stated that they had felt negative emotions during the pandemic. Primary school pupils mostly reported missing their friends (86%), family (80%), school (68%) and teachers (51%). The results of Covid-Kids II suggest that girls and older children more frequently

experienced worries and negative feelings (Figure 43), in line with the results reported in scientific literature.[152,157]

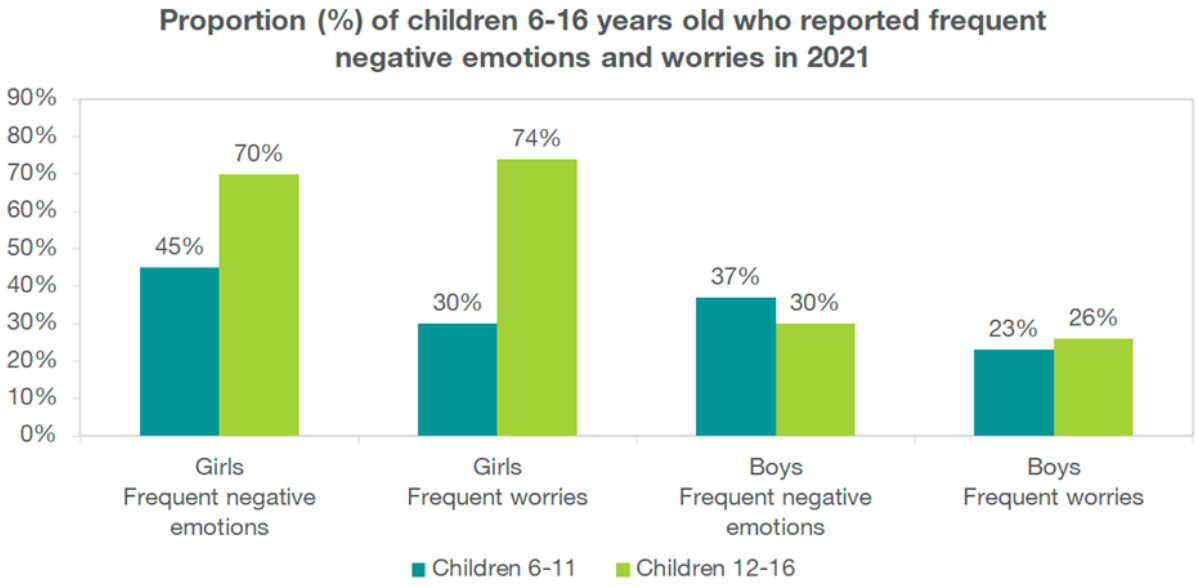


Figure 43 Proportion (%) of 6-16 year old children in Luxembourg who reported frequent negative emotions and worries during the pandemic, 2021, Luxembourg.

Source: Covid-Kids II.[152]

Mental health support and care

The government responded to the increasing demand for mental health support during the pandemic by setting up several telephone helplines, in addition to the existing ones such as Kanner-Jugendtelefon (KJT). However, the demand for the KJT decreased by 6.7% from 2019 to 2020: from 1713 to 1598 calls from children, adolescents or parents. In parallel, 76 new requests for online help were reported, corresponding to an increase of 32%. This trend of decreasing calls and increasing online requests continued in 2021 and 2022.[158] Mental health issues were the main reason for children to contact the helpline, for which calls increased by 19% in 2020. Other recurrent concerns were intra-familial relations and conflicts. Calls concerning abuse and violence also increased.

The Centre for Socio-Emotional Development (Centre pour le Développement Socio-Emotionnel), which is in charge of pupils with behavioural and emotional problems, reported an increase in requests for support.[153] During the school year 2019–2020, a total of 420 interventions were reported, increasing to 539 interventions during 2020–2021, in particular, for primary school children (71%).

Hospitalizations for mental and behavioural disorders

In the previous chapter on mental health, the annual hospitalization rate involving overnight stays due to mental and behavioural disorders among children aged 0–12 years was presented. This showed more hospitalizations in 2021 and 2022 than in the pre-pandemic years (Figure 40). Many studies highlight that children and adolescents were found to experience more depressive and anxious symptoms than the reported pre-pandemic rates, specifically with high levels of fear and concern regarding the impact of COVID-19 on their lives.[159,160]

Suicide risks

The evolution in the number of suicides by children does not show any specific trends. Among children aged 0 to 15 years there were five suicides or suspected suicides in 2020 compared with four in 2019, according to the WHO definition.[153] The number of attempted suicides was not reported.

Behaviours and Lifestyle

International studies show school closures to be associated with reductions in exercise, increased sedentary behaviour and greater consumption of unhealthy food, all of which led to an increase in overweight and obesity among children. This may purely be due to school closures, and studies show that longer durations of closure are associated with larger increases in BMI. However, given that school closures were not the only measures implemented, these changes may also reflect the wider context of the pandemic.[157]

Studies also suggest that school closures affected sleep in different ways. Negatively, possibly due to increased anxiety, reduced physical activity and increasing social media use. On the other hand, positively, as some students reverted to a more natural sleep routine, with many sleeping and waking later. The increased time spent on social media may nevertheless have contributed to a deterioration in mental health.[157,158]

Data is not available on dietary behaviours in Luxembourg during the pandemic, but there is some information about BMI changes and physical activity. Between 2018 and 2022, overweight, including obesity, increased by 4 percentage points among boys aged 11 to 12, while it decreased by 1 percentage point among girls (see Figure 28 for more details). No study currently exists that has investigated how much of this increase can be attributed to the pandemic. However, a recent systematic review found evidence from other countries, that the pandemic did cause an increase in overweight and obesity among children.[161]

The COVID-Kids in Luxembourg study showed that time spent on the internet or the computer increased from 0.9 hours reported in 2019 to 2.6 hours during the pandemic among primary school children.[151] A third of them declared having often played video games. The secondary school children indicated spending time “doing nothing” more frequently than primary school children (46% vs 15%) (Figure 44). Meanwhile, the study showed a significant correlation between “doing nothing” and the emotional well-being of children; those spending more time on their computer or on the internet were more likely to develop negative feelings and anxiety.[151]

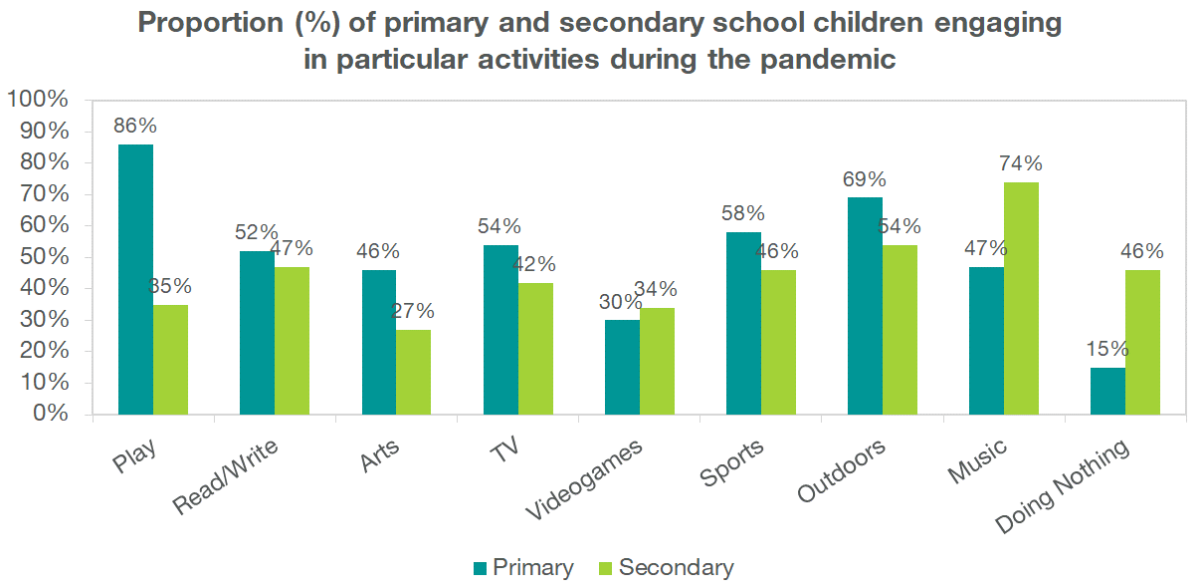


Figure 44: Proportion of schoolchildren that engaged **"**often" or "very often" in particular leisure activities during the COVID-19 confinement in 2020 (March to May 2020), Luxembourg.

Source: Covid-Kids. [151]

Conclusions on the effects of COVID-19

Despite the high incidence of SARS-CoV-2 infections, only a small number of children developed severe forms of the disease or required hospitalization. The medium and long-term consequences of the pandemic for children remain unknown to a large extent, and only limited data is available for a precise follow-up of the indirect effects of the COVID-19 crisis among Luxembourg children. The impact of social inequalities on the COVID-19 burden is starting to appear in many countries. As the OECD report shows, the pandemic disproportionately affected elderly and disadvantaged populations in Luxembourg. However, data is less clear concerning the differential impact on children's health. It has been reported elsewhere that children from poorer families were more exposed to negative health determinants, such as noise, tobacco smoke and a lower quality diet as a result of the pandemic.[162]

The health system for children

This second part of the report describes the health system in Luxembourg and the human and structural resources available to serve children, and it discusses the system's performance by using measurable outcomes. It starts with a general description of the available services and questions of responsibilities and then uses quantitative indicators to describe and observe developments in different parts of the health system in greater detail.

1. Description of the health system

Children and pregnant mothers are a population with specific needs that have to be reflected in a country's health system. This chapter describes the services and specificities related to the provision of and access to health services for this population in Luxembourg, covering health promotion, preventative and acute care, and their resources and infrastructure, including the entities responsible for the implementation of health policies and financing.

1.1 Responsibilities for child health between ministries

Although Luxembourg ratified the International Convention on the Rights of the Child in 1993, there is no general national framework covering children's right to health. Further, the responsibility for the legal, financial, organizational and planning arrangements for protecting children's health is distributed between various ministries, each exercising their responsibilities within the scope of the competences allocated to them.

Over the last few decades, the Ministry of Health has drawn up health policies, has drafted laws and regulations relating to health care providers and services, and was responsible for planning, organising and—in part—financing health services, including prevention. The Ministry of Social Security has been responsible for legislation, regulation and supervision of the national health insurance (assurance maladie-maternité), accident insurance and care related to people in a position of dependency. Since November 2023, these responsibilities have been merged within the Ministry of Health and Social Security. The Ministry of Education, Children and Youth deals with legislation and general policy covering children and youth, including childcare facilities, child support and children's rights, as well as specific education centres (Centres de competence) for pupils with special needs. In the area of child health, the Ministry for the Family, Integration and the Greater Region manages the Fund for the Future of the Child (Zukunftskeess) and oversees the provisions of services and the structures for people with disabilities.

As health policies for children are thus the shared responsibility of several ministries and players, a national strategy with a multi-sectorial approach would be essential to guide, support and monitor concerted policies and programmes aimed at the highest achievable health status for children. Nevertheless, we failed to identify a national health strategy for children with set targets.

1.2 Planning, organization and provision of health care and services for children and pregnant women

Health promotion

The policies to make healthy choices accessible to all children and families are distributed between multiple ministries in Luxembourg. These include the Ministry of Health and Social Security, the Ministry of Education, Children and Youth, and the Ministry of Sport. As a corollary, advice and guidance for parents and carers on healthy habits (for instance nutrition,[163] physical activity,[164,165] sleep[166] or screen time[167]) for children at different ages are scattered across different websites and on various media. Here we highlight two policies

aimed at nutrition and physical activities, two important aspects of child health that can be influenced by health promotion policies.

The *Gesond Iessen, méi bewegen* programme (GIMB: eat healthy, be more active) has targeted overweight, obesity and sedentary behaviour since 2006 by promoting a balanced diet and regular, appropriate physical activity at all ages. It is jointly supported and steered by four ministries.[168] GIMB promotes healthy eating, by publishing online evidence-based recommendations and advice for a balanced diet, and appropriate physical activity at all ages, including for infants, toddlers and children. It also grants 'GIMB labels' to national and local events.[163,164]

The national *Concept pour une éducation motrice, physique et sportive des enfants de 0-12 ans* (concept for motor skills, physical and sports education for children aged 0-12) was launched in 2018 by the Ministry for Education and the Ministry of Sport, with the aim of promoting physical activity and motor skills among children by involving all stakeholders in a coherent way in their respective roles, and identifying areas for action.[169] Efforts have been made to develop appropriate tools to measure the motor skills of pupils in schools, but assessment is currently made on a voluntary basis.[170]

Preventative care

According to the WHO, disease prevention describes measures to reduce the occurrence of risk factors, prevent the occurrence of disease, arrest its progress and reduce its consequences once established.[171]

Vaccinations

Routine vaccination against infectious diseases is one of the most effective public health interventions to protect the population and thereby avert associated health service utilization and costs.[172] One of the goals of an effective health system should be to reach child immunization rates sufficiently high so as to protect children from preventable infectious diseases. The WHO urges member states to demonstrate stronger leadership and governance of national programmes to achieve immunization goals and targets.[173]

In Luxembourg, the Directorate of Health oversees the universal vaccination programme according to the recommendations of the National Immunization Technical Advisory Group (NITAG: Conseil supérieur des maladies infectieuses, CSMI), including childhood and maternal immunization. The Health Directorate acquires vaccines by tender from the state budget and distributes them free of charge to healthcare providers (mainly primary care medical practices), which then vaccinate target populations according to the recommended schedule. For at-risk populations, specific vaccines—for example, to protect against influenza—are available in pharmacies on prescription, and submitted for reimbursement. Pending the full roll-out of a national electronic vaccination record enabling the assessment of the vaccination coverage at all ages, the Health Directorate follows the vaccine coverage of 25–30 month old children through surveys conducted every 5 years.

Screening offered to pregnant women

Medical check-ups during pregnancy and in the postnatal period are a key element of prevention systems and useful for directing families to appropriate care services. The WHO recommends a minimum of eight antenatal care contacts for a positive maternal experience and to reduce perinatal mortality. The WHO recommends the initial contact should take place in the first trimester (up to 12 weeks of gestation), followed by two contacts in the second trimester (at 20 and 26 weeks of gestation) and five contacts in the third trimester (at 30, 34, 36, 38 and 40 weeks).[174]

Systematic medical check-ups for pregnant women have been in place since 1977 in Luxembourg, in conjunction with a financial birth allowance. They include at least five medical examinations and a dental examination, as well as a postnatal examination after the birth.[175] The birth allowance is paid in three instalments (prenatal, birth and postnatal allowances), each of 580.03 euros, conditional on proof of attending the planned medical check-ups.

In 2022, the Health Directorate updated the *Carnet de maternité*, a maternal health booklet that is available to all pregnant women at the time of their first visit to the gynaecologist-obstetrician or midwife. This booklet provides health information for expectant mothers, and specifies the dates of medical and dental check-ups to secure their entitlement to the childbirth allowance. The booklet also specifies that as a general rule, one consultation per month with a midwife or gynaecologist is recommended.[176]

Well-child visits

Well-child visits are regular appointments to monitor a child's growth and development from birth until reaching 18 years of age. Well-child visits include a variety of measures and offer many opportunities for prevention. The WHO recommends five visits between the age of 1 and 24 months, then at 3, 4 and 5 years old, followed by visits at 8, 10 and 12 years of age.[177] For each visit, the WHO specifies the objectives as well as the parameters to be monitored.

In Luxembourg, the provision of well-child visits up to the age of 4 relies on primary care medical doctors (paediatricians, general practitioners or internists). They are fully reimbursed by the National Health Fund.

For infants, systematic check-ups have been in place since 1977, and are incentivized by the third instalment of the childbirth allowance on completion of six visits before the age of 2, carried out by a paediatrician, general practitioner or internist.[178] The first two visits are scheduled during the first 48 hours and between 5 and 10 days. The four subsequent visits take place at 3–8 weeks, 4–6 months, 9–12 months and 21–24 months of age.

After a child's second birthday, two preventive medical visits at 30–36 months and at 42–48 months of age are recommended and reimbursed by the National Health Fund, but do not carry a financial reward for attendance. The visits include checks of the physical, functional, cognitive and emotional development of the preschool child.[179]

For school-aged children, the Directorate of Health is responsible for the oversight of the medical health examinations in all state schools in four different schoolyears (Cycle 1.2.and 2.1 and 3.1. and 4.2.), as well as for annual dental screening.[180] Municipalities organize the school-based examinations, including visual and hearing screening, for pre-school and primary education (children 4-13 years old). Most municipalities, representing around 80% of school-age children, rely on professional multidisciplinary teams from the Ligue médico-sociale, while the remaining five municipalities have their own medical, social and school teams. All these providers must be accredited by the Ministry of Health.

The *Carnet de santé* is a paper-based health record given to any child at birth. It serves the purpose of recording findings at medical check-ups, screening and—on demand—health care and services provided between these check-ups. Other countries have used child health records to include trusted information and tips for parents to help them promote and maintain the health of their children and to prepare them to obtain the most benefit from their next well-child visit or screening. [181,182] Such information is also provided online in various languages in multilingual countries.[182,183]

Screening programmes

For children, screening programmes (Table 5) include a prenatal screening for congenital anomalies at the national level, hearing and visual screenings, dental screening, school health programmes and medical examinations for school-aged children. These preventive programmes are set up either by the Health Directorate, or in partnership between the Ministry of Health and Social Security, the National Health Fund, municipalities and (where appropriate) specialist services.

There is usually no formalized referral pathway from a positive screening result to a diagnostic procedure and to treatment and follow-up in Luxembourg. In the event of a positive screening test result, parents are invited to consult a specialist to confirm the diagnosis and, if necessary, initiate treatment. There is no systematic follow-up mechanism to ensure that the child has been assessed and treated in a timely manner. As a result, there is no data available on the incidence and prevalence of screened conditions among the population.

Table 5: Childhood screening programmes in Luxembourg, 2023.

	Target population	Providers	Set-up	Organization	Financing	Incentive
Prenatal check-ups	Pregnant women	Obstetricians-Gynaecologists in private practices and hospitals	Private practices and hospital out-patient services	(-)	National Health Fund (fee-for-service)	Prenatal allowance
Non-invasive prenatal testing (chromosomal anomalies)	Fetus (on prescription)	National Health Laboratory	Blood sampling in laboratories	(-)	National Health Fund	none
Inborn metabolic diseases	Neonates (5–10 days)	National Health Laboratory	Blood sampling by midwives	National Health Laboratory	State budget	none
Congenital cardiac defects	Neonates	Midwives / Paediatricians	Maternity facilities	(-)	National Health Fund	none
Well-child visits	Children up to the age of 2 years	Paediatricians, General practitioners, Internists	Maternity facilities, private practices	(-)	National Health Fund (fee-for-service)	Postnatal allowance
	Children 30–36 months and 42–48 months	Paediatricians, General practitioners, Internists	Private practices		National Health Fund (fee-for-service)	special tariff
	Children from the age of five in schools	Paediatricians, General practitioners, nurses from school health services	School facilities	School medical services / Health Directorate	Ministry of Health, Municipalities	none

Hearing screening	Neonates (≥2 days)	Audiometrists from the Health Directorate	Maternity facilities	Health Directorate	Ministry of Health	none
	Children ≥30 months and at school entry	Audiometrists from the Health Directorate	Testing centres	Health Directorate	Ministry of Health	none
	School-aged children	Nurses from school health services	School facilities	School medical services / Health Directorate	Ministry of Health, Municipalities	none
Visual screening	Children 10 and 40 months old	Optometrists from the Health Directorate	Testing centres	Health Directorate	Ministry of Health	none
	School-aged children	Nurses from school health services	School facilities	School medical services / Health Directorate	Ministry of Health, Municipalities	none
Dental screening	Children 30-36 months and 42-48 months	Dentists	Private practices	(-)	National Health Fund (fee-for-service)	special tariff
	School-aged children	Dentists	School facilities	School medical services / Health Directorate	Ministry of Health, Municipalities	none

Fetal and neonatal screening

The Laboratoire national de santé provides antenatal screening for the most frequent chromosomic anomalies through non-invasive prenatal testing (NIPT), which is reimbursed by the national health insurance.[xxxvi] It operates a neonatal universal screening programme for phenylketonuria, congenital hypothyroidism, congenital adrenal hyperplasia, medium-chain acyl-coenzyme A dehydrogenase (MCAD) deficiency, and since 2018, cystic fibrosis from the state budget.[184,185] Since 2022, all newborns are also screened for cyanogenic heart defect by pulse oximetry.

Hearing and visual screening

Given the important role of hearing in a child's development and education, it is essential to address hearing loss at the earliest possible time.[186] The screening of newborns can bring significant advantages in terms of reducing the age for diagnosis and—in the event of positive diagnosis—intervention, as well as improving language and cognitive development with lifelong benefits, if followed up by treatment.[186] Pre-school and school-aged children who had minimal hearing loss at birth, or those with progressive hearing loss, may remain unidentified in the absence of systematic screening during childhood. The WHO recommends universal hearing screening for newborns, as well as systematic screening for pre-school and school-aged children, followed by appropriate care and intervention if required.[187]

In Luxembourg, the Health Directorate organizes and conducts audiometric screening for newborns, a speech and language assessment with a hearing test for children at 30 months of age (*Bilan 30*), and a hearing test for 4–5 year old children attending any state or private school.[185] Invitations to participate in audiometric and language test at 30 months of age are sent to the parents. If any of the screening visits reveal a potential hearing, language or speech deficiency, the parents are invited to make an appointment with a specialist of their choice.

Eye problems are common among children of all ages. Uncorrected eye and vision problems can worsen over time, therefore early diagnosis and treatment is important to avoid long-term complications and to prevent vision loss. The WHO recommends an eye examination for all newborns and an age-adapted vision examination for all children from 3 years of age, to offer early detection of potential amblyopia, strabismus and refractive errors. Further assessment of vision and visual acuity is recommended for all infants and children during well-child visits.

The Health Directorate in Luxembourg provides vision screening for all 10 and 40 month old resident children (*vision test 10* and *vision test 40*). [185] A personal invitation letter for a voluntary, free-of-charge vision screening appointment is sent to the parents of all resident children, and appointments can be made in one of the eight visual screening centres run by the Health Directorate across the country. Children who participate in the screening at 10 months old are invited to a follow-up screening at 40 months of age. Orthoptists from the Health Directorate also systematically screen pre-school children (4–6 years old) from all public and some private kindergartens. In primary and secondary schools, visual screening is conducted concomitantly with the school medical examinations.

Dental screening

There is evidence of the benefit of early preventive dental visits before the age of 3 years, in particular for children at risk of or with existing dental disease.[188] The WHO recommends that children and adolescents visit a dentist every six or twelve months for a preventative check-

[xxxvi] Mém. A 117 of 17 July 2007, p. 2164

up visit, depending on children's individual needs, risk status or susceptibility to caries and periodontal disease.

In Luxembourg, dental screening for pre-school and primary school pupils is the shared responsibility between municipalities and a school dental team from the health directorate. Since 2022, oral health promotion for children aged 4 to 6 years has been stepped up during those dental screenings: every child screened in cycle 1 and cycle 2.1 participates in an oral health promotion workshop to raise oral health awareness.

In addition, two preventive visits to a dentist are recommended, at the ages of 30–36 months and 42–48 months.[179,189] Since 2023, information on these preventive check-ups is mailed to all parents of children aged 28 months. A checklist setting out the topics to be covered during those consultations was also distributed to dentists to raise awareness of the need to incorporate oral health promotion into consultations.

Primary care

In addition to their role in health promotion, disease prevention and the early detection of diseases, primary health care providers often act as the first point of contact in the healthcare system for children and their families. According to the WHO, primary care focuses on the comprehensive and interrelated aspects of physical, mental and social health and wellbeing.[177] It strives to be people centred and to meet the whole spectrum of health needs—from disease prevention and health promotion, to treatment, rehabilitation and palliative care; from birth to end of life.

There is no formal or legal definition for primary care in Luxembourg. For this report, primary care is defined as health services and care provided outside the hospital or an organized prevention programme. While primary care in Luxembourg mainly relies on health professionals in private practices, delivering care on a fee-for-service basis, only specificities that relate to pregnant women and children are highlighted here: the workforce, infrastructure and organization.

The WHO recommends that antenatal care should be provided by 'practitioners with good clinical and interpersonal skills within a well-functioning health system'.[174] For children, the WHO quality of care standards explicitly foresee that, 'for every child, competent, motivated, empathic staff are consistently available to provide routine care and management of common childhood illnesses'.[177]

Organization of the healthcare workforce

Published works about planning and policies relating to healthcare professionals all emphasize the importance of having reliable data on human resources for health. This is important for monitoring and ensuring accountability for the implementation of national strategies.[190] In Luxembourg, strategic planning based on the analysis of the health labour market has proved difficult, mainly due to the lack of reliable data and information.[191] Since 2019, the Ministry of Health has been working on the content of the register of health professions, in order to improve the ability to analyse and study the workforce demographics in Luxembourg.

Among the medical specialties and subspecialties specifically dedicated to maternal and child care in Luxembourg, the Ministry of Health recognizes paediatrics, child psychiatrics, child surgery and obstetrics-gynaecology (Ob-Gyn).[192] Other subspecialties, such as neonatology, are not recognized. While offering post-graduate, specialized training in general practice (GP), neurology and oncology under the authority of the Ministry for Higher Education and Research, Luxembourg currently does not offer specialty training in paediatrics, (child) surgery, (child)

psychiatry or obstetrics. Hence, the supply of medical specialists relies exclusively on immigration by doctors trained in other countries.

Midwives and paediatric nurses, like other health professionals, are licensed by the Ministry of Health. The Ministry for Education and, since 2023, the Ministry for Higher Education and Research, are responsible for their education and training.

A health practitioner in Luxembourg can chose between self-employment and being a salaried employee, as well as the type and location of practice. Currently, no regulations or incentives exist to influence the decisions of health practitioners regarding where to open or join a practice.

For Ob-Gyn, GPs and paediatricians, solo practice has been the dominant model, but mono-specialty group practices are gaining ground. By comparison, most midwives and paediatric nurses were salaried in 2019, according to a national study on the health workforce.[191] According to the same study, midwives are under-utilized in Luxembourg, as the follow-up of pregnancies and normal deliveries are nearly exclusively carried out by Ob-Gyns. For paediatric nurses, the centralization of paediatric care left those professionals who were established in other parts of the country without paediatric occupation.

Emergency and night and weekend services

Outside the opening hours of doctor's offices, all practicing paediatricians not involved in hospital duties participate in the national paediatric on-duty medical centre (Maison médicale de garde pédiatrique) located in the Centre Hospitalier de Luxembourg (CHL), providing continuity of primary care for children 0-16 years old at night (7–10 p.m.) and during weekends and holidays (9 a.m. to 9 p.m.). All practicing GPs also have to participate in the continuity of primary care during night times, weekends and holidays, in the three on-duty medical centres (Maisons médicales de garde) in Ettelbruck, Luxembourg and Esch-sur-Alzette, where they provide unplanned care, whatever the patient's age.

Emergency situations for pregnant women and children are handled by the general emergency medical assistance service (SAMU).

Hospital care

Over the last ten years, the Ministry of Health has gradually centralized acute care to address issues of workforce shortages and to maintain and develop the skills of dedicated teams for specialized paediatric hospital care, paediatric out-of-hours care and complex maternity care.[193,194]

As a result, hospital care for children is centralized at the CHL, with national departments dedicated to specialized paediatrics, paediatric surgery, paediatric intensive care, neonatal intensive care, paediatric emergency care and child psychiatric care.[195] In line with the centralization of specialized care for children, the CHL offers a range of paediatric subspecialty clinics and plays a prominent role for patients with rare diseases: it hosts the national coordination hub for European reference networks (ERNs),[196] as well as being a full member for rare endocrine diseases in the RareEndoERN network.[197,198]

The neonatal emergency care and transport service (SAMU neonatal) operates on a 24/7 basis and is based at CHL. It provides neonatal expertise, including remotely (tele-expertise), to maternity facilities lacking neonatal intensive care competences. It also operates newborn transfers between first-level facilities and the neonatal intensive care department (NICU) located in the CHL or abroad.

Pharmaceuticals

Similar to other European countries, Luxembourg has faced stock shortages of pharmaceuticals in recent years.[199] In 2021, there were shortages of vaccines, including DTP-containing vaccines (diphtheria, pertussis and tetanus), Hepatitis B-containing vaccines, and Hib-containing vaccines, being out of stock for up to five months.[200] In spring 2022, two of the four paediatric forms of paracetamol syrup authorized for use in Luxembourg were unavailable.[6] In 2023, one syrup was removed from the list of authorized medications in Luxembourg due to unavailability.[201,202]

1.3. Health insurance coverage

According to the Social Security Code, all children under the age of 18 years residing in Luxembourg and who are not insured in any other capacity (also, who do not fall under the scope of development cooperation or peacekeeping operations within the framework of international organizations) are compulsorily affiliated to the health insurance scheme as co-insured. This means that all children registered as Luxembourg residents are automatically covered by the full benefit package of the national health, accident and dependency insurance. For children who are affiliated voluntarily, or those who are registered migrants or asylum seekers, the first three months are subject to conditions respective to their status. Irregular children have access to the 'Couverture universelle des soins de santé' (CUSS), covering the same basket of health services.

The National Health Fund has an extended reimbursement policy for children up to the age of 18 years: it reimburses the full cost of any medical or dental appointment or service in private practice, including well-child visits. Moreover, reimbursement of hospital services amounts to 100% of the tariff for children admitted to hospital for acute or rehabilitative care. Services from dieticians, physiotherapists and orthophonists are also fully reimbursed, as well as hearing aids. Specific rules concerning reimbursement apply to children regarding certain supplies, medical food and orthopaedic prostheses.

Overall, there are no out-of-pocket fees due for outpatient visits, hospital stays and regular medical care for affiliated children. However, normal reimbursement rules apply for medication.

Apart from the health services that are reimbursed, the health care for children also requires care for minor illnesses. These are often treated using over-the-counter medications, which have to be paid for by the parents or caregiver. A recent exercise by STATEC calculated the monthly budget needed to raise young children in Luxembourg, including the budget needed for health among children aged 0–6 years.[203] The estimate calculated that to cover medications and care equipment, 10 euros per month are needed for a child 0–6 months old and 6 to 7 euros for children 18 months and older. Overall, the budget needed to cover medical costs for children in Luxembourg is relatively small compared with the other costs families need to meet for their children.

1.4. The voice of children in the health system

Children's health is first and foremost about ... children. However, in Luxembourg, to date there is no systemic mechanism for consulting children on what is important to them. A mission, supported by UNICEF and financed by the European Union, is currently assessing how children's opinions are collected in Luxembourg, to explore how to best integrate their voice in the policy-making process.

1.5. Special rights regarding the health of children

The legal age of majority is 18 in Luxembourg. In line with the civil code, the 2014 law on patient rights and obligations states that the rights of non-emancipated minors are exercised by their parents or any other legal representative. A notable exception to this rule was introduced in the pandemic law: minors from the age of 16 were given the right to opt to be given the COVID-19 vaccination.

In order to favour the inclusion of children in decisions related to their health, the 2014 Law on patient rights provides that, ‘depending on their age and maturity and as far as possible‘, minors can exercise all rights relating to their health. Minors who have the discernment capacity deemed necessary to make a reasonable assessment of their interests may be allowed by their health care provider to exercise their rights to health autonomously, including for the reimbursement of claims.[204] In 2017, the Scientific Council for Health Care published a guide for health care providers on how to inform minor patients. This was revised in 2022.[205]

The Ombudsman for health issues recently published a comprehensive review of the exercise of minors' health rights.[206] The number of requests for mediation relating specifically to children’s health care is not recorded, but is reportedly very low.

Despite the attention and care given to the exercise of minors' health rights, it is legitimate to investigate if health services in Luxembourg are suitably adapted to their specific needs, and weather their best health interests are safeguarded by the measures implemented within the health system. The 2011 Council of Europe Guidelines on Child Friendly Healthcare were endorsed by the 47 member states in 2011, and lay out ways to make healthcare more inclusive of children, their rights and their interests.[207,208] Recent rights-based standards for children undergoing health testing, treatment, examination or interventions have been developed in an international, multi-stakeholder, child-inclusive process.[209] Currently, no institution in Luxembourg is responsible for the national implementation of such initiatives concerning child-friendly health services.

Conclusions on the health system for children

Luxembourg has a number of health policies and programmes covering health promotion, prevention and the early detection of diseases. These policies fall under the responsibility of several ministries. While in some instances a multi-sectorial approach has been adopted (for example, *Gesond Iessen, Mei Bewegen*), we were not able to identify a published national strategy for child health with set targets and information on existing policies and programmes. There is no single body responsible for ensuring child-friendliness in health services and care and that these services and care respect their fundamental rights and needs.

Prenatal and well-child visits, including those incentivized to ensure optimal participation, and vaccinations are provided by self-employed practitioners (see Section 1.3 for the coverage for these services). Many universal screening programmes are available free of charge, but the outcomes after a positive screening test remain largely undocumented.

Information for parents, carers and the public on how to best promote and protect the health of children at specific ages, and on the available health programmes for children, is scattered across various brochures and websites; in the absence of a health record including guidance and recommendations, parents and carers are left on their own to search for trusted information.

Hospital care for complex and at-risk pregnancies and for children is centralized at the CHL. Out-of-hours emergency paediatric visits are organized with primary care paediatricians. Primary care for children and pregnant women is not planned by regulation.

The national health insurance covers health care and services for children generously, with no out-of-pocket fees due for outpatient visits, hospital stays and regular medical care.

2. Resources for the care of children

Sufficient resources to provide the necessary services and care for children and pregnant women are important to ensure the health of these populations. This chapter looks at the health workforce, infrastructure and the provision of pharmaceuticals for children and pregnant women in the Luxembourg health system.

2.1 Health workforce

As the availability of professionals specialized in the care of children and pregnant women is essential for the provision of effective, safe and patient-centred care during childhood, this section provides an overview of practicing child healthcare professionals, including the specialized workforce for the care of pregnant women.

When assessing the available health workforce for children, it is necessary to consider the specific organization and delivery of child healthcare and services within the health system, and the various professionals involved in these services, namely doctors (paediatricians, general practitioners (GP) and other specialists), nurses, midwives, physiotherapists and pharmacists, among others.

Published works on planning and policies related to healthcare professionals all emphasize the importance of having reliable data on human resources for health, to monitor and ensure accountability for the implementation of national strategies.[190] Strategic planning based on the analysis of the health labour market has proved difficult in Luxembourg, mainly due to the lack of reliable data.[191] Since 2019, the Ministry of Health has been working on the content of the register of health professions in order to improve the ability to analyse and study the workforce demographics. Only professional qualifications recognized in Luxembourg are consistently recorded in this registry, which is a limitation to the assessment of the paediatric workforce.

This section first shows the density of child health professionals in Luxembourg compared with selected neighbouring countries (where data is available), and the trends that could be observed over the years 2012 to 2020. It then describes the proportion of care for children aged 0–12 years old divided between paediatricians and general practitioners (GPs), and the type of care they provide, in an attempt to understand how the different specialties account for medical services provided to children. Lastly, it describes the recurrence pattern of outpatient visits among selected specialties by young children, and the seasonality of primary healthcare for children.

Hospital activities, including emergency department admissions, are not covered in this section, as hospital admissions and their related indicators will be presented in the 2023 edition of the *Carte sanitaire*.

Main findings:

- Luxembourg has been reported as a mixed primary care system, in which GPs and paediatricians play significant but complementary roles in primary care for children. However, in 2022, paediatricians provided 97% of consultations for children aged under 1 year old (GPs 3%), and 86% of consultations for children 1–3 years old. Paediatricians provide almost all preventative child visits.
- The density of paediatricians is greater in Luxembourg than in France, Belgium and the Netherlands, and equivalent to that in Germany. It has increased over the past decade, from 0.16 paediatricians per 1000 inhabitants in 2012, to 0.19 in 2022.
- Compared with nearby countries, the density of other main healthcare professionals involved in the care for children in Luxembourg is high for dentists (0.94 per 1000 inhabitants), at comparable levels for midwives (34.3 per 1000 live births) and in the

middle for obstetrician-gynaecologists (0.18 per 1000 inhabitants, compared to 0.10 in the Netherlands and 0.26 in Germany).

- The overall volume of services billed by paediatricians, GPs and dentists is increasing; however, the number of services billed per provider has decreased.
- There is no data available for waiting times for paediatric services or to assess whether supply meets the demand for these services
- The activity of paediatricians and GPs shows seasonal variations, with high volumes of services from October to March.

Primary care system for children in Luxembourg

According to the Models of Child Health Appraised (MOCHA)-project that appraised models of primary health care for children in 30 European countries,[210210210210207] three models of primary care for children coexist in Europe: 42% of countries have a mixed system in which both GPs and paediatricians play significant roles (such as Luxembourg, France, Belgium and Switzerland), 34% have a GP-led system (such as Netherlands) and 19% have a paediatrician-led primary care system (such as Germany) (Figure 45). [210]

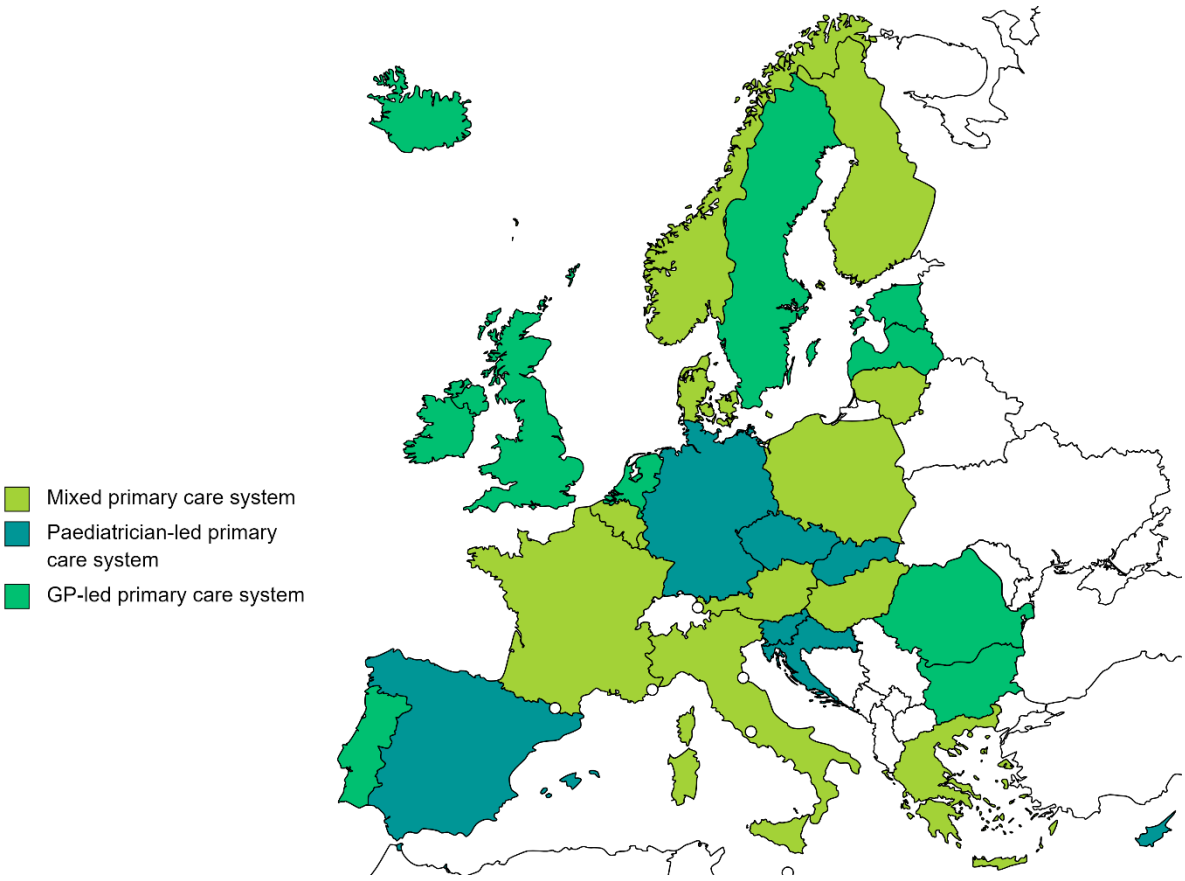


Figure 45: Primary care systems for children in Europe, 2017.

Source: Models of Child Health Appraised (MOCHA).

Practising health workforce providing services for children

The density is a standard measurement to assess the availability of the health workforce in a country or region.[211] As cross-border workers account for a substantial proportion of the workforce in Luxembourg, we assess the density of health professionals, independent of their country of residence.

The results shown in this section are based on data from the social security database and consider a certain activity threshold. Doctors were included when considered "active" during at least 6 months of a given year: if they were salaried (purely or mixed with self-employed activity), or self-employed and invoicing more than 500 EUR in a given month. If this threshold was reached, the professional was considered as regularly providing care in Luxembourg and was included in the count of practitioners in the following sections. Information on working

hours or the proportion of time devoted to the professional activity was not available and hence not considered in the analysis.

For purposes of international comparisons, the density is expressed in head counts per 1000 inhabitants, unless otherwise stated. The comparison data were taken from the OECD.stat database.[212]

PAEDIATRICIANS

Figure 46 shows the density of paediatricians in Luxembourg and in neighbouring countries in 2021. For Luxembourg, the number of paediatricians includes all practicing paediatricians in primary and hospital care. Compared internationally, Luxembourg had a proportionally higher number of paediatricians (0.18 paediatricians per 1000 inhabitants) than Belgium, France and the Netherlands (respectively, 0.14, 0.13 and 0.11) but lower than Switzerland (0.24). The number of paediatricians per 1000 inhabitants in Luxembourg is equivalent to Germany, where the primary care system is led by paediatricians, according to the MOCHA study.

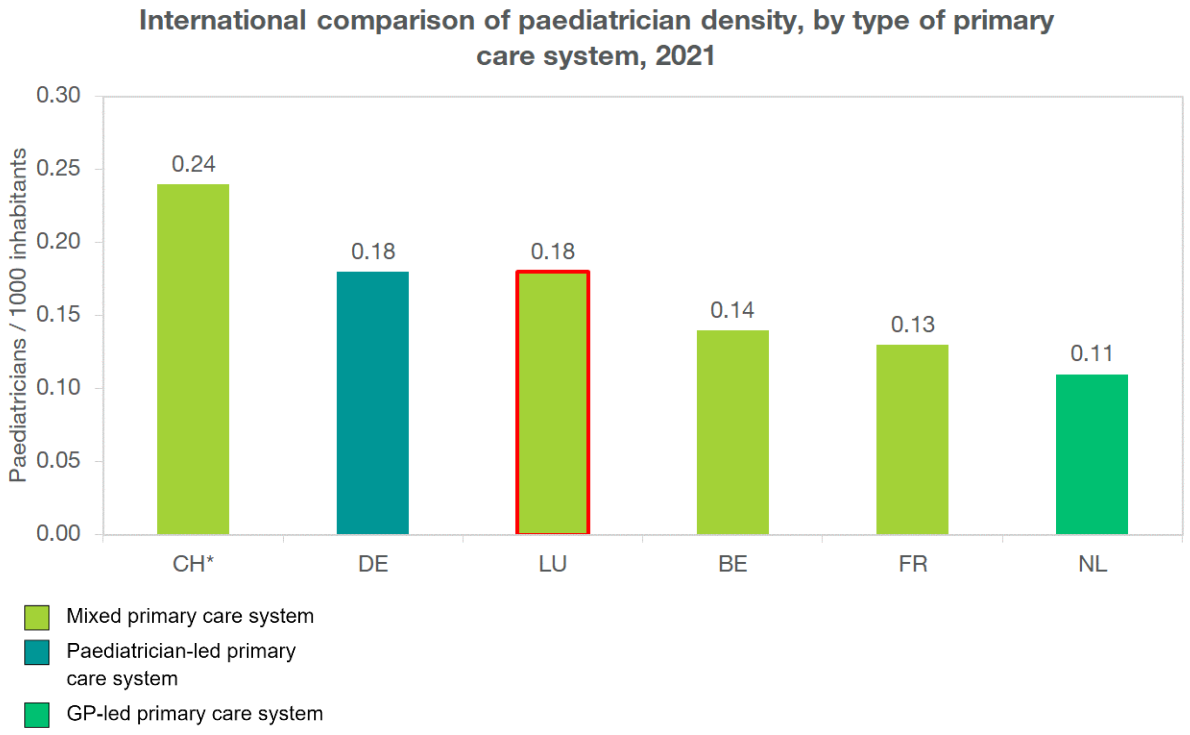


Figure 46: International comparison – Number of paediatricians per 1000 inhabitants and type of primary care system in 2021, by country.

Sources: LU: Social security database, computed by ObSanté; BE, FR, NL : OECD; CH*: OBSAN. [213]. Source for type of primary care system: MOCHA study

The number of paediatricians in Luxembourg has increased by 45% over 10 years: from 85 paediatricians in 2012 to 123 in 2022 (Figure 47). There has also been an increase in the density, rising from 0.16 paediatricians per 1000 inhabitants in 2012 to 0.19 in 2022.

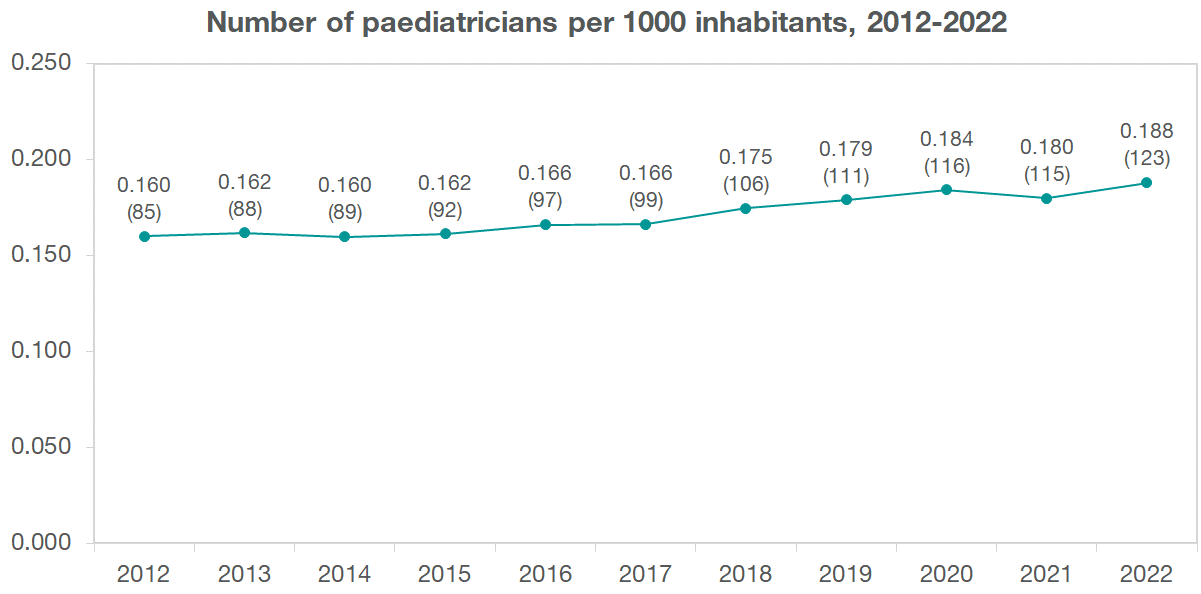


Figure 47: Number of paediatricians per 1000 inhabitants in Luxembourg, 2012–2022 (the total number of paediatricians per year is shown in brackets).

Source: Social security database; STATEC. Indicator computed by ObSanté.

According to a European survey conducted in 2012, around 25% of the countries surveyed reported a stable number of paediatricians in 2012, a further 25% reported increased numbers and the remaining 50% had decreasing numbers.[214]

Published reports have also examined the ratio of paediatricians to children, taking into account the target population. If we compute the number of paediatricians fulfilling the 6-months activity threshold described above, Luxembourg had 0.99 paediatricians per 1000 children under 18 years of age in 2022, which has increased since 2012 (0.77 paediatricians per 1000 children under 18 years of age) (Figure 48).

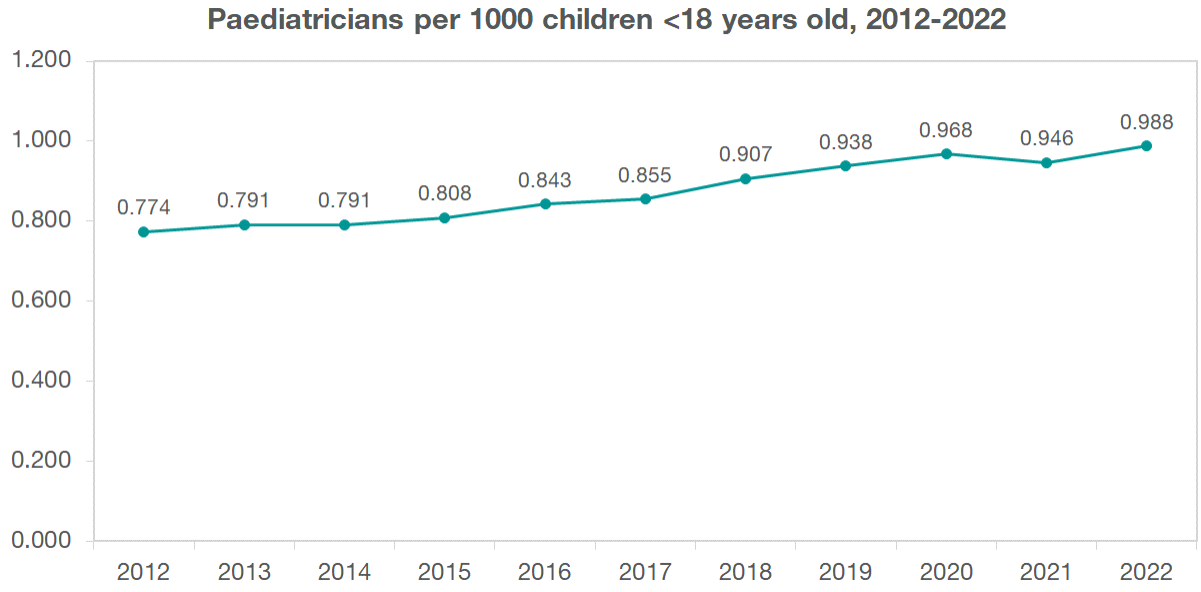


Figure 48: Number of paediatricians per 1000 children under 18 years old in Luxembourg, 2012–2022.

Source: Social security database; STATEC. Indicator computed by ObSanté.

This rate is in the upper range observed in Europe in 2019, where there is a median density of 0.87 paediatricians per 1000 children below the age of 18 years, with an interquartile range of between 0.49 and 1.35.[215]

The paediatrician workforce in Luxembourg is ageing, with 41% of them over the age of 50 in 2022 compared with 35% in 2012. However, this proportion is still lower than for the entire physician workforce. A national study showed that 54.4% of GPs and 60% of specialists were over the age of 50 in 2017.[191] In France, the proportion was much higher, with 65% of paediatricians in the primary sector over the age of 50 in 2020.[216]

The percentage of women among Luxembourg paediatricians has risen from 54% in 2012 to 60% in 2022. The profession is significantly more feminized than the average physician workforce, with women accounting for 41% of GPs and 25% of specialists in 2017.[191]

OBSTETRICIAN – GYNAECOLOGISTS

Compared internationally, in 2021, Luxembourg had a proportionally higher number of obstetrician-gynaecologists (0.18 per 1000 population) than Belgium, France and the Netherlands (respectively, 0.14, 0.12 and 0.10) but fewer than Germany and Switzerland (respectively, 0.26 and 0.23) (Figure 49).

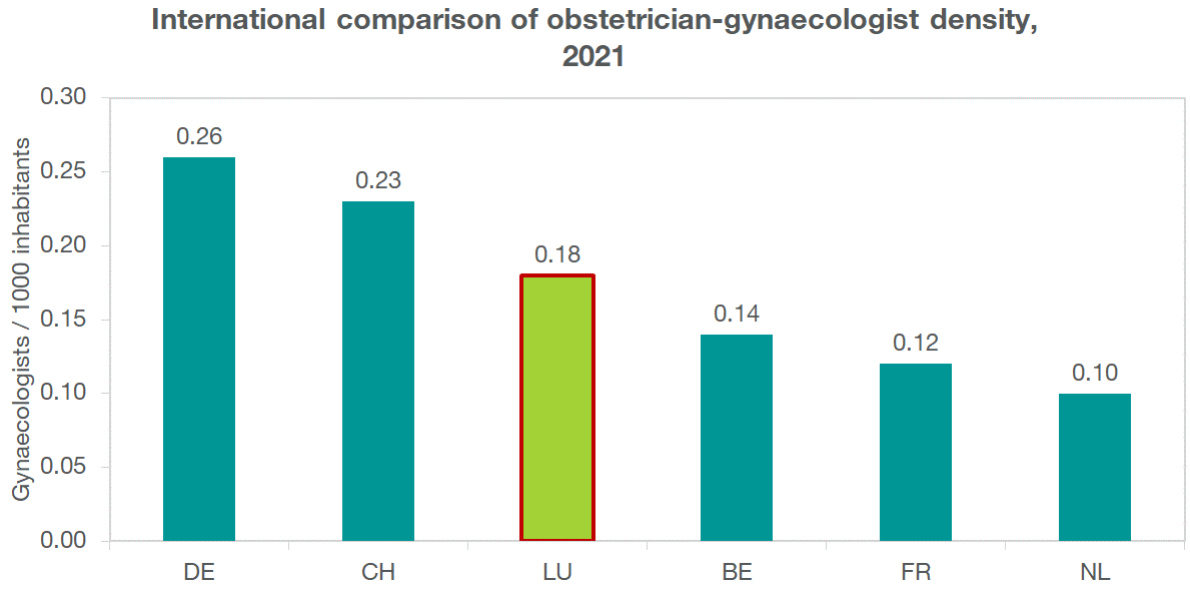


Figure 49: International comparison – Number of obstetrician-gynaecologists per 1000 inhabitants in 2021 (or latest years available), by country.

Sources: for LU the Social security database; STATEC. Indicator computed by ObSanté; for other countries OECD.

The number of obstetrician-gynaecologists has increased by 38% in Luxembourg over the 10 years examined: from 82 in 2012 to 113 in 2022. There has also been an increase in the density of obstetrician-gynaecologists per 1000 inhabitants, from 0.15 in 2012 to 0.17 in 2022 (Figure 50).

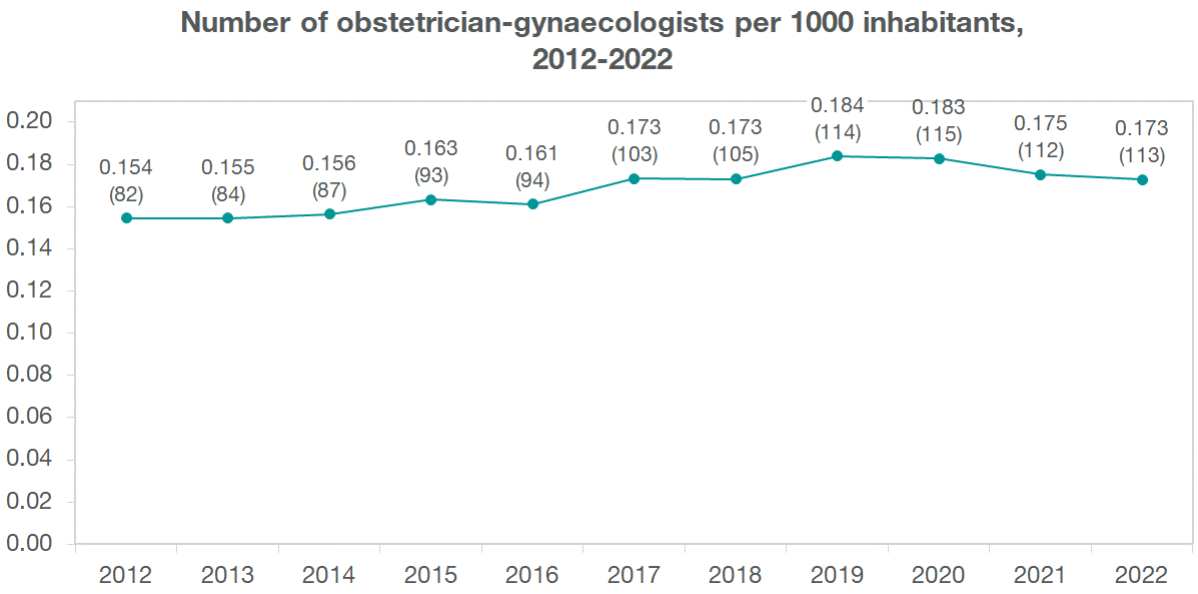


Figure 50: Number of obstetrician-gynaecologists per 1000 inhabitants in Luxembourg, 2012–2022 (the total number of gynaecologists per year is shown in brackets).

Source: Social security database; STATEC. Indicator computed by ObSanté.

The age distribution of the obstetrician-gynaecologist workforce has remained stable over the years. 56% of obstetrician-gynaecologists were over the age of 50 in 2022, and the proportion was the same in 2012. The percentage of women obstetrician-gynaecologists has risen from 35% in 2012 to 55% in 2022.

CHILD PSYCHIATRISTS

The number of child psychiatrists has remained fairly stable: from 18 in 2012 to 21 in 2022. There has also been little variation in the density of child psychiatrists per 1000 children up to 18 years old, ranging from 0.16 in 2012 to 0.17 in 2022 (Figure 51).

The child psychiatrist workforce is ageing. 52% of child psychiatrists were over the age of 50 in 2022, compared with 33% in 2012; however, the percentage of women has risen from 50% in 2012 to 67% in 2022.

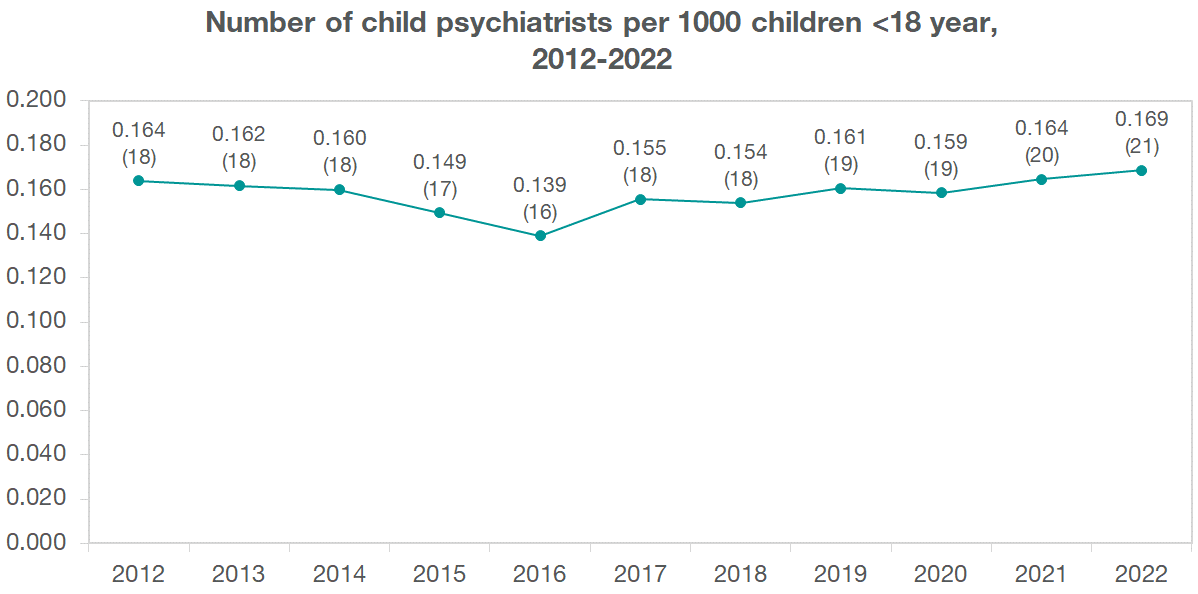


Figure 51: Number of child psychiatrists per 1000 children up to 18 years of age in Luxembourg, 2012–2022 (the total number of child psychiatrists per year is shown in brackets).

Source: Social security database, STATEC. Indicator computed by ObSanté.

DENTISTS

Oral health is associated with general health outcomes. Some dentists provide both dental and orthodontic care, while orthodontists offer solely orthodontic care. In addition to dentists, orthodontists and oral surgeons are included in the following data for international comparison and national trend.

In an international comparison, for 2021, Luxembourg had a proportionally higher number of dentists (0.94 dentists per 1000 inhabitants) than Germany, Belgium, France and the Netherlands (respectively, 0.86, 0.77, 0.66 and 0.57) (Figure 52).

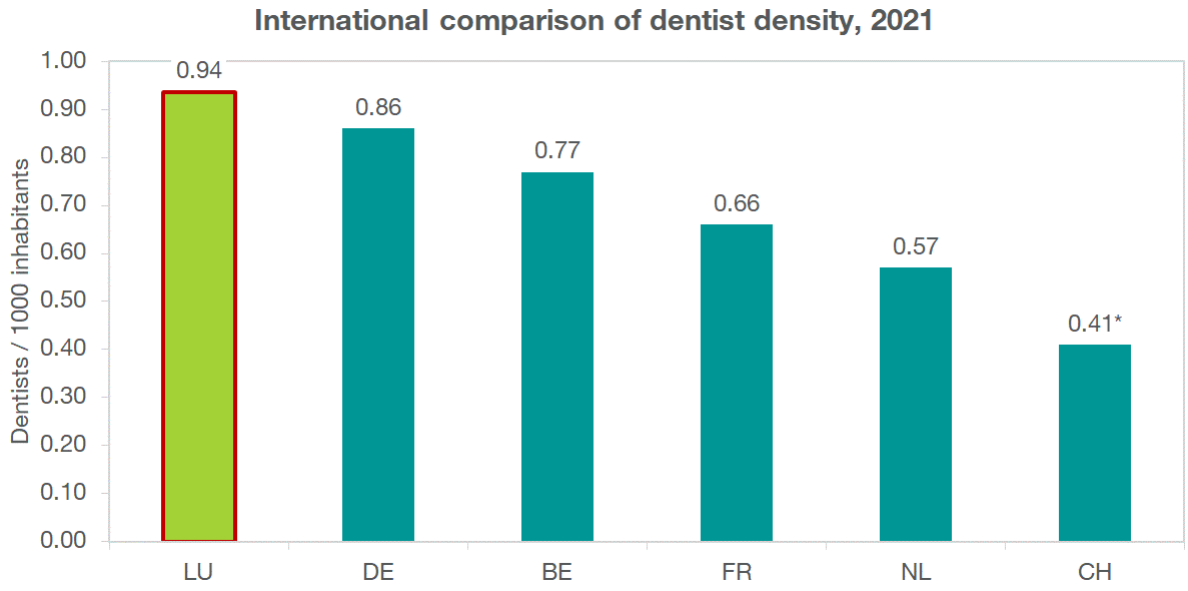


Figure 52: International comparison – Number of dentists, including orthodontists and oral surgeons per 1000 inhabitants in 2021, by country.

Sources: LU: Social security database; STATEC. Indicator computed by ObSanté; DE, CH*, BE, BE, FR, NL: OECD. (*data from 2019)

The number of dentists increased by 61% over 10 years in Luxembourg: from 398 in 2012 to 639 in 2022. There has also been an increase in the density of dentists per 1000 inhabitants, rising from 0.75 in 2012 to 0.98 in 2022 (Figure 53).

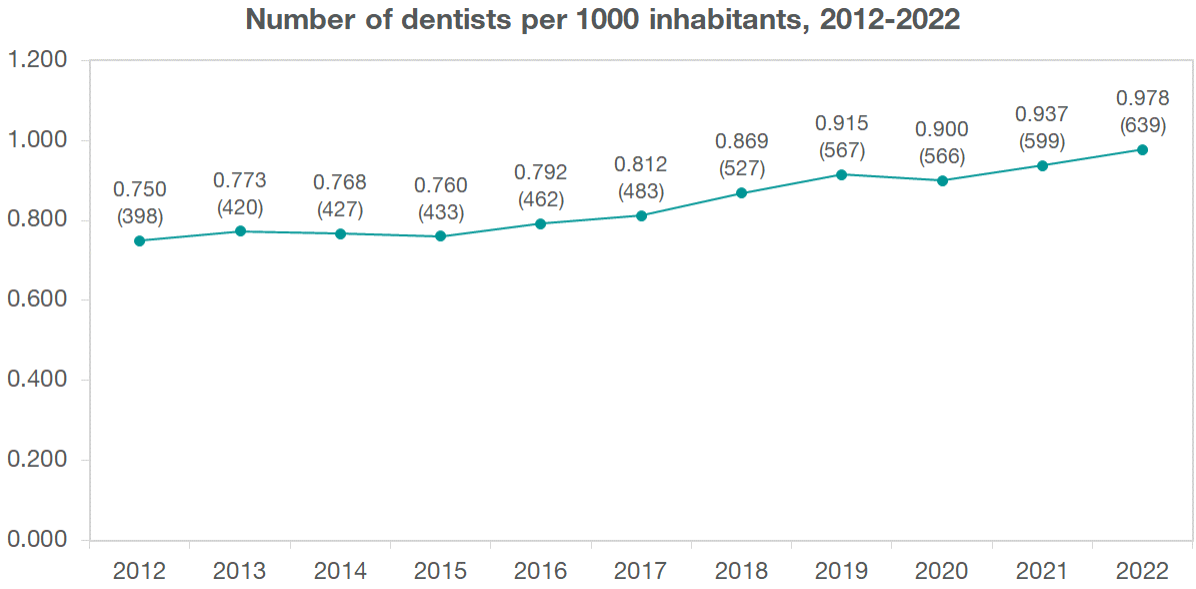


Figure 53: Number of dentists, including orthodontists and oral surgeons per 1000 inhabitants in Luxembourg, 2012-2022 (the total number of child psychiatrists per year is shown in brackets).

Source: Social security database, STATEC. Indicator computed by ObSanté.

The dentist workforce is younger than other specialists: 37% of dentists were over the age of 50 in 2022 and this percentage has been relatively stable over time (39% in 2012). The percentage of women has risen from 34% in 2012 to 43% in 2022 among dentists.

MIDWIVES

Midwives are an essential element of the workforce for the effective delivery of high-quality antenatal, delivery and postnatal care. According to the latest available data in 2020, there were 262 licenced midwives, up from 234 in 2019.[217] That equates to a density of 34.3 midwives per 1000 live births in 2020.

Compared internationally using data for 2020, Luxembourg had a proportionally higher number of midwives than Germany, France and the Netherlands, but much lower than Belgium. This density is similar to that in Switzerland (Figure 54).

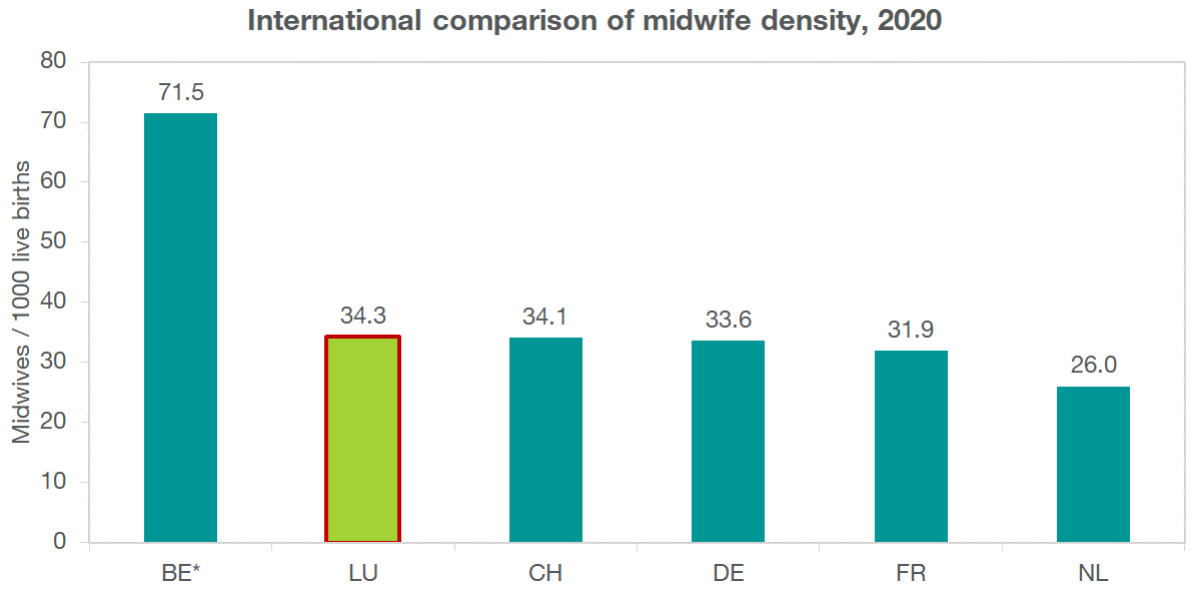


Figure 54: International comparison - Number of midwives per 1000 live births in 2020 (or latest year available), by country. (*Data from 2019).

Source: LU: Registre des professions de santé du Ministère de la Santé (Rapport Général de la Sécurité Sociale,2022[217]); BE,CH,DE,FR, NL: OECD.

PAEDIATRIC NURSES

Paediatric nurses are essential in the provision of specialized care to neonates, infants and children.

According to the latest available data from 2020, there were 283 licensed paediatric nurses in Luxembourg, up from 268 in 2019.[xxxvii] [217] International comparable data is not available.

[xxxvii] Number of pediatric nurses in Luxembourg, 2019-2020.
Source: LU: Registre des professions de santé du Ministère de la Santé (Rapport Général de la Sécurité Sociale,2022[217]).

NUMBER OF SERVICES

An overall assessment of the total numbers for the health services provided to children 0–12 years old and billed to the National Health Fund gives a general picture of the medical specialties most involved in the care of children. The results should be interpreted with caution, as billed activities are not necessarily reflective of the time spent with each patient and the workload. Further, the number of billed services that can be provided during a consultation can vary significantly between professions. However, this analysis allows us to detect variations in the services provided for children 0–12 years old for each category of medical specialization—paediatricians, GPs and dentists—and to estimate how services provided for children are distributed among paediatricians and GPs. It also minimizes the effect of part-time work that was not able to be accounted for in the previous section on workforce density.

As shown in Figure 55, the total annual number of services provided by paediatricians to children 0–12 years old increased by 11% between 2012 and 2022. Meanwhile, the average annual number of services provided per paediatrician decreased by 23% over the same period (from 3539 in 2012 to 2715 in 2022). Further analysis is needed to understand the drivers of the observed trends.

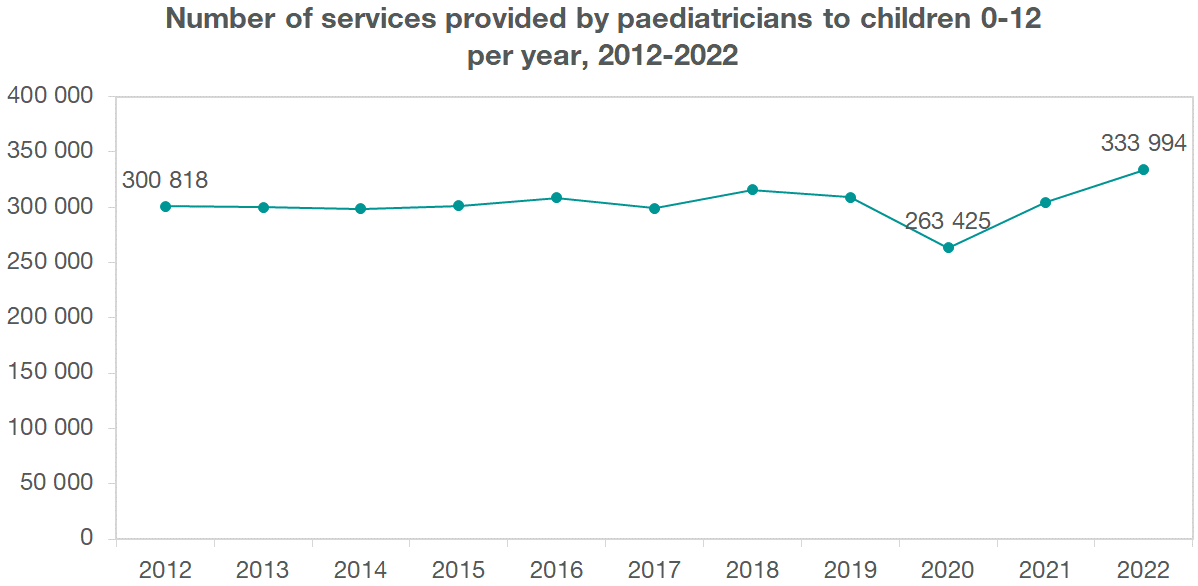


Figure 55: Number of services provided by paediatricians for children aged 0-12 years, 2012-2022, Luxembourg. Services provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

For GPs, the total annual number of services provided to children 0–12 years old increased by 25% between 2012 and 2022. Over the same period, the average annual number of services provided per GP decreased by 10% (from 206 to 186) (Figure 56).

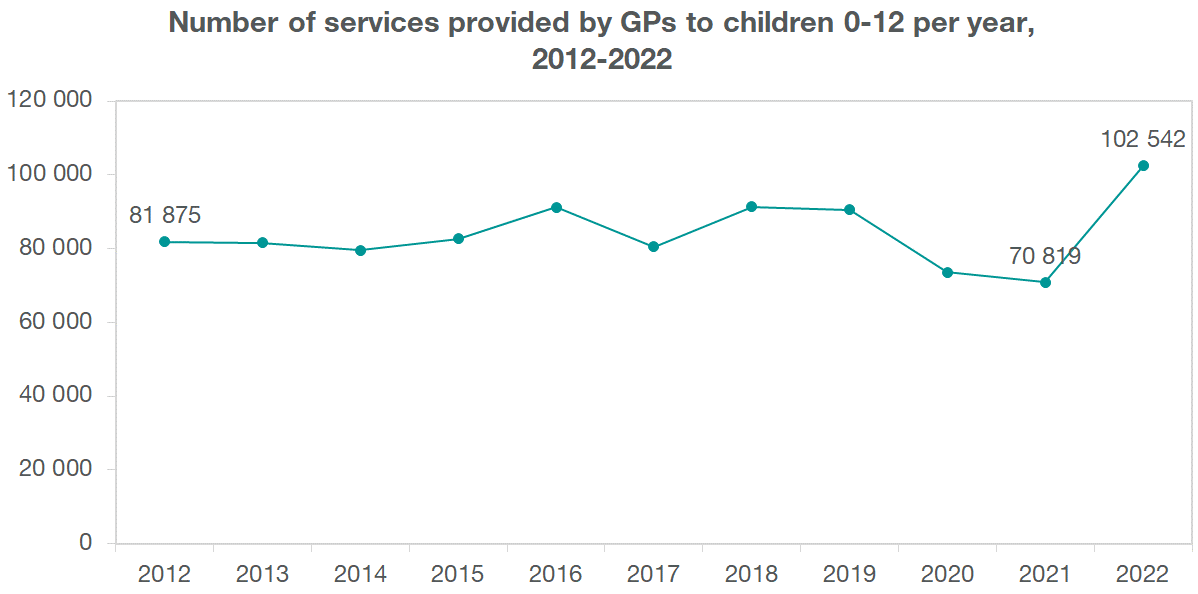


Figure 56: Number of services provided by general practitioners for children aged 0-12 years, 2012-2022, Luxembourg. Services provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

Furthermore, the number of GPs providing (regular or occasional) services to children 0–12 years old can be estimated by the number of GPs who billed for outpatient services. In 2022, 548 GPs provided one or more outpatient services to a 0–12 year old child. Of them, 525 provided at least one regular consultation (codes C1 and MR03) or prescription refill (C41) for a child, 122 provided a preventive care visit (codes E14-E19, but mostly code C47) and 289 provided at least one unplanned (emergency) visit (codes C51-C54, C801 and C803). This gives an appreciation of the number of GPs who are involved in the care of children in Luxembourg. In addition, 313 GPs provided teleconsultation services for children 0–12 years old in 2022, and 127 made a home visit.

For dentists, the overall number of services provided to children 0–12 years of age increased by 56% between 2012 and 2022 (Figure 57).

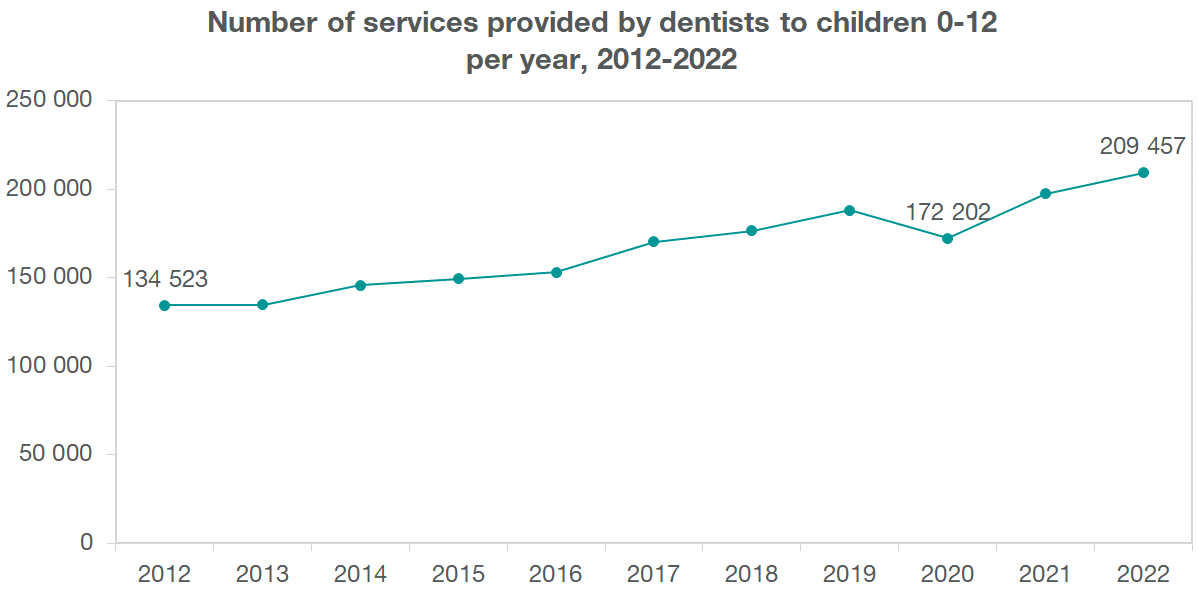


Figure 57: Number of services provided by dentists, orthodontists and oral surgeons, for children aged 0-12 years, 2012-2022, Luxembourg. Services provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

CONSULTATIONS FOR CHILDREN BY PAEDIATRICIANS AND GPS

Analysing the volume of various types of consultations with paediatricians and GPs, this section aims to describe the proportions of comparable health services offered by these providers to children.

The following analysis relies on consultations provided to children aged 0–12 years, per medical specialty. Consultations, as defined by the Inspection générale de la sécurité sociale, include billing codes for regular outpatient visits in medical practices,[xxxviii] codes for preventive visits in medical practices[xxxix] and codes for home visits,[xl] as well as codes for a number of technical procedures that can be considered as consultations.

Figure 58 shows the proportion of consultations provided by paediatricians, out of the total number of consultations provided by GPs and paediatricians, by age categories for children up to 12 years old.

In 2022, paediatricians provided 97% of consultations for children under 1 year old, while this proportion decreased as the age of children increased. By comparison, GPs provided a growing proportion of consultations with increasing children's age, reaching 56% of consultations for children 10–12 years old (Figure 58). This distribution was relatively stable over the 2012–2022 period.

[xxxviii] Refers to C codes from Chapter 1 in the *Nomenclature des médecins et médecins-dentistes.*
[xxxix] Refers to E codes from Chapter 1 in the *Nomenclature des médecins et médecins-dentistes.*
[xl] Refers to V codes from Chapter 1 in the *Nomenclature des médecins et médecins-dentistes.*

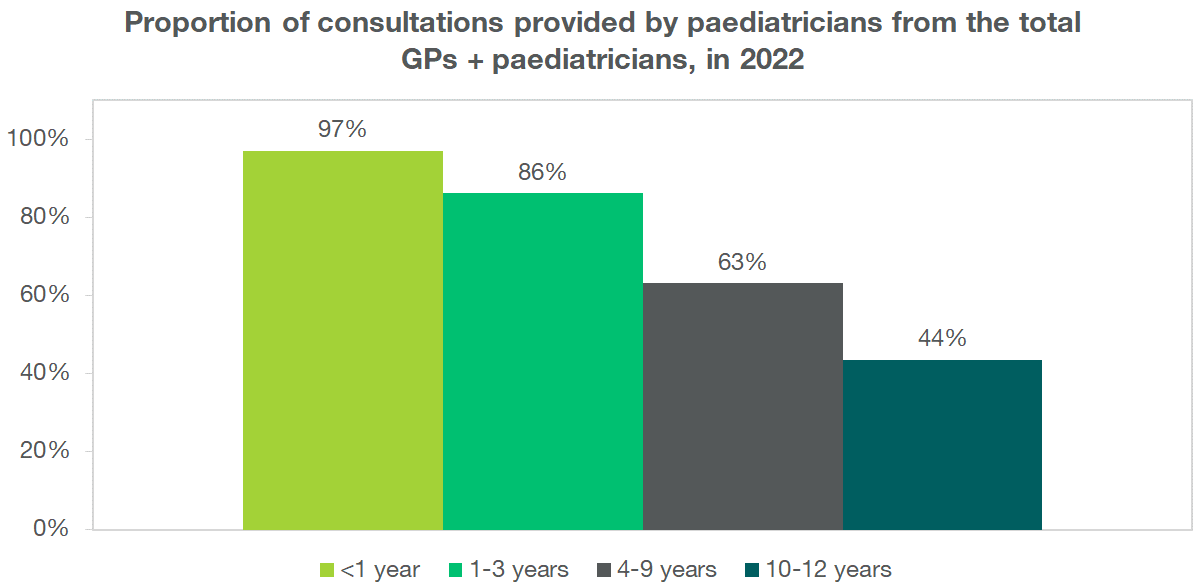


Figure 58: Proportion (%) of child consultations provided by paediatricians for children 0–12, by age category, out of the total number of consultations provided by GPs and paediatricians in Luxembourg, 2022. Consultations provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

The proportion of consultations for infants provided by paediatricians compared with GPs is much higher in Luxembourg than in France, where the primary care system for children is qualified as 'mixed'. In 2018, paediatricians in France provided 38% of consultations for children aged 0–11 months, while GPs provided 62%.[216]

The distribution of the number of consultations by age and medical specialty highlights the dominant role of paediatricians in the primary care of children: overall, they provided 256 500 consultations for children in 2022, compared with 83 092 consultations provided by GPs. This number remained fairly stable over the years, except in 2020 and 2021 during the COVID-19 pandemic when a lower volume of activity was observed for both paediatricians and GPs.

We looked at the distribution of consultations provided by paediatricians and GPs to children 0–12 years old, by age categories, over the years 2012–2022, according to the billing data for the corresponding codes[xli]. Over the years, this distribution remained constant for each category of provider (Figure 59).

[xli] Codes from the Chapter 1 of the *Nomenclature des actes des médecins et médecins-dentistes*.
For Paediatricians, planned care includes regular consultations (codes C6, C7 and MR03) and prescription refills (C41), preventive care includes preventive practice visits (codes E8-E13. E18-E19 and C47), unplanned care includes emergency visits to practices and emergency departments (codes C55-C58, C801 and C803), home visits refer to codes V10-V16, and teleconsultations to code C45.
For GPs, planned care includes regular consultations (codes C1 and MR03) and prescription refills (C41), preventive care includes preventive practice visits (codes E14-E19 and C47), unplanned care includes emergency visits to practices and to emergency departments (codes C51-C54, C801 and C803), home visits refer to codes V1 and V3-V7, and teleconsultations to code C45.

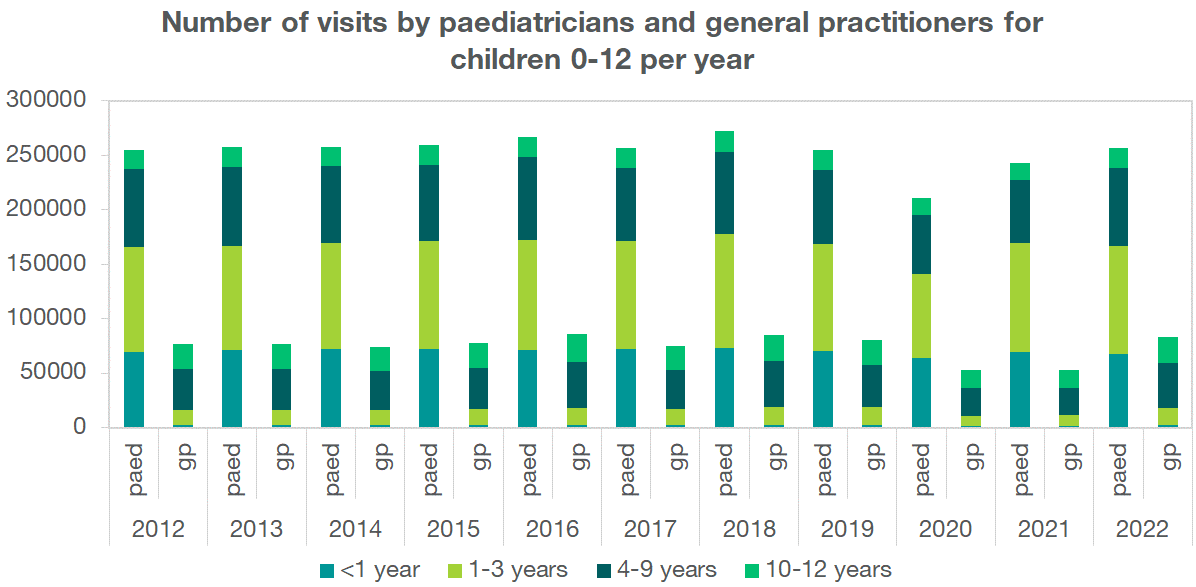


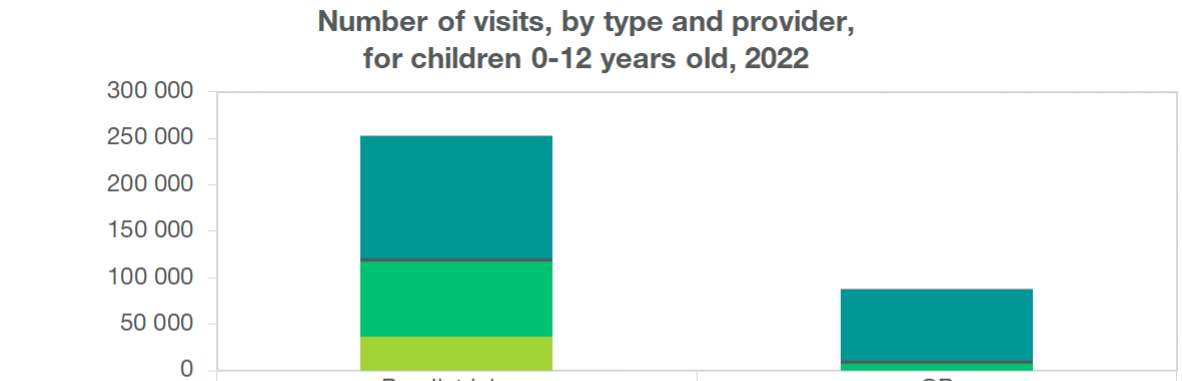
Figure 59: Number of visits provided by paediatricians and general practitioners for children, by age categories, 2012–2022. Visits provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

We also looked at the distribution of planned, unplanned and preventive consultations provided by paediatricians and GPs for children aged 0 to 12, based on billing data for the corresponding codes.[xlii]

Figure 60 shows that in 2022, planned visits accounted for the largest number of consultations for children 0–12 years old, both by paediatricians and GPs, at 52.3% and 87.1%, respectively. Unplanned visits were in second place, at 31.8% and 7.7% for paediatricians and GPs, respectively. Preventive visits were third, with this type of care being quasi-exclusively provided by paediatricians (14.7% of their visits by children 0–12 years old). These results demonstrate the prominent role played by paediatricians in providing primary care for children in Luxembourg, in particular, for preventive services.

[xlii] Codes from the Chapter 1 of the *Nomenclature des actes des médecins et médecins-dentistes*.
For Paediatricians, planned care includes regular consultations (codes C6, C7 and MR03) and prescription refills (C41), preventive care includes preventive practice visits (codes E8-E13. E18-E19 and C47), unplanned care includes emergency visits to practices and emergency departments (codes C55-C58, C801 and C803), home visits refer to codes V10-V16, and teleconsultations to code C45.
For GPs, planned care includes regular consultations (codes C1 and MR03) and prescription refills (C41), preventive care includes preventive practice visits (codes E14-E19 and C47), unplanned care includes emergency visits to practices and to emergency departments (codes C51-C54, C801 and C803), home visits refer to codes V1 and V3-V7, and teleconsultations to code C45.



	Paediatricians	GP
home visits	61	312
planned care	132 304	76 775
teleconsultations	2 783	3 792
unplanned care	80 410	6 764
preventive care	37 255	547

Figure 60: Number of visits, by type of service, provided by paediatricians and general practitioners for children 0–12 years old, 2022, Luxembourg. This indicator includes visits provided to insured resident children only.

Source: Social security database. Indicator computed by ObSanté.

RECURRENCE OF OUTPATIENT CARE DURING THE FIRST FOUR YEARS OF LIFE

As observed, paediatricians play a major role in the provision of preventive care for young children. We were interested in investigating whether this role is part of a long-term relationship between doctors, and the children and their caregivers.

To this end, we looked at outpatient visits from 2012 to 2022 by children during their first four years of life, and at the recurrence of visits to at least one given practitioner, per medical specialty. Outpatient visits included any consultation, planned or unplanned and preventive or not. Only children who were affiliated to the national health insurance during their first four years of life, and who had at least one visit to a medical doctor of the selected specialty were considered for the analysis.

Figure 61 shows that 95% of children had more than five recurring outpatient visits to the same paediatrician during their first four years of life. This suggests that parents tend to stay with one paediatrician to seek care for their young children.

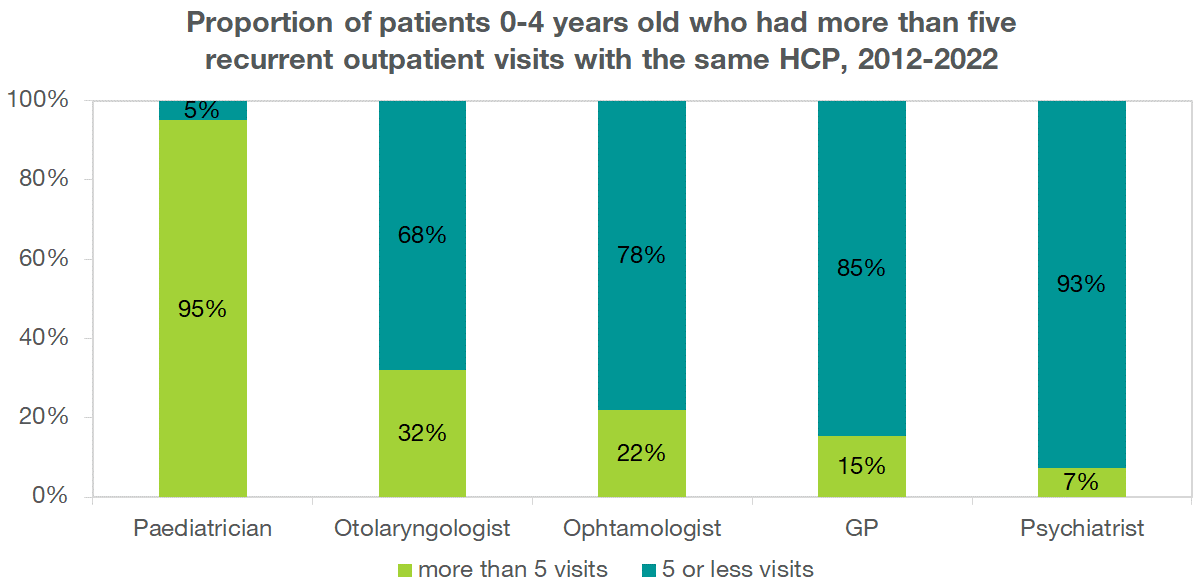


Figure 61: Proportion (%) of children (up to age 4) according to their recurring pattern of outpatient visits to the same practitioner, selected specialties, 2012–2022, Luxembourg. Insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

SEASONAL VARIATION IN OUTPATIENT CARE FOR CHILDREN 0–12 YEARS OLD

Seasonal variation has been described for paediatric diseases such as bronchiolitis, gastroenteritis and asthma, as well as for functional complaints including headaches and abdominal pain.[218] Since these variations will have an impact on the demand for primary healthcare, we looked at changes in the monthly volume of outpatient services for children provided by paediatricians and GPs for the years 2012–2022. Figure 62 shows the proportion of outpatient health services for children provided by paediatricians, GPs and dentists, summed up for all years from 2012—2022, for each calendar month. For paediatricians and GPs, the monthly variation is similar, showing a sustained high service volume from October until peaking in March, with a dip in the summer holidays, particularly in August. For dentists, the activity profile only shows a dip during the main summer and winter holidays.

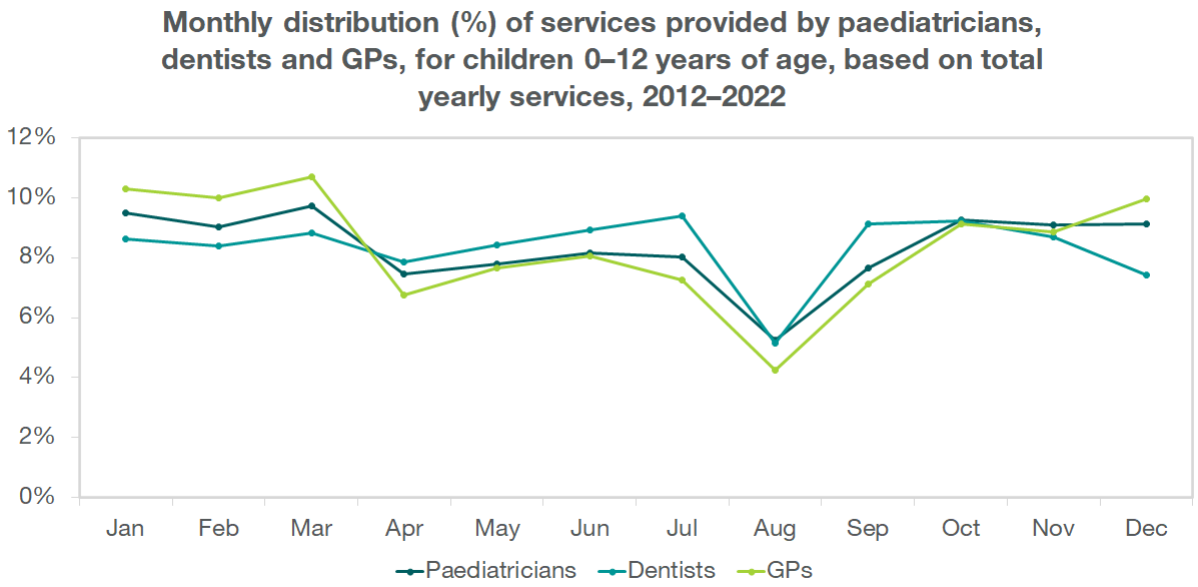


Figure 62: Monthly distribution (%) of services provided by paediatricians, dentists and general practitioners, for children 0–12 years of age, based on total yearly services, 2012–2022. Services provided to insured resident and non-resident children are included.

Source: Social security database. Indicator computed by ObSanté.

Conclusions on the health workforce

In summary, the density of the workforce providing care to pregnant women and children in Luxembourg has increased over the 10 years examined. For paediatricians, obstetricians-gynaecologists and dentists, this density is higher than in most neighbouring countries, while it is on par for midwives. No international comparison was identified for child psychiatrists or for paediatric nurses.

Nevertheless, the high density of healthcare providers does not mean that their supply meets the demand. The level of professional activity (in terms of time devoted to care) and the organization of care within the health system, among other factors, play a critical role in the workforce availability.

Our analyses show that health care in Luxembourg is a paediatrician-led care system for children up to the age of 9 years, with paediatricians playing a major role in the provision of primary care for children.

The density of paediatricians per 1000 inhabitants rose from 0.16 in 2012 to 0.19 in 2022: higher than in France, Belgium and the Netherlands and equivalent to that in Germany.

Compared with nearby countries, the density of the other main healthcare professionals involved with children in Luxembourg is high for dentists, and in the same range for obstetrician-gynaecologists and midwives. There is no reliable comparative data for child psychiatrists or paediatric nurses.

While on average 60% of medical specialists in Luxembourg were over the age of 50 in 2017, paediatricians were relatively young, with only 41% being older than 50. Between 2012 and 2022, changes in the age distribution of practitioners varied from one specialty to another: the proportion of paediatricians and child psychiatrists over the age of 50 rose from 35% to 41%

and 33% to 52%, respectively, while the proportion of obstetrician-gynaecologists and dentists remained stable at 56% and 37% respectively.

The overall activity of paediatricians, GPs and dentists—measured by the billed services—is increasing; however, the volume of services billed per paediatrician and GP shows a decreasing trend.

There is no data available about waiting times for paediatric services or to assess if the supply meets the demand for these services. The number of services billed per 1000 children decreased between 2012 and 2022.

Paediatricians provide a high proportion of primary care consultations for children up to 4 years of age. In 2022, they provided 97% of consultations for children aged under 1 year old (GPs 3%), and 86% of consultations for children 1 to 3 years old. By comparison, paediatricians in France provided 38% of consultations for children aged 0 to 11 months in 2018, while GPs provided 62%.[216] Paediatricians also play a leading role in the provision of preventive visits, and these are quasi-exclusively provided by them. Once a paediatrician is chosen, it appears likely that children will remain with the same paediatrician, as 95% of children under the age of 4 visited the same paediatrician more than five times.

2.2 Infrastructure

An appropriate infrastructure, based on sufficient and well-equipped health facilities is needed for a health system to provide effective and efficient services. Optimally, this functions through the interplay with a suitable, qualified health workforce, the availability of adequate drugs and consumables and the implementation of appropriate processes. This chapter focuses on the infrastructure available in Luxembourg to provide services for children and pregnant women. The chapter provides a description of the child-specific infrastructure available in the primary and hospital sector, as well as the digitalization of services.

Main findings:

- The hospital law introduced the centralization of specialized paediatrics, while reserving the possibility to establish local paediatric departments.
- The same law established the centralization of care for high-risk pregnancies, introducing the concept of level 1 and level 2 maternity facilities, while retaining the four maternity facilities spread across the county.
- Luxembourg has a relatively low number of paediatric hospital beds, compared with its neighbouring countries.
- Digitalisation of health services for children is progressing, but is still rather limited.

Primary care sector

Several entities provide primary care for children in Luxembourg, including pharmacies, primary care paediatricians and GPs, who provide care and services in private practices across the country. Other medical specialties offering services for children, such as child psychiatrists, are also organized in practices across the country. However, the data available for this report does not include information on the number of practitioners working in private practices, nor on the composition or the organisation of practices.

Information on the distribution and accessibility of paediatric practices is provided in section 3.2 on access to care.

The on-call medical centres provide continuity of primary care outside the opening hours of doctors' surgeries. The paediatric on-call medical centre is housed in the Kannerklinik premises at the CHL and operates in the evenings on weekdays, and at day times during weekends and holidays. The on-call medical centres, located at three sites across the country (Esch-sur-Alzette, Ettelbruck), operate in the evenings and at night during the week, and around the clock on weekends and public holidays.

Hospital sector

The number of hospital beds available is a standard measurement for assessing and comparing hospital capacity. Hospital bed capacity and the associated metrics such as bed occupancy and the ratio of beds to population numbers are key to determine the availability of inpatient care. The number of beds in a hospital can be conceived as a capital stock, which is influenced by the performance of medical staff and equipment.

This section presents the number of hospital facilities for maternity and childcare, their role and their geographical distribution. As occupancy rates for these facilities were not available, this section cannot fully assess whether bed capacities are adequate to meet children's needs. This analysis will be carried out as part of a focus in the 2023 edition of the *Carte sanitaire* dedicated to hospital admissions for children.

The hospital law determines the number of beds and provides definitions and standards for hospital departments.[195] The number of beds reported below includes all those that are regularly maintained and staffed, and immediately available for use.[197] It was not always possible to present trends over time, because the scope of the data recorded has changed, making comparisons impossible.

Maternity units and neonatal care departments

NUMBER OF BEDS IN MATERNITY UNITS

In 2021, there were 100 maternity beds, of which 64 were in level 1 maternity facilities and 36 in a level 2 facility, equating to a density of 14.9 beds per 1000 live births (Table 6).[197] This is lower than in Belgium (25.5 beds per 1000 births in 2014) and France (20 beds per 1000 live births in 2020).[197] All the beds authorized in 2019 were in place.[197]

Table 6: Number of installed inpatient beds in maternity units in Luxembourg, 2021.

Source: Carte sanitaire, 2021.

Maternity facilities	Hospital sites	Number of inpatient beds 2021
Level 1	CHdN-Ettelbruck	10
	HRS-Bohler*	36
	CHEM-Esch	18
Level 2	CHL-Maternité	36
TOTAL		**100**

Note: * this ward records more than 1500 deliveries per year.

The average length of stay (ALOS) in hospitals is often regarded as an indicator of efficiency in health service delivery. The ALOS for a normal delivery in Luxembourg is 4 days, which is higher than the EU average (3.4 days), and longer than the ALOS in Belgium, Germany, Switzerland (all 3 days) and the Netherlands (1.5 days), although similar to France (3.9

days).[197] Reducing the length of stay for normal deliveries shifts postnatal care from inpatient to less intensive home-based care, and frees up the bed capacity in maternity wards.

NUMBER OF BEDS FOR NEONATAL CARE

In 2021, there were 23 neonatal beds, of which 16 were intensive care beds in the national neonatal intensive care unit (NICU) and 7 were non-intensive care beds in a neonatal unit located in a level 1 maternity facility. This equates to a density of 3.4 beds per 1000 live births (

Table 7).

The NICU also hosts six parent-child rooms. These allow one of the parents to stay with their newborn baby under the supervision of the ward team.

Table 7: Number of installed inpatient beds in intensive and non-intensive neonatology departments, 2017, 2021.

Source: Carte sanitaire, 2017, 2021.

Neonatal care facilities	Hospital sites	Number of inpatient beds 2017	Number of inpatient beds 2021
Intensive care	CHL-Kannerklinik	14	16
Non intensive care	HRS-Bohler	7	7
TOTAL		**21**	**23**

Paediatric care departments

The target population for paediatric wards are children under the age of 16 and, when appropriate, up to the age of 18. In these wards, the infrastructure, equipment and organization must be adapted to the specific needs of children in this age range and differs from non-paediatric wards.

To assess the infrastructure, the number and density of available beds is reported.

NUMBER OF BEDS IN PAEDIATRICS DEPARTMENTS

In 2021, there were 53 paediatric care beds overall in the country, of which 12 were in local paediatric departments, 21 were in the national specialized paediatric department and 15 were in the national paediatric surgery department. Out of the 21 paediatric beds in the national paediatric care departments, four were dedicated to the treatment of onco-haematology disorders. In addition, there were five intensive care paediatric beds in the national department (Table 8).

This equals a density of 3.9 paediatric non-intensive care beds per 10 000 children under 18 years of age. In Belgium, there were 12.9 licensed paediatric beds (E-beds) per 10 000 children under 15 years of age in 2018.[219]

Between 2017 and 2021, the number of beds fell by 33% in Luxembourg. Decreases were also observed in neighbouring countries.[219,220]

Table 8: Number of installed inpatient beds in paediatrics departments, 2017 and 2021.

Source: Carte sanitaire, 2017, 2021.

Paediatric care departments	Hospital sites	Number of inpatient beds 2017	Number of inpatient beds 2021
Paediatrics (local)	CHdN-Ettelbruck	8	3
	HRS-Bohler	12	5*
	CHEM-Esch	15	4
Specialized paediatrics	CHL-Kannerklinik	24	21
Paediatric surgery	CHL-Kannerklinik	15	15
Subtotal paediatrics non-intensive-care beds		***74***	***48***
Paediatric intensive care	CHL-Kannerklinik	5	5
TOTAL		**79**	**53**

Note: *for this description, beds for non-intensive neonatal care are included above with neonatal care and not in paediatric care departments as mentioned in their authorization.

This inpatient capacity is complemented by ten paediatric day care beds located in the CHL-Kannerklinik.

Paediatric psychiatric care departments

There is one national paediatric psychiatric care department in the CHL-Kannerklinik, with eight inpatient beds and eight day care beds for children 0–13 years old. Mental health care for children 13 years of age and above is provided at the national juvenile psychiatric care department located in the HRS.[197]

Emergency care departments

Children's health emergencies require appropriate hospital care capacity. A previous analysis showed that over the period 2019–2021, children under the age of 15 years accounted for almost a quarter of all hospital emergency visits.[221] A similar situation is observed for France, where children under 18 years of age account for 26% of hospital emergency visits.[222]
The same analysis documented that the rate of emergency hospital visits varies with age: 47.5% of children 0–4 years old had at least one visit to an emergency department in 2019, compared with 30.3% of 5–9 year olds. The proportion was 24.8% for the whole insured population, including adults. [221]

Paediatric emergency department

The national paediatric emergency department located in the CHL-Kannerklinik provides 24/7 emergency care for children 0-16 years old and, when appropriate, up to 18 years old. This department includes a three-bed short stay unit.
According to the previous report, in 2019-2021, the national paediatric emergency department accounted for 45% of hospital emergency visits for children under 15 years of age. [221]

Paediatric care pathways in emergency departments

There are four (general) emergency department wards located in the four general hospitals (CHdN, CHL, HRS and CHEM). The organisation of specific care pathway for children in these departments has not been documented. The CHL emergency department systematically refers children to the paediatric emergency department at the CHL-Kannerklinik.

Neonatal emergency care and transport service

The neonatal emergency care and transport service (SAMU néonatal) is a 24/7 service that brings neonatal expertise to level 1 maternity wards lacking neonatal intensive care expertise and operates newborn transfers between these maternity wards and the NICU located in the CHL-Kannerklinik, or abroad.

Digitalization

Digitalization of the health system can allow a more efficient use of resources, improve the access to services for less-mobile populations and can also increase the resiliency of the health system to challenges—for example, the COVID-19 crisis—by making it more adaptive to new circumstances.[223,224] This section looks at the available digital health services for children in Luxembourg and how they have developed over time. Specifically, the use of electronic health records, teleconsultations and telemedicine is explored.

NUMBER OF CHILDREN WITH AN ELECTRONIC HEALTH RECORD

A shared electronic health record called DSP (*Dossier de Soins Partagé*) was created by the Agence eSanté in 2014, for all people affiliated to the Luxembourg social security system. The aim of DSP is to support the exchange of essential patient data between health care providers through a nationwide platform. It bridges, but does not replace, the patient files kept by health professionals and institutional health care providers.

As of 31 December 2022, there were 1 027 569 DSPs (resident and non-resident population), including 71 412 in the 0–12 years age group (source: Agence eSanté).

The number of DSPs for resident children increased from 95 in 2016 to 64 324 in 2022 (Figure 63). A DSP is defined as active once a first document is added to it. The main data stored in the DSP comprises laboratory results and medical imaging reports and images. Even though many COVID tests were performed in 2020, it is important to acknowledge that the activation of the DSP was primarily driven by laboratory results performed over the years.

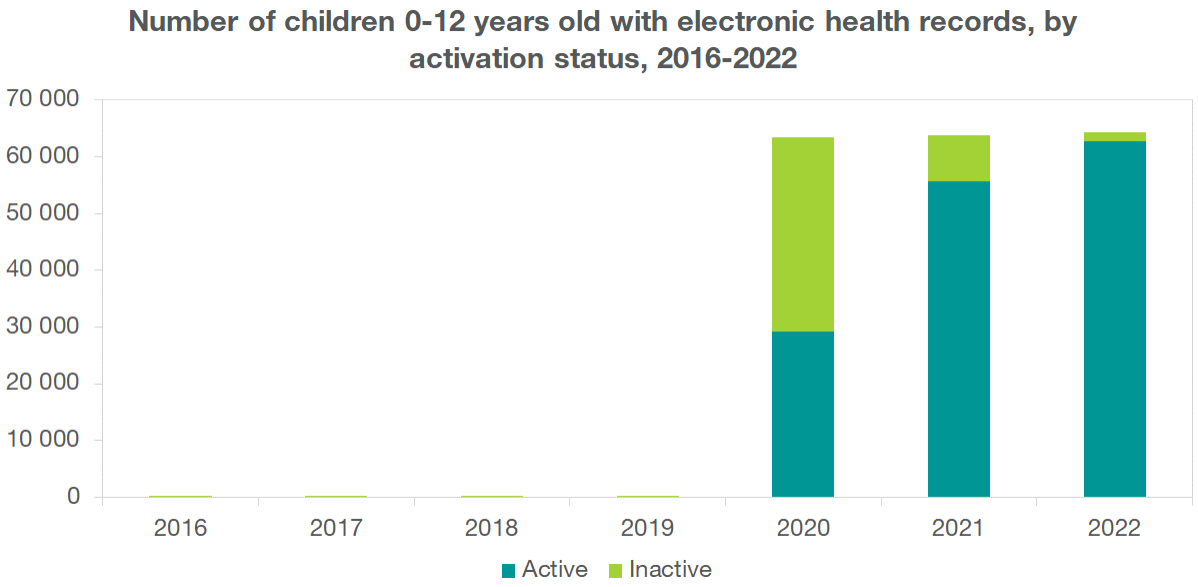


Figure 63: Number of resident insured 0-12 year old children with an electronic health record (DSP), by DSP activity status, 2016–2022, Luxembourg.

Source: Agence eSanté.

NUMBER OF CHILDREN WITH AN ELECTRONIC VACCINATION RECORD

The electronic vaccination record, called 'CVE' (*Carnet de Vaccination Electronique*), has been promoted by the Ministry of Health to provide a portable version of the paper vaccination record or 'yellow card', enable notification of vaccination reminders and personalised vaccination advice in line with national recommendations, and facilitate the management of the immunization programme. The CVE is an electronic information system for vaccinations, covering the entire resident and non-resident population. It records all doses of vaccines administered to people in Luxembourg.

The CVE has been rolled out to Luxembourg's medical practices since February 2022. 363 doctors have the CVE software offered by the Agence eSanté and 244 doctors use it regularly in their practice. Up to July 2023, 21 794 CVEs have been created for patients of all ages. Children 0–14 years of age account for 40% of all CVEs (source: Agence eSanté).

The number of CVEs for resident children has increased progressively, from 1 228 in February 2022 to 8,803 in July 2023. By July 2023, around 20% of resident children aged between 0–23 months had a CVE, compared with 10% for 2–6 year olds and 5% for 7–14 year olds.[xliii]

TELECONSULTATIONS

During the COVID-19 pandemic, teleconsultations were introduced to maintain access to non-COVID-19 health services. Teleconsultations are currently still in place.

[xliii] Proportion (%) of resident children 0-14 years old, having an electronic vaccination record (CVE), July 2023, Luxembourg. Source: Agence eSanté

Out of the total number of consultations provided by GPs and paediatricians for resident and non-resident children (280 461 in 2020, 308 363 in 2021 and 354 854 in 2022), only a small proportion were carried out via teleconsultation[xliv]. This proportion was highest in 2020 (5.1% for children aged 0–12 years) and fell to 2.0% in 2022. Over the past three years, teleconsultations were proportionally more used for children aged 5–12 years than for younger children (Figure 64). Overall, even during the main COVID-19 pandemic waves in 2020, teleconsultations for children played only a minor role.

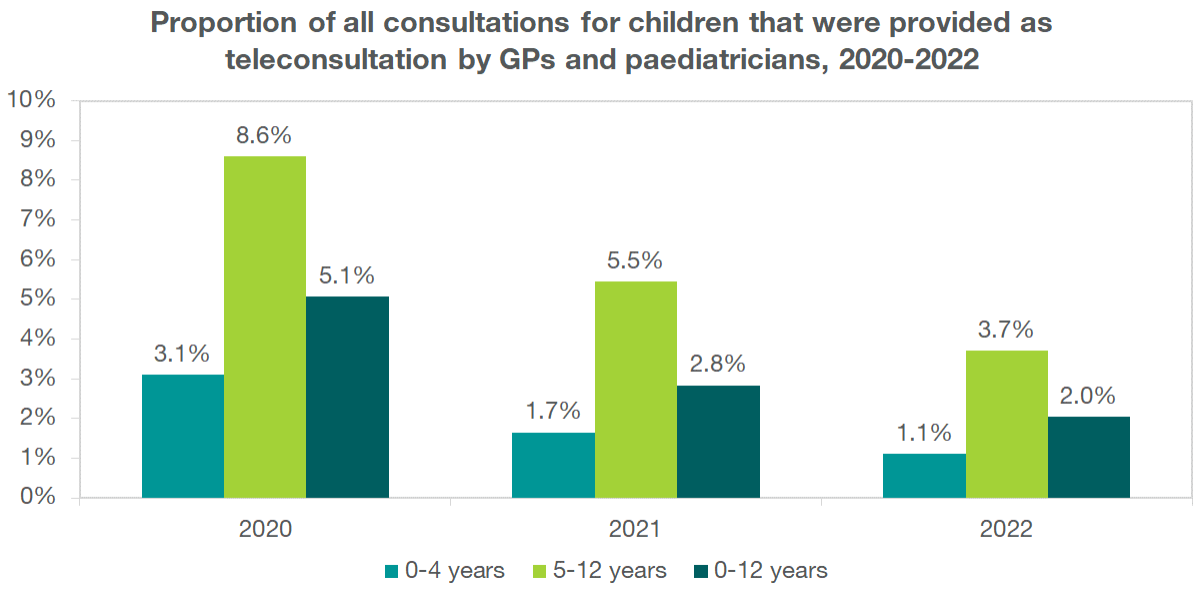


Figure 64: Proportion (%) of all consultations for children that were provided as teleconsultation by general practitioners and paediatricians in Luxembourg, 2020-2022. The analysis includes consultations to insured resident and non-resident children.

Source: Social security database. Indicator computed by ObSanté.

In the same three-year period, around half of the practising GPs provided teleconsultations for children aged 0–12 years (49.8% in 2020 and 46.5% in 2021) and fell to 24% in 2022. The proportion of practising paediatricians providing teleconsultations (a minimum of 10 consultations) was 63.3% in 2020, 59.6% in 2021 and 36.9% in 2022.[xlv]

TELEMEDICINE

The use of telemedicine in Luxembourg is currently limited to some tele-monitoring applications or tele-expertise—either national (for example, paediatric expertise for neonatal intensive care in maternity wards without neonatal coverage) or international (for example, the European Reference Networks for rare diseases)—or tele-pathology between hospitals and the National Health Laboratory for remote biopsy analysis. It was not possible to assess the usage of these services for children.

[xliv] This indicator is based on practitioners with significant activity. Certain criteria were therefore applied:
Practitioners with a supplier code allocated by the CNS and aged between 25 and 74 years during the reference year; in the case of self-employment, the net amount invoiced during the year is equal to or greater than the average annual minimum social salary; only practitioners who have the same status (as active) during the 12 months of the corresponding year were considered.

[xlv] Proportion (%) of general practitioners and pediatricians providing teleconsultations to children 0-12 years old, 2020-2022, Luxembourg. Consultations to insured resident and non-resident children were included.
Source: Social security database. Indicator computed by ObSanté.

Conclusions on infrastructure

There is limited information available on primary care infrastructures for children in Luxembourg, which precludes a valuable description.

The centralisation of complex care for mothers and children has led to the development of specialised services at the CHL and a reduction in the number of paediatric beds in other hospitals. Overall, maternity units are available in the four acute care hospitals. At the Kannerklinik, the CHL hosts all the national departments dedicated to the specialist care of children in the age range of this report, while the other three acute hospitals have local paediatric departments.

The assessment of the hospital sector carried out for this report is mainly based on the number and density of beds available in the hospital sector. The number of available maternity beds per 1000 live births and the number of paediatric beds per 1000 children are lower than in neighbouring countries. However, this section did not assess occupancy rates of hospital beds, so further analysis is needed to judge whether the lower density in terms of beds has also led to high occupancy rates, thereby increasing the risk of insufficient capacity in the event of greater demand.

Digitalization is making progress through the implementation and adoption of digital health and vaccination records. The use of telemedicine and teleconsultations, however, is very limited for children.

3. Service delivery

In this section, we use indicators to assess the service delivery for children in the Luxembourg health system.

Main findings:

- More than 90% of pregnant women and young children take part in preventative visits, especially in the prenatal and postnatal periods, and if the completion of visits is incentivized.
- For children aged 2 and over, screening programmes and preventive visits are no longer incentivized, and fewer children are reached: during their third and fourth year of life, fewer than half of all children 30 months old attended speech and language screening (Bilan 30), 21% of children born in 2018 attended both recommended well-child visits, and around 5% attended the two dental visits before age four.
- Low birth weight rates are decreasing and maternal mortality is low, but there are still a high proportion of potentially preventable deaths among children, such as accident and transport-related deaths.
- Maternal and child care are generally accessible, as measured by the distance to reach a paediatric practice, the time to reach a maternity facility or having a midwife visit at home; however, living in the north of the country increases the travel time.
- Compared with neighbouring countries, unmet needs for dental or medical care are very low for children in Luxembourg, also among those from households with a lower income (below 60% of the national median equalized income) (0.9% and 1.1%, respectively).
- High rates of caesarean sections (30.4%) compared with neighbouring countries point to potential opportunities to improve the efficient use of hospital services.
- The use of antimicrobials among children showed a continuous decline between 2011 and 2019; however, after 2022, a rebound in the prescription of antibacterials was observed, including broad-spectrum antibiotics.
- There are still a considerable number of pre-term children being born in level 1 maternity wards.

3.1 Effectiveness

The extent to which health care and services achieve the desired results or outcomes can be measured at the patient, population or organizational level. We explore how the delivery of public health services, primary care and hospital care are effective in reaching their objectives, using available, selected indicators.

Main findings:

- The provision of preventative services for mothers and infants up to the age of 2 years has very good coverage (over 90%).
- High vaccine coverage rates are observed for young children; however, data is currently not available on vaccine coverage for older ages, including the *Human papilloma virus* (HPV) vaccine.
- The participation rate of children in preventative visits after their second birthday is much lower, reaching 46.9% of the target population for speech and language

screening and hearing tests, and 42.4% and 19.3%, respectively, for the medical and second dental visit before the age of 4 years.

- Less information is available for services used by children of school age, partly due to a lack of suitable data.

Public health

While optimal health outcomes are the ultimate goal when providing health services, a high participation rate of the target population is a prerequisite for a service to achieve the intended outcomes. Moreover, health outcomes are not always measurable, or may be influenced by other factors. Therefore, the coverage—or participation rate—is a useful measurement of the effective delivery of public health services.

The indicators in this section include participation rates and coverage for public health programmes targeted at children, as well as rates of preventable health outcomes.

Prenatal and early childhood services

Medical check-ups during pregnancy are essential to protect the health of women and their unborn children. The World Health Organization (WHO) recommends a minimum of eight antenatal care contacts for a positive maternal experience and to reduce perinatal mortality. The initial contact should take place in the first trimester (up to 12 weeks of gestation), two contacts in the second trimester (at 20 and 26 weeks) and five contacts in the third trimester (at 30, 34, 36, 38 and 40 weeks) [xlvi].[174;]

TIMING OF THE FIRST ANTENATAL VISIT

In Luxembourg, the first antenatal visit is scheduled before the end of the third month of gestation, in line with WHO recommendations.[178]

The proportion of women having a first visit before the end of the third month of gestation reflects the access to prenatal care for pregnant women, as well as indicating compliance with recommended care to ensure the best possible outcome. Data from the PERINAT registry, covering all births in Luxembourg, is used to show when pregnant women had their first prenatal visit.

Figure 65 shows that between 2012 and 2022, an average of 93% of women who gave birth had a first early prenatal visit according to the set schedule. The COVID-19 pandemic did not have an observable impact on this proportion.

[xlvi] In 2022, the Health Directorate updated the *Carnet de maternité*, a maternal health booklet that is available to all pregnant women at the time of their first visit to the gynaecologist-obstetrician or midwife. This booklet provides health information for pregnant women and specifies the dates of medical and dental check-ups to secure their entitlement to the childbirth allowance. The booklet also specifies that as a general rule, one consultation per month with a midwife or gynaecologist is recommended.[176]

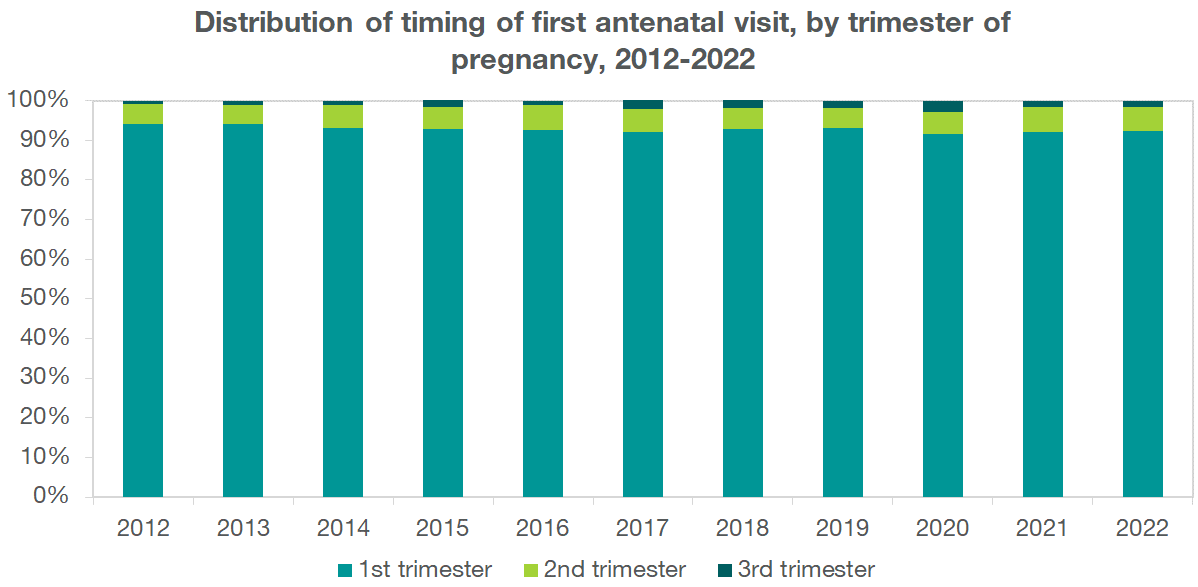


Figure 65: Distribution (%) of timing of first antenatal visit, by trimester of pregnancy, 2012-2022, Luxembourg.

Source: PERINAT.

To identify potential socio-demographic inequalities in compliance with the set visits, we looked at the timing of the first antenatal visit for women from different socio-demographic groups (family structure), within three consecutive years (Figure 66). On average, pregnant women living alone or in an institution had their first prenatal visit at a later stage than women living with a partner or a family.

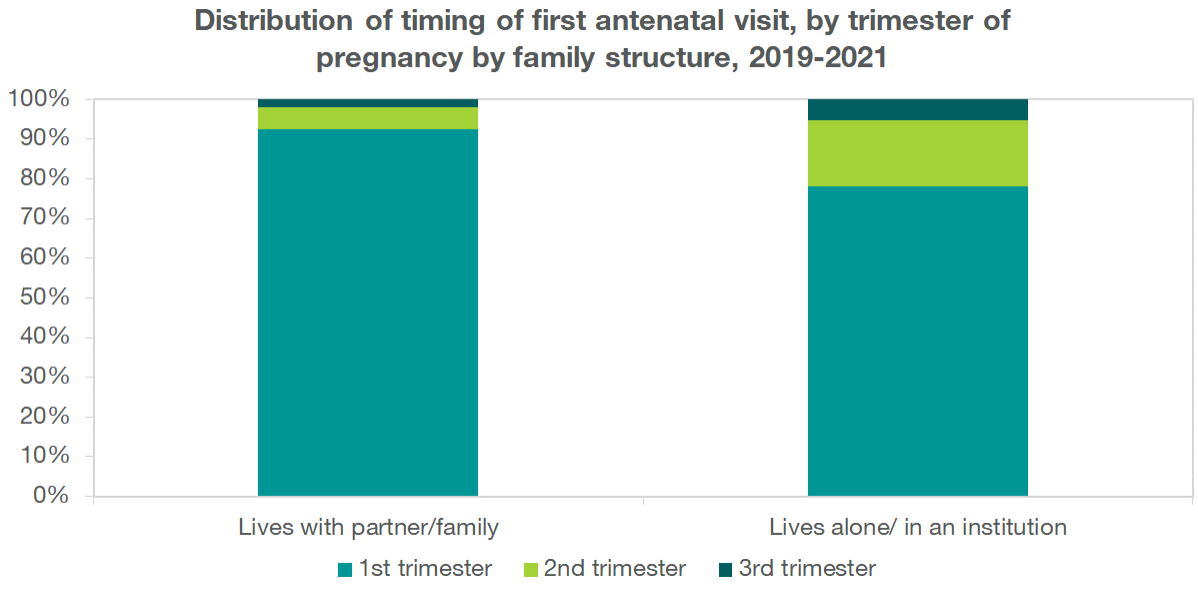


Figure 66: Distribution (%) of first antenatal visit, by trimester of pregnancy and by family structure, 2019-2021, Luxembourg.

Source: PERINAT.

Adherence to recommended prenatal and early childhood visits

Each antenatal and early childhood scheduled visit offers an opportunity to screen for illnesses and detect anomalies in the mother and the fetus, or the child. They are also an opportunity to provide the mother with information on positive health behaviours and warning signs, as well as to provide emotional support. According to the WHO, these contacts are associated with a better experience for the mother and improved health outcomes for both the mother and child.

The indicators below highlight the proportion of women completing all recommended prenatal visits and the first postnatal visit according to the national schedule on the one hand, and the proportion of children completing all recommended childhood visits until the age of 24 months on the other hand. The determination of the indicators was based on data for the disbursement of birth allowances, which are monetary incentives by the Children Future Fund (CAE), for adherence with all recommended prenatal and early childhood visits.[225]

ALL RECOMMENDED PRENATAL VISITS AND FIRST RECOMMENDED POSTNATAL VISIT

Between 2011 and 2021, an average of 94% of resident women who gave birth completed the five antenatal visits recommended in line with the set national schedule (Figure 67), and an average of 95% of women completed the first postnatal visit. This proportion remained constant over time, including during the COVID-19 pandemic.

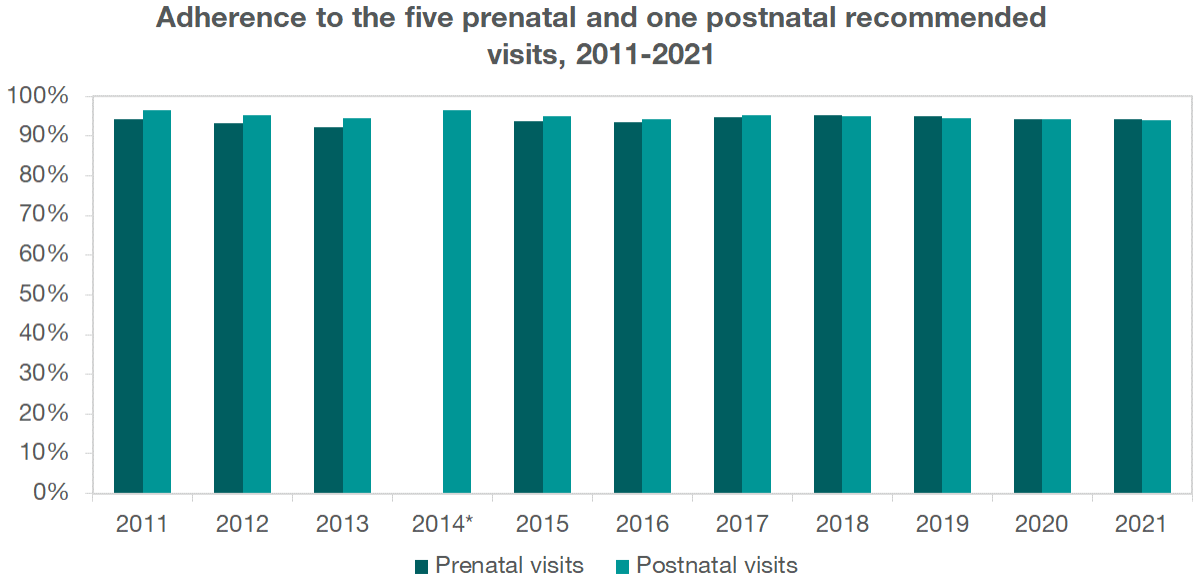


Figure 67: Proportion (%) of women who gave birth in Luxembourg and who completed the five recommended prenatal visits, respectively the first postnatal visit in line with the national schedule and received a prenatal respectively birth allowance ("allocation prénatale", "allocation de naissance"), 2011-2021. Insured resident women were included in the analysis.[225]

Note: *No data was available for prenatal visits for 2014.

Source: Children Future Fund (CAE), social security database.

WELL-CHILD VISITS UP TO THE AGE OF 24 MONTHS

Well-child visits are regular appointments to monitor a child's growth and development from birth up to the age of 18 years. The WHO recommends five visits between the age of 1 and 24 months.[177] In Luxembourg, well-child visits are carried out according to the schedule set by regulation: six visits, two of which are during the perinatal period and four of which are between the ages of 2 and 24 months. These reflect important checkpoints for early child development,

including physical, cognitive, social and emotional growth. To incentivize parents to complete all visits, a monetary allowance (postnatal allowance) is offered that can be requested after the last visit.

Among resident children who turned 2 years of age between 2011 and 2019, the proportion of them who completed all six well-child visits in line with the set national schedule remained stable over time at over 90% (Figure 68).

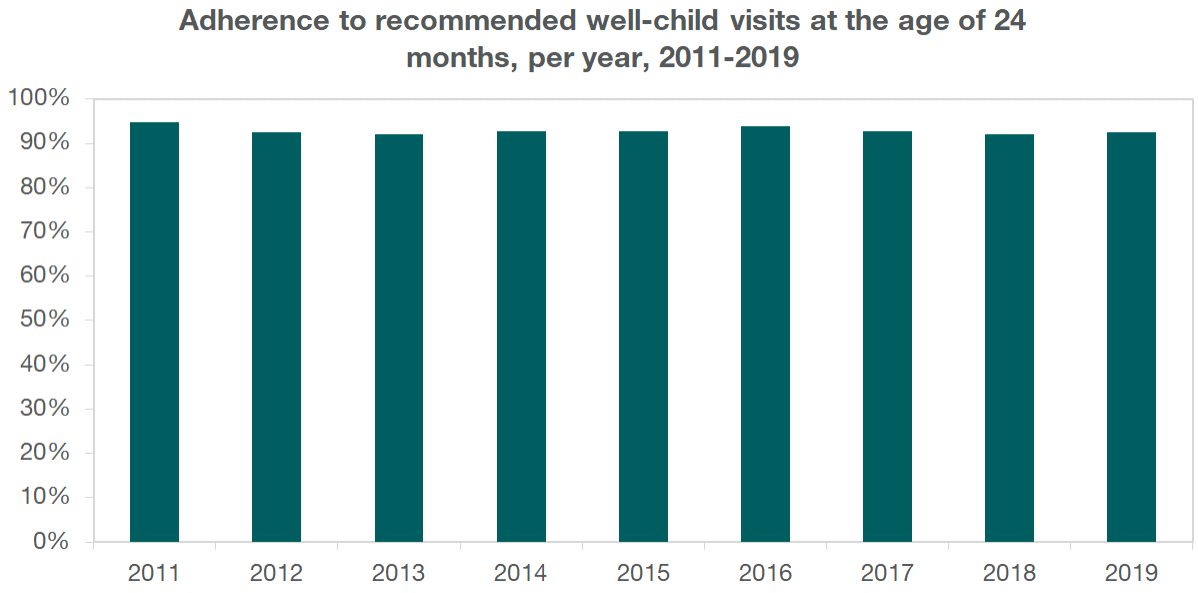


Figure 68: Proportion (%) of children that completed all well-child visits at the age of 24 months, in line with the national recommendations, and received a postnatal allowance ("allocation postnatale"), 2011-2019, Luxembourg. Insured resident children were included in the analysis.[225]

Source: Children Future Fund (CAE), social security database.

AUDIOMETRIC SCREENING FOR NEWBORNS AND CHILDREN

The WHO recommends universal hearing screening for newborns as well as systematic screening for pre-school and school children, followed by appropriate care and intervention.[187]

We report here on the proportion of newborns and of 30 month old children who participated in hearing screening, out of all resident children.

Over the last 12 years, 98.1% of registered newborns (born in Luxembourg or abroad) were screened for hearing impairment. This high participation rate remained constant over the years, ranging from 97.6% to 98.5%.[xlvii]

Between 2011 and 2022, overall 40.4% of all children that reached 30 months of age received a speech and language assessment with hearing test, ranging from 32.7% in 2014 to 46.9%

[xlvii] Coverage (%) of hearing test in newborns that were born in Luxembourg and resident newborns that were born abroad, 2011-2022.
Source: Health Directorate

in 2019. In recent years, between 5.9% and 10.7% of children were put on a waiting list due to limited testing capacity (Figure 69).

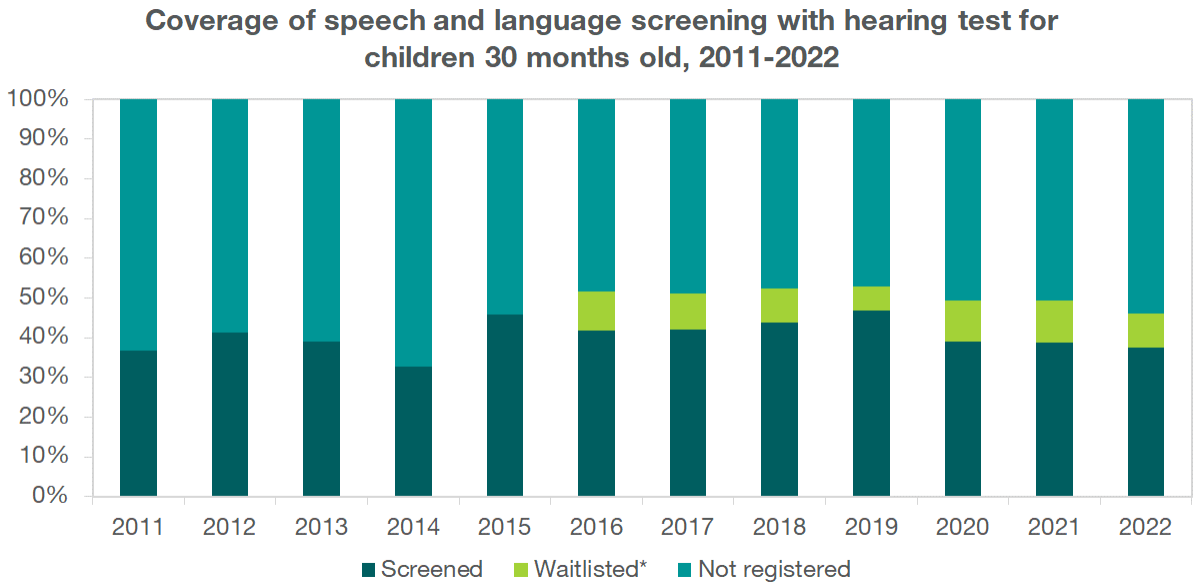


Figure 69: Coverage (%) of screening with speech and language with hearing test in resident children 30 months old in Luxembourg, 2011-2022.

Source: Health Directorate.

The school-based hearing screening programme that targets children 4 and 5 years of age was interrupted from March 2020 until September 2021 due to the COVID-19 pandemic. On average for the years 2011–2019 and 2021–2022, it covered 98.5% of registered pupils in public and private schools.[xlviii]

RECOMMENDED DENTAL VISITS

Some caries may be prevented by early detection and better oral hygiene. There is evidence of the benefits of early preventive dental visits, before the age of 3 years, in particular for children at risk of or with existing dental disease.[188]

In Luxembourg, the national health insurance fully reimburses two preventive dental visits for children in their third and fourth year (at the ages of 30–36 months and 42–48 months).[179]

To assess the proportion of children participating in these preventive visits, the corresponding billing codes were used.[xlix] To understand the extent of early childhood dental visits, preventive or otherwise, we also include children who had at least one regular visit to the dentist between 30 and 48 months of age.[l] These children might have benefitted from a preventative visit that was billed differently.

[xlviii] Coverage (%) of hearing test in 5-6 year old schoolchildren (cycle 1.2) in Luxembourg, 2011-2022.
Source: Health Directorate

[xlix] Examens dentaires des enfants âgés de 2 à 4 ans tels que prévus par la loi du 15 mai 1984 et le règlement grand-ducal du 12 décembre 1984 (art.3)

1) Examen dentaire de l'enfant âgé de 30 à 36 mois : DE2
2) Examen dentaire de l'enfant âgé de 42 à 48 mois : DE3

[l] Nomenclature des actes et services des médecins-dentistes. Consultation du médecin-dentiste : DC1

For each birth cohort from 2009 until 2019, we show the proportion of children who had a dental visit during their third or fourth year of life, and who had both visits (Figure 70). Complete data is only available for children born in or before 2018, as those born in 2019 had not yet reached the age for the second dental visit.

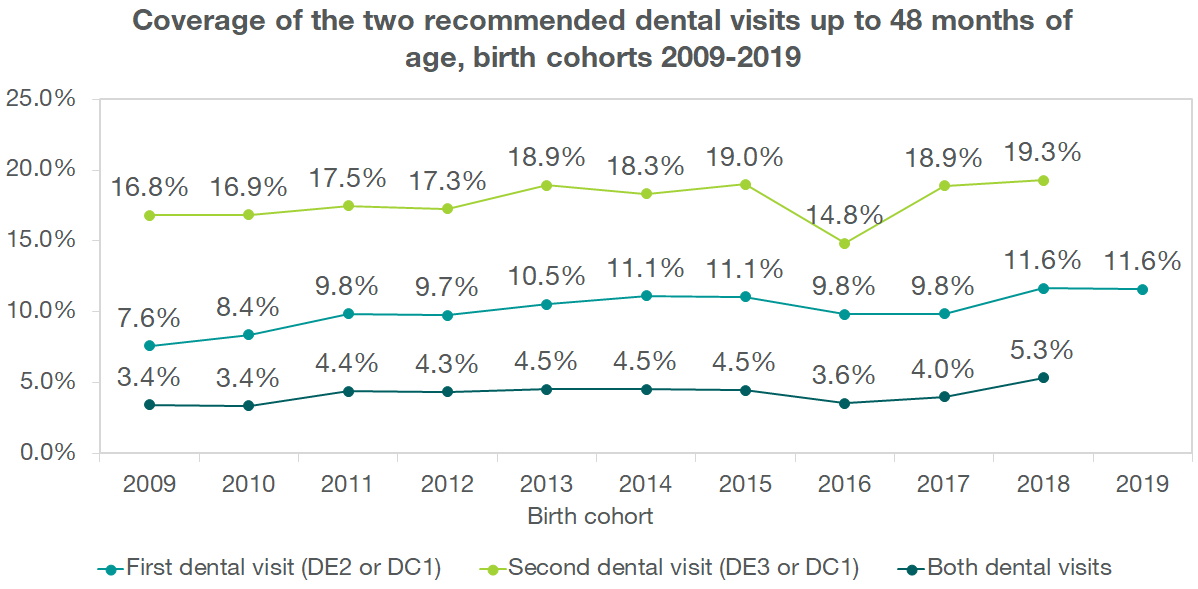


Figure 70: Coverage (%) of the two recommended dental visits among children 30 to 48 months of age, in the birth cohorts 2009-2019, Luxembourg. The indicator includes insured resident children only.

Source: Social security database. Indicator computed by ObSanté.

More children had a dental visit in their fourth year of life than in their third one. Overall, the proportion of children who had dental visits during their first four years of life remained stable. Of the children born in 2018, some 11.6% had a visit during their third year, 19.3% during their fourth and 5.3% had both visits. We found relatively lower rates for those cohorts that were eligible for a visit during 2020 (the 2017 cohort for the first visit and the 2016 cohort for the second visit), the first year of the COVID-19 pandemic.

There are also differences by migration background. In this regard, children with two parents born abroad were less likely to have had two dental checks than children with two parents born abroad were more likely not to have had two dental checks than children with at least one parent born in Luxembourg (Figure 71).

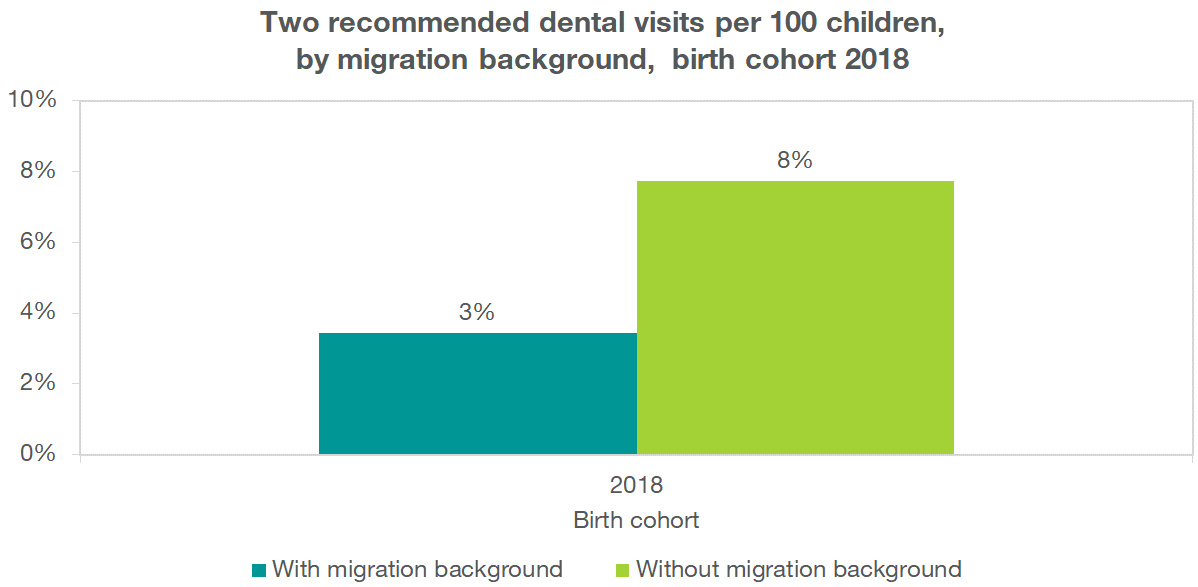


Figure 71: Coverage (%) of the two recommended preventive dental visits in insured children 2 to 4 years of age, in the 2018 birth cohort, by migration background, Luxembourg. The analysis includes insured resident children.

Source: Social security database, computed by ObSanté.

RECOMMENDED MEDICAL VISITS AT 30 TO 36 AND 42 TO 48 MONTHS

To assess the proportion of eligible children participating in well-child visits, we used the corresponding billing codes.[li] As most young children also have acute-care medical visits, only codes for well-child visits (*Examens médicaux systématiques,* systematic medical assessment) are taken into account.

For each birth cohort from 2011 to 2019, we show the proportion of children who had a medical preventive visit during their third or fourth year of life, and of those who had both visits (Figure 72).

The proportion of children participating in a medical preventive visit in their third or fourth year of life has remained stable over recent years, at 42.4%, 28.8% and 20.7% for the first, the second, and both visits, respectively, for the latest available cohort data. The slight dip observed in the participation rate for children born in 2016 (for a visit at 42–48 months) and in 2017 (for a visit at 30–36 months) corresponds to visits planned during the first year of the pandemic.

[li] Examens médicaux systématiques pour les enfants âgés de deux à quatre ans prévus par la loi du 15 mai 1984 :

1) Examen effectué entre l'âge de 30 et 36 mois par un médecin généraliste, par un médecin spécialiste en pédiatrie ou en médecine interne : E18
2) Examen effectué entre l'âge de 42 et 48 mois par un médecin généraliste, par un médecin spécialiste en pédiatrie ou en médecine interne : E19

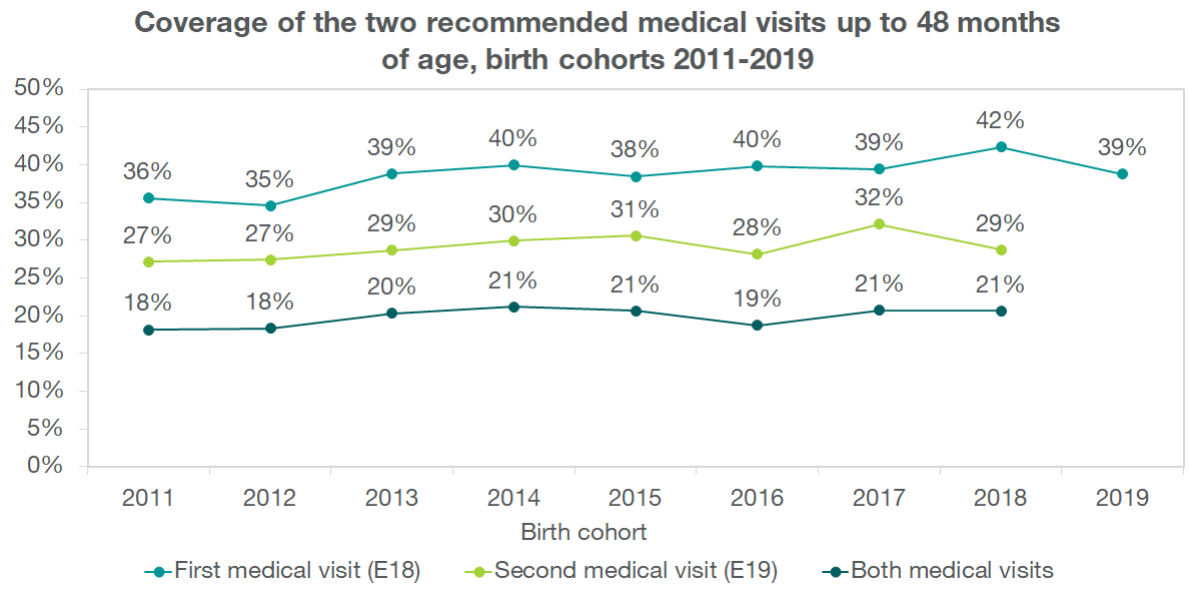


Figure 72: Coverage (%) of two recommended preventive medical visits in the birth cohorts 2011–2019. The analysis includes insured resident children.

Source: Social security database. Indicator computed by ObSanté.

Universal vaccination programme

Routine vaccination against infectious diseases is one of the most effective public health interventions to protect the population and thereby avert associated health service utilization and costs.[172] One goal of an effective health system should be to reach high child immunization rates, in order to protect children from preventable infectious diseases. The challenges to accomplishing high vaccination coverage include vaccine supply shortages, growing vaccine hesitancy and disruption to routine service provision during the COVID-19 pandemic.

VACCINATION COVERAGE AMONG CHILDREN 25–30 MONTHS OLD

In Figure 73, we show the level of vaccination coverage, defined as the percentage of children being fully vaccinated as per the national vaccination schedule for children before the age of 25 months, against 13 infectious diseases for which the national programme provides childhood immunization free of charge. The coverage was surveyed in 2018 among children 25 to 30 months.[226,227]

In 2018, coverage of children 25-30 months old ranged between 86.9% for Measles-Mumps-Rubella-Varicella (MMRV 2 doses) and 97.5% for Meningococcal C vaccine (1 dose).[227]

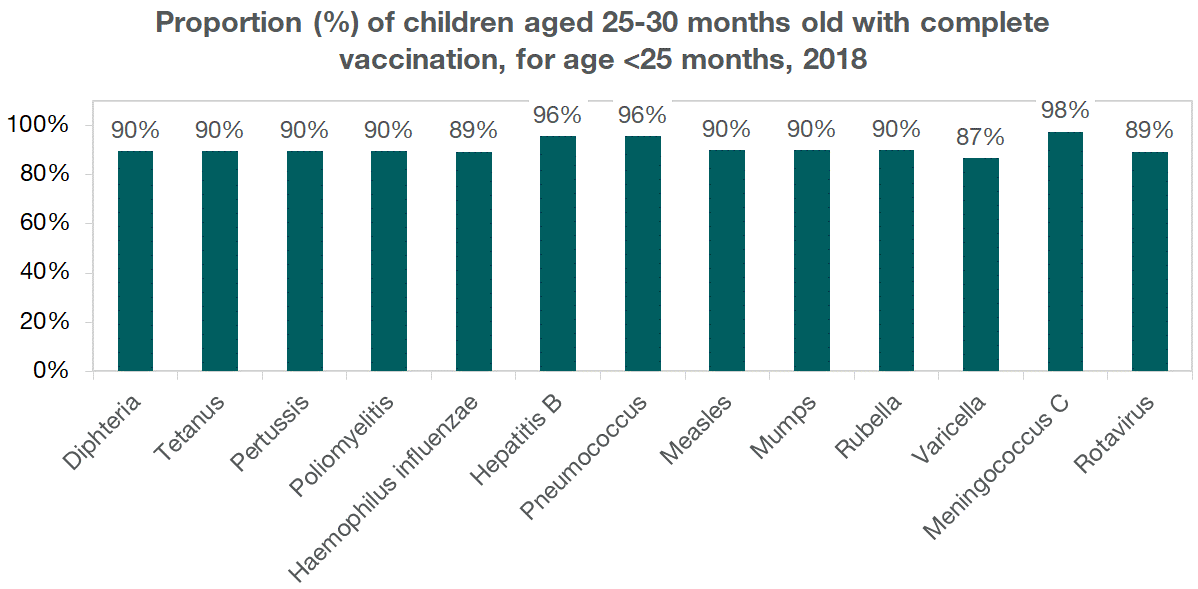


Figure 73: Proportion (%) of children aged 25-30 months old with complete vaccination as per the national vaccination schedule for children by age 2 years, 2018, Luxembourg.

Sources: Vaccination Coverage Survey 2018 by the Health Directorate[227]

Comparative estimates for vaccine coverage are available for children from the WHO database (

Table 9).[228] It shows that Luxembourg compares favourably with neighbouring countries, as well as the Netherlands and Switzerland, achieving high vaccination coverage with all recommended vaccines among 1 year old children.

Table 9: International comparison – Vaccination coverage estimates (WHO/UNICEF Estimates of National Immunization Coverage) for 1 year old children in 2022.

Note: na = not available.

Source: WHO.[228]

Vaccine	Luxembourg	Belgium	Denmark	France	Germany	Netherlands	Switzerland
DTP (3 doses)	99	98	97	96	91	93	96
Polio (3 doses)	99	98	98	96	91	93	96
Hib (3 doses)	99	97	97	96	90	91	95
HepB (3 doses)	96	97	na	95	87	88	76
MMR (1 dose)	99	96	95	94	97	89	96
PCV (3 doses)	96	94	96	95	82	90	89
Rotavirus (2 resp. 3 doses)	89	86	na	na	68	na	na

HUMAN PAPILLOMA VIRUS (HPV) VACCINATION COVERAGE

The World Health Organization recommends universal vaccination against HPV, with a target coverage rate of 90% among girls.[229] This vaccine was introduced in Luxembourg in 2008.

Since 2018, boys have also been included in the target group. Currently, the Conseil supérieur des maladies infectieuses recommends two doses of the 9-valent vaccine against HPV for girls and boys aged 9–14 years.[230]

There is no current estimate for the HPV vaccine coverage: as the vaccine has been directly available, free of charge in doctors' practices since 2019, it is no longer possible to calculate the vaccination coverage of the target population using medico-administrative data (medical prescriptions). The latest available data on HPV vaccine coverage in Luxembourg was published in 2018.[231] Out of nearly 40 000 females born between 1991 and 2003, 22 082 (55.7%) were given at least two doses of the HPV vaccine between 2008 and 2016. The highest level of coverage for two doses of the HPV vaccine was observed for the cohort born in 1998 (64.5%). Annual trends showed an increase in coverage among younger girls.

In this study, vaccine coverage was found to be associated with nationality, and higher among Portuguese and former Yugoslav girls (80% and 74% of HPV 1-dose coverage, respectively) than Belgian (52%), German (47%) or French (39%) girls.

VACCINE-PREVENTABLE DISEASE INCIDENCE AMONG CHILDREN

The incidence of vaccine-preventable diseases can be indicative of the success of vaccine delivery within a country, but may also be influenced by other factors, such as public health measures or variations in the circulation of the diseases.

Data from the national surveillance system of infectious diseases was used to assess the number of notified new vaccine-preventable disease cases among children 0–12 years old for the years 2011 to 2022.[lii] During this period, Luxembourg had no cases of diphtheria, four cases of measles, seven cases of Haemophilus influenza type b (Hib) invasive infection (all occurring in the years 2020-2022), and nine cases of Meningococcal invasive disease. Out of the nine cases, six were serotyped, and Meningococcus type C was detected in two cases.

Whooping cough (pertussis) cases were confirmed in 62 children, 38 of them being under 5 years old. The ECDC Surveillance Atlas of Infectious diseases reported average whooping cough incidence rates across Europe in 2019 of 46.6 per 100 000 children under 1 year of age, and 19.2 cases among children 1–4 years of age.[233] Luxembourg reported an incidence rate of 31.6 (<1 year of age) and 3.8 (1-4 years of age) cases per 100 000 children in 2019, which is below the EU average.[233] The incidence of whooping cough in Europe dropped considerably in 2020 and 2021, probably due to the interventions implemented to control the COVID-19 pandemic.[234,235]

MATERNAL MORTALITY

Most maternal deaths are preventable with adequate care and are closely linked to the access to and quality of health care and hospital care.[236] Over the last century, a sharp decrease in maternal mortality has been observed across the globe, but has remained a major issue in lower-income countries.[237] In Luxembourg, a sudden increase or high rates of maternal mortality would be indicative of serious problems in the health system. The effectiveness of interventions to prevent and treat maternal complications during pregnancy, labour or the

[lii] Number of notified diphtheria, measles, Haemophilus influenza type b (Hib) invasive infection, Meningococcal invasive disease cases in children 0-12 years old, 2011-2022. Up to 2019, cases from mandatory notification by physicians upon biological confirmation, except for clinical meningitis cases. Since 2020, clinical cases are reported by the physicians and biological confirmation is reported by laboratories.[232]
Source: Directorate of Health

postnatal period results in a reduction in maternal mortality, which in turn is often regarded as a good indicator of the effectiveness of a health system.[238]

Maternal mortality includes any death of a woman while pregnant or within 42 days of the termination of pregnancy—irrespective of the duration and site of the pregnancy (intra- or extrauterine implantation of a fertilised egg)—for any cause related to or aggravated by the pregnancy or its management. Deaths caused by accidental or incidental causes are excluded.[239] The relevant data was extracted from the national register of causes of deaths, and includes all maternal deaths that occurred in the territory of Luxembourg.

Three maternal deaths were registered between 2011 and 2021 in Luxembourg. This corresponds to a maternal mortality rate of 4.5 per 100 000 live births within the years 2011-2021.[liii]

A recent study on maternal mortality rates in European countries found mortality rates of 4.7 between 2014 and 2018 in The Netherlands, 8.0 between 2013 and 2015 in France and 3.4 between 2013 and 2015 in Denmark, using enhanced methods to detect maternal mortality cases.[240]

Primary care

LOW BIRTH WEIGHT

A birth weight lower than 2500 g is associated with many adverse perinatal health outcomes, including mortality, stunting and long-term chronic diseases during adulthood. It is also related to poor maternal health.[58,241] Good control and treatment of maternal risk factors for low birth weight—such as chronic diseases, hypertension or preeclampsia— as well as maternal smoking, could reduce the rate of children with low birth weight.[242,243] The prevalence of low birth weight in newborns is therefore an indicator of the effectiveness of primary care.

In European countries, the prevalence of low birth weight ranged from 4.0% in Finland to 10.1% in Cyprus in 2019, with lower proportions in northern countries, for example, 5.6% in the Netherlands.[58]

The proportion of newborns in Luxembourg with low birth weight decreased from 7.2% in 2016 to 5.8% in 2020 and 2021 (Figure 74). A similar trend has been observed in most other European countries, where the percentage of low weight births decreased slightly from 2015 to 2019.[58]

[liii] Maternal mortality rate in Luxembourg: Number of maternal deaths per 100 000 live births, within the years 2011-2021. Deaths that occurred on the territory of Luxembourg are included. For the number of live births of only residents are included. Source: National register of causes of death; STATEC. Indicator computed by ObSanté.

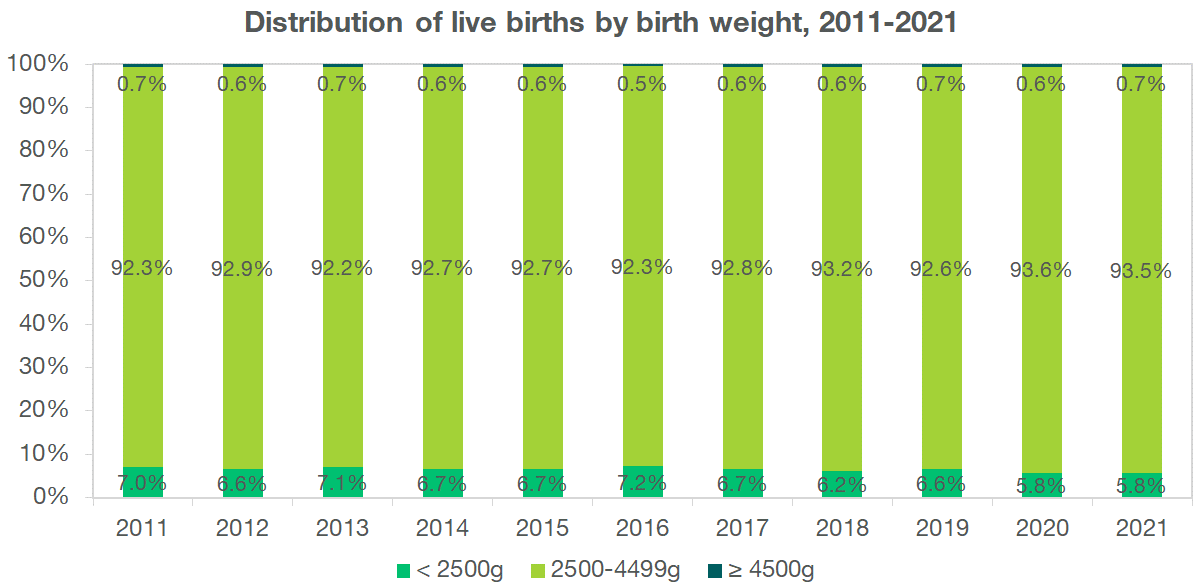


Figure 74: Distribution (%) of live births by birth weight, 2011-2021, Luxembourg.

Source: EuroPeristat for 2011-2019, PERINAT 2020-2021.

Hospital care[liv]

HOSPITALIZATION RATE AMONG CHILDREN

The hospitalization rate for children can be influenced by various factors. Effective public health interventions, primary care access and home-based services can reduce hospital admissions, while a rising child population, as well as chronic complex diseases could increase the demand for hospital-based care.[219] Moreover, seasonal and epidemic illnesses, such as gastro-enteritis, acute upper respiratory tract infections, or bronchiolitis and Respiratory syncytial virus (RSV) pneumonia, can account for a significant proportion of hospital stays.[219] This limits the extent to which hospital rates can be used to assess the effectiveness of the health system. A full assessment of the effectiveness of paediatric hospital care must therefore consider other factors, including the reason for the admission, any patient co-morbidities, the outcome and the length of stay. This will be carried out as part of the next *Carte sanitaire* in 2023, which will more extensively assess the performance of hospital care for children. The main causes for hospitalizations among children are described in the Chapter 2.2 Physical health status, (Figure 33).

The hospitalization rates presented in Table 10, should therefore only be used as a general indication of hospital use among children. The table shows the rate of hospitalizations per 1000 resident children 0-12 years old. Hospitalization rates decreased over time, from 136.6 admissions per 1000 children in 2012 to 94.1 in 2022. The proportion of hospitalisations without overnight stay among the total admissions remained stable over the whole period.

Compared with other age categories across childhood, children below the age of 12 months usually have the highest hospitalization rate.[220] This is also true in Luxembourg, where the

[liv] Hospital effectiveness is only partially assessed in this section, as a more thorough analysis will be presented in the 2023 edition of the Carte sanitaire.

admission rate of children 0–11 months old ranged from 178.8 per 1000 children to 281.3 over the whole period, as shown in

Table 11. In this age range, the proportion of hospitalizations without overnight stay was 9% in 2022.

A study on hospitalization rates among children and adolescents in seven European countries reported wide variations in admissions per 1000 children and adolescents aged 0–19 years in 2009–2012, with values ranging from 94.1 (Spain) to 195.9 (Germany).[244] However, due to methodological variations in assessing the hospitalization rates across countries and regions, it is currently difficult to make international comparisons with the admission rates in Luxembourg.

Table 10: Number of hospitalizations, per 1000 children 0-12 years old, by type of stay, 2012-2022, Luxembourg. Hospitalisations of resident insured children are included.

Source: Social security database. Indicator calculated by the ObSanté.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total number of hospitalizations / 1000 children 0–12 years	136.6	127.5	118.3	124.4	115.8	109.8	107.7	107.4	74.9	83.3	94.1
Number of hospital stays without overnight stay / 1000 children 0–12 years	78.6 (58%)	72.9 (57%)	68.3 (58%)	76.3 (61%)	66.6 (58%)	61.4 (56%)	60.8 (56%)	61.8 (58%)	41.5 (55%)	48.6 (58%)	51.1 (54%)
Number of hospital stays with overnight stay / 1000 children 0–12 years	58.0 (42%)	54.6 (43%)	50.0 (42%)	48.2 (39%)	49.2 (42%)	48.4 (44%)	47.0 (44%)	45.6 (42%)	33.4 (45%)	34.7 (42%)	43.0 (46%)

Table 11: Number of hospitalizations, per 1000 children 0-11 months old, by type of stay, 2012-2022, Luxembourg. Hospitalisations of resident insured children are included.

Source: Social security database. Indicator calculated by the ObSanté.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total number of hospitalizations / 1000 children 0-11 months	281.3	246.8	242.5	257.9	265.2	280.7	264.1	256.7	210.6	178.8	250.8
Number of hospital stays without overnight stay / 1000 children 0-11 months	27.6 (10%)	25.7 (10%)	19.6 (8%)	21.2 (8%)	19.8 (7%)	25.7 (9%)	18.0 (7%)	20.5 (8%)	13.5 (6%)	15.6 (9%)	21.4 (9%)
Number of hospital stays with overnight stay / 1000 children 0-11 months	253.7 (90%)	221.1 (90%)	222.8 (92%)	236.7 (92%)	245.4 (93%)	255.1 (91%)	246.1 (93%)	236.2 (92%)	197.1 (94%)	163.2 (91%)	229.4 (91%)

DISTRIBUTION OF APGAR SCORE AT 5 MINUTES

The Apgar score is an assessment that is systematically used to assess newborns at 1, 5 and 10 minutes after birth. It was designed to help health care providers assess a newborn's overall physical condition so that they can rapidly decide if the baby needs immediate medical care.[245]

The Apgar scoring system is divided into five categories: heart rate, respiratory rate, muscle tone, reflexes and appearance (colour). Each category is given a score of 0 to 2 points. At most, a child will receive an overall score of 10; a score between 7 and 10 at 5 minutes is reassuring. A score of 4 to 6 is 'moderately abnormal' and a score of 0 to 3 is concerning. The lower the Apgar score, the higher the risk of death and/or disability in the absence of medical intervention. However, the value of the Apgar score at 5 minutes has not been found to predict babies' long-term health, behaviour or outcomes.[245]

Here, we show the proportion of newborns with an Apgar score below 7 after 5 minutes, which is considered as a reflection of the effectiveness of care given to the mother and newborn before and during delivery, and in the first moments of life.[245]

Between 2011 and 2021, the rate of newborns scoring below 7 ranged from 8 to 17 per 1000 babies, while the rate of newborns scoring 0–3 was stable, ranging from 1 to 4 per 1000 babies (Figure 75).

Large variations in the distribution of Apgar scores are likely to be due to national scoring practices, make the Apgar score an unsuitable indicator for benchmarking newborn health across countries.[246] For this reason, no international comparisons are displayed here.

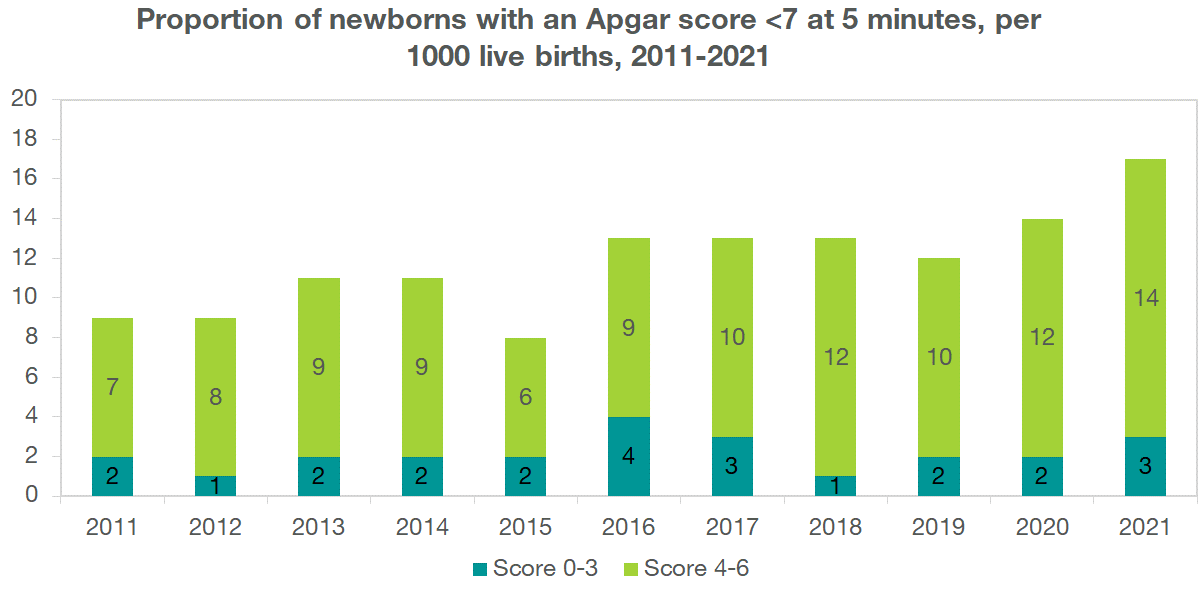


Figure 75: Proportion (‰) of newborns with an Apgar score <7 at 5 minutes, per 1000 live births in Luxembourg, 2011-2021.

Source: PERINAT.

Conclusions on effectiveness

We found that public health services for prenatal and postnatal care, as well as well-child visits, reach almost the entire target population, especially if the services are promoted and carry monetary incentives. Similarly, services provided at the point of care, such as the neonatal hearing screening performed for most neonates during their stay on the maternity wards, are reaching their target population. Potentially as a result of the high attendance rates for the well-child visits before the age of 2 years, Luxembourg also achieves high vaccine coverage rates of above 90% for all recommended vaccines among children aged 25–30 months. A lack of suitable data currently prevents the assessment of vaccine coverage for children above the age of 30 months, including up-to-date information on HPV vaccine coverage. More structured data collection at school medical visits, which assess vaccinations records for pupils, or the systematic use of the electronic vaccination record, could help to cover the existing gap in data in the future.

Programmes that do not carry a financial reward, or are not embedded in the provision of other services, have much lower participation rates. Fewer than half of all children at the age of 30 months participated in the speech and language screening with hearing test and the recommended preventive medical visit, and even fewer in the recommended dental visit during the third year of life. The same was true for children between 42–48 months, where fewer than 25% had a preventive medical or dental visit.

The effectiveness of primary care can be assessed using indicators that measure the frequency of conditions that are, at least partially, avoidable through good primary care, such as low birth weight or maternal and child mortality (see section 2.1 Mortality). The developments were positive overall, with decreasing rates of low birth weight and maternal mortality. Hospital admission rates for children also decreased over the past decade, which could indicate more effective primary care able to prevent hospitalizations. However, further analysis is needed to determine the reasons for of this decrease, as other factors could also result in fewer hospital admissions.

In terms of hospital care, neonatal mortality (see Section 2.1 Mortality), which was stable at low rates, could be a result of effective prenatal and intrapartal care, including the timely detection of congenital anomalies and the prevention of prematurity. Effective and safe neonatal (intensive) care may also have contributed to the low neonatal mortality rate. However, specific analyses are needed to understand the underlying drivers.

3.2 Access to care

Access is defined as the extent to which services are available and accessible to potential users in a timely and affordable manner.[247,248]

This section investigates the access to Luxembourg's health services, taking into consideration health services provided in primary care and in hospitals.

Main results:

- In 2022, 82% of women received postnatal home midwife visits.
- Women from higher-income households had higher levels of at-home midwife visits, while women from lower-income households had the lowest levels of visits.
- Maternity wards can be reached by car within 30 minutes at peak traffic time (8 a.m.) for 82.5% of women of childbearing age. However, for people without a car and living further from cities, this can be a challenge.
- Some 94.5% of children 0–12 years old have a paediatric practice within 10 km of their home.
- Out-of-hours paediatric consultations represent an alternative to emergency department visits in evenings and at weekends.
- The use of hospitals outside the country is relatively limited.

USE OF AT-HOME MIDWIFE VISITS

One indicator used to assess access to primary child healthcare is the proportion of women receiving postnatal midwife home visits. Home visits after childbirth help prevent complications associated with hospitalization, such as nosocomial infections. In addition, they enable early detection of medical complications for mothers and newborns, aligning with WHO recommendations.[249]

As part of planned postnatal care in Luxembourg, midwives record their observations and remarks in each child's health record, ensuring the continuity of comprehensive care. Women have the option of postnatal home care, covering 15 days after childbirth, or complex postnatal home care, lasting 21 days after delivery.[250] As of October 2023, some 55 self-employed midwives were providing services, distributed throughout the country.[251]

To calculate the indicator, reimbursement data from midwife services covering 15 or 21 days after delivery were considered. However, it should be noted that these visits could only be identified after 1 April 2022, as the specific nomenclature codes were only introduced recently. The denominator of this indicator includes all insured resident women who gave birth in Luxembourg in the last 9 months of 2022.

The indicator highlights women using postnatal home midwife visits based on household income quintiles (Figure 76). It shows that the use of home midwife services increases in line with household income, where fewer than two-thirds of women in households in the lowest income quintile use the service compared with over 90% in the two highest income quintiles.

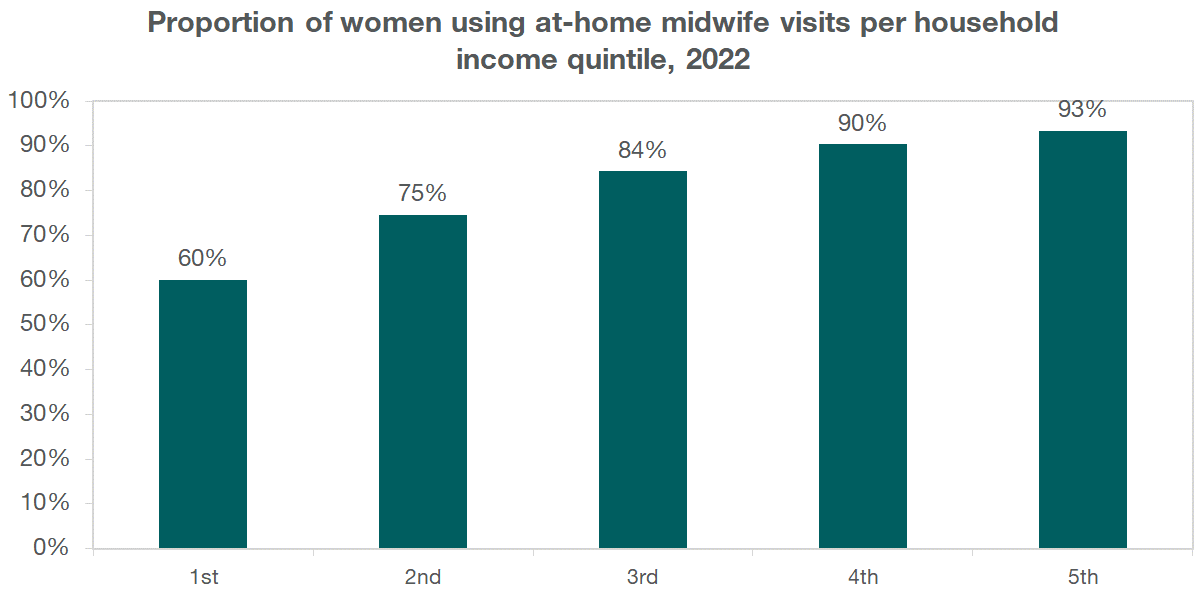


Figure 76: Proportion (%) of women using at-home midwife visits per household income in 2022, Luxembourg. First quintile: lowest income, fifth quintile: highest income. Resident insured women are included.

Source: Social security database.

ACCESS TO CARE PROVIDERS

According to the results of the 2019 European Health Interview survey (EHIS), distance or transportation issues are reported to be one reason for reduced health care seeking in Luxembourg and elsewhere.[252] For children, paediatricians are normally the first point of contact with the health system, but accessing them may be more difficult for children living far away from the nearest paediatric practice.

In this indicator, we explore the distance children in Luxembourg have to travel in order to access the nearest paediatric practice.[lv]

Figure 77 shows the spatial distribution of paediatricians in Luxembourg (left-hand map), and (right hand map) the distance (as the crow flies) between children 0 to 12 years old and the nearest practice, categorized as within 5 km (green), from 5 to 10 km (blue) or more than 10 km (red). A darker colour indicates a more densely populated area. The left part of the Figure 77 highlights that most paediatric practices are located in the south or central part of Luxembourg, in particular, close to Luxembourg City. Only a few are located in the northern, northwest and eastern regions of the country. However, mapping the location of paediatricians to the distribution of children in the country shows that despite the unequal geographic distribution of paediatricians, 94.5% of children live within 10 km of their closest paediatric

[lv] The measurements are the 'as the crow flies' distance from each square kilometre centre to the nearest healthcare professional. The GISCO-Eurostat grid was used to define the 1 km^2 geographical units on which the analyses are based. The target population data was provided by the National Register of Natural Persons (RNPP). The data was received as population data aggregated by geographical unit using the geolocated address database of the Land Registry and Topography Administration, guaranteeing the anonymity of the persons concerned while enabling quantitative studies of the density of selected target populations in 2023, for each geographical unit. The professional addresses of healthcare providers, already publicly available, were supplied by the Agence eSanté in an assembled form.

practice (Table 12). The 5.5% of children who live further than 10 km away are spread across the northern and northwest regions.

Distribution and access to paediatrician practices in 2022

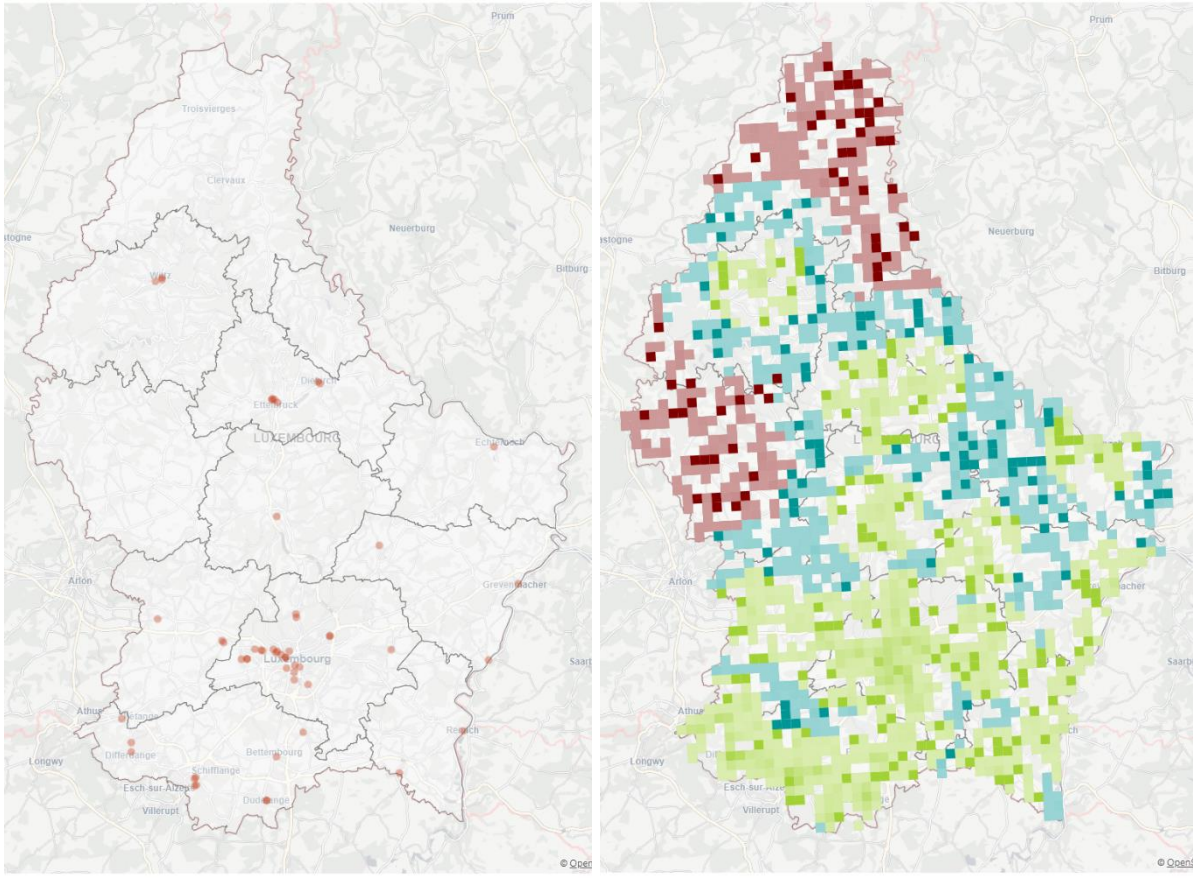


Figure 77: Distribution of paediatric practices in Luxembourg (left) and distance (as the crow flies) between children 0-12 years old and the closest paediatrician,2022. <=5 km (green), >5 and <=10 km (blue), and >10 km (red). A denser colour indicates an area that is more densely populated by children.

Source: eSanté.lu; RNPP 2023. Computed by ObSanté.

Table 12: Distribution (%) of resident children 0-12 years old according to the distance (as the crow flies) to the nearest paediatric practice in Luxembourg, 2022.

Source: eSanté.lu ; RNPP. Computed by ObSanté.

Distance to nearest paediatric practice	% of Children 0-12
<= 5 km	80.8%
> 5 and <= 10 km	13.7%
> 10 km	5.5%

CONSULTATIONS AT THE NATIONAL PAEDIATRIC ON-DUTY MEDICAL CENTRE

To provide a picture of the access to paediatric consultation outside regular office hours in Luxembourg, we used the number of monthly visits in 2022 to the national paediatric on-duty medical centre (Maison médicale pédiatrique de garde) located adjacent to the national paediatric emergency department.[lvi]

While a complete assessment of the access to out-of-hours paediatric consultations should include other factors as well as a combined analysis of the activities of both the on-duty medical centre and emergency department, Figure 78 shows that the number of paediatric medical centre visits fluctuated between February and December of 2022. Visits peaked in March (n=1330) and slowly decreased during spring, with the lowest number of visits in August (n=495). The number rose again in autumn, peaking at 1431 visits in December.

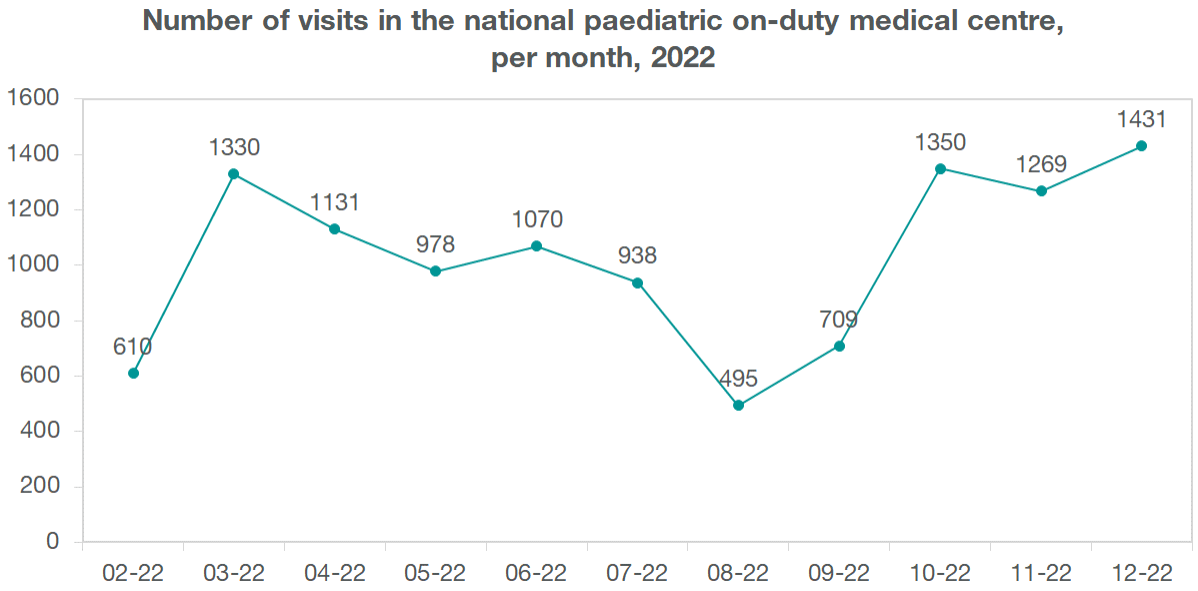


Figure 78: Number of medical visits in the national paediatric on-duty medical centre (Maison médicale de garde pédiatrique) in Luxembourg Centre, by month, February to December 2022. Count of single visits of children aged 0-18 years old.

Source: Health Directorate.

Unmet needs

Measuring unmet needs in healthcare is vital for identifying and addressing gaps in care, ensuring equitable access to services, and ultimately improving health outcomes for all children. People who forgo necessary healthcare when they need it may jeopardize their health. Disparities in unaddressed healthcare needs can also lead to diminished health and can worsen disparities in health outcomes.[253] Data from the SILC study (see the Data sources section) was used to investigate unmet medical need in Luxembourg.[253] The survey includes a self-reported health perception component, which encompasses unmet needs for medical and dental care for children living in the household.

[lvi] Up to 2022, only the national paediatric on-call medical centre had the capability to track the number of paediatric primary care consultations. Consultations with patients in the target age group (0–18 years) may have taken place at other on-call medical facilities, but are not specifically identified as paediatric consultations.

CHILDREN WITH UNMET DENTAL CARE NEEDS

Figure 79 illustrates the proportion of children aged 0–15 years for whom unmet needs for dental care were reported, by household income in 2021. Overall, the unmet needs for dental care were very low in Luxembourg compared with other countries. Further, no pronounced differences exist related to household incomes.

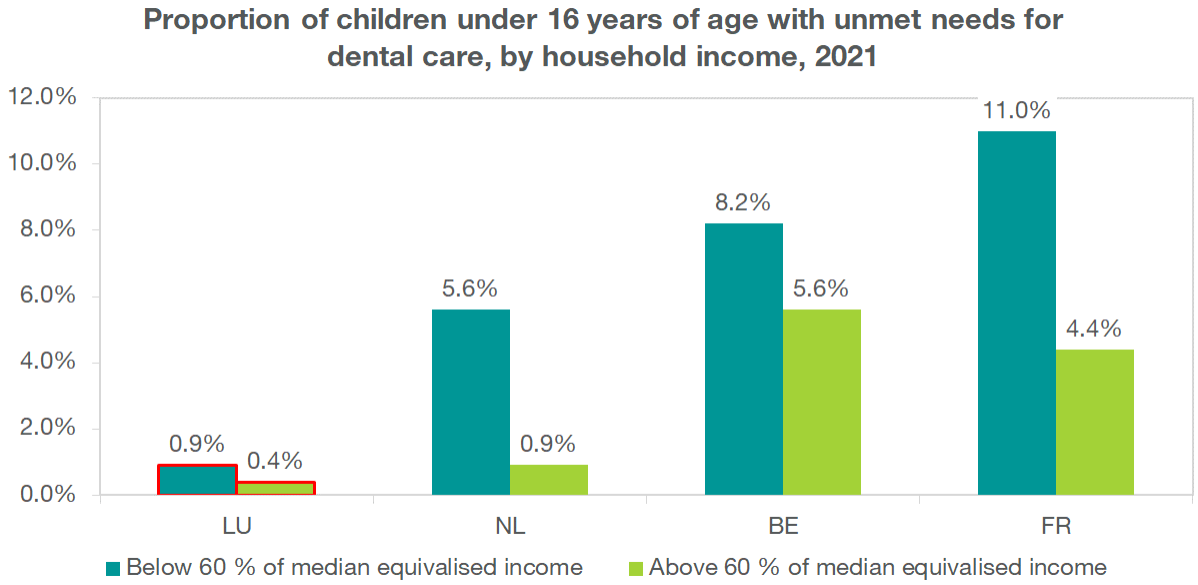


Figure 79: International comparison – Proportion (%) of children below 16 years with unmet needs for dental care, by household income, 2021.

Source: EU-SILC.

CHILDREN WITH UNMET MEDICAL NEEDS

Figure 80 shows the results for the unmet needs for medical care by household income in 2021. Similar to the position for dental care, unmet needs for medical care were very low in Luxembourg compared with its neighbouring countries and the Netherlands.

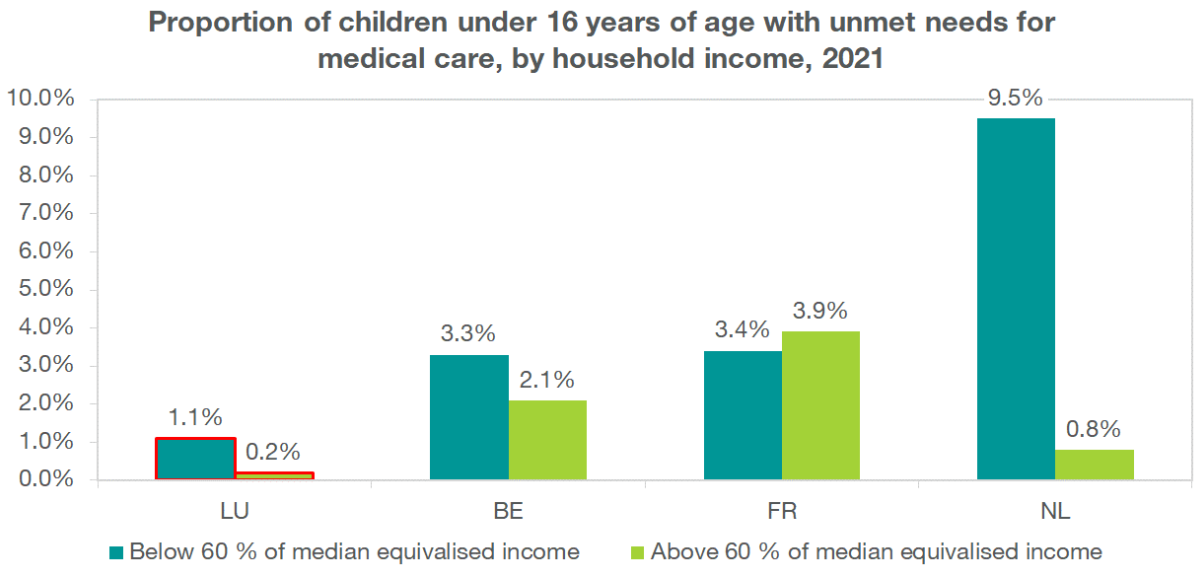


Figure 80: International comparison – Proportion (%) of children below 16 years with unmet needs for medical care, by household income, 2021.

Source: EU-SILC.

Hospital sector

This section investigates the access for children and their caregivers to services offered at hospitals. Hospitals are of particular importance for the delivery of a child, and then later on to provide specialized care or surgical procedures that cannot be offered elsewhere.

The main focus of this section is on the accessibility of hospital services for pregnant mothers and newborns. The section then also reports on the proportion of hospitalizations outside of Luxembourg for children living in Luxembourg. Luxembourg does not offer certain highly-specialized care, making it necessary to seek care outside of the country.

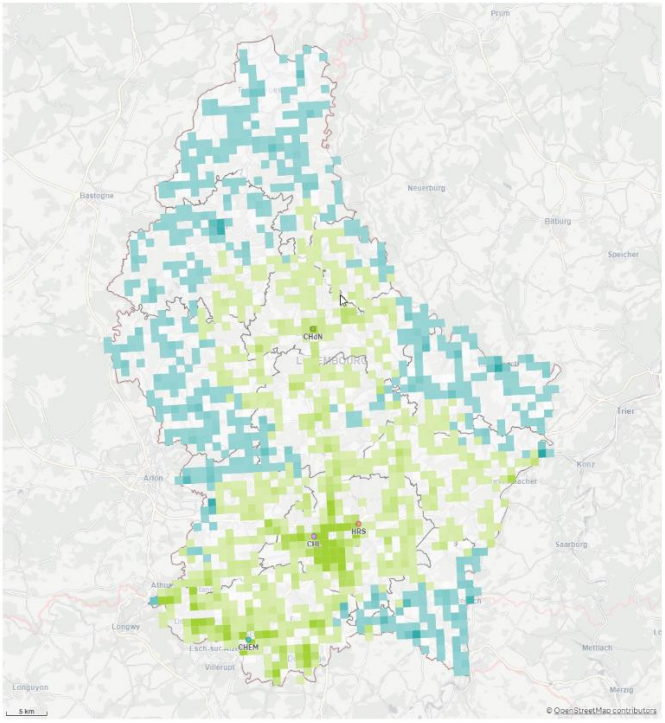
TRAVEL TIME TO NEAREST MATERNITY WARD BY CAR

The travel time to a maternity ward is important for all potential mothers in terms of receiving timely care. Long travel times may lead to unplanned out-of-hospital births that could negatively affect child and maternal health outcomes.[254,255]

The Luxembourg Observatoire de la mobilité provided us with travel times by car for peak hours, with an arrival time defined as 8 a.m. at the nearest maternity ward. We overlaid this with the spatial distribution of women aged 15–49 years in 2023 in Luxembourg, to estimate the time women in child-bearing age need to reach the nearest maternity ward. Figure 81 shows the spatial distribution of travel time by car for women needing less than 30 minutes (green), 30 to 60 minutes (blue) and more than 60 minutes (red).

Travel times exceeding 30 minutes at 8 a.m. are primarily in the north, northwest and northeast of Luxembourg. When using a car, 82.5% of women aged 15-49 years can reach a maternity ward within 30 minutes, 17.5% within 60 minutes and none need longer than 60 minutes.

Distribution and access to nearest maternity ward, 8 a.m., 2023



Travel time by car	% of Women
< 30 min	82.5%
30-60 min	17.5%
> 60 min	0%

Figure 81: Travel time by car to access maternity wards in Luxembourg (left) for women aged 15–49 years, 2023. <30 min (green), >30 and <=60 min (blue) and >60 min (red). A denser colour indicates an area that is more densely populated by women 15–49 years. Travel time was used for peak hours, with an arrival time defined as 8 a.m at the nearest maternity ward.

Distribution (%) of resident women aged 15–49 years according to the travel time to the next maternity ward in Luxembourg, 2023.

Source: eSanté.lu, computed by ObSanté.

TRANSFER OF NEWBORNS TO OTHER HOSPITALS

To guarantee that high risk newborns or preterm infants receive the necessary neonatal expert care immediately after birth, good clinical practice recommends moving both the mother and the unborn baby (*in utero* transfer) to a specialized neonatal facility in concert with neonatal experts before the actual birth.[256] Extremely preterm babies have better long-term health outcomes when born in a specialized maternity facility.[257] However, high-risk pregnancies and newborns are sometimes not identified in advance, leading to birth in a non-specialized facility. To approximate the proportion of preterm and at-risk newborns born outside a specialized facility, we used the proportion of newborns that required transfer to another national or international facility after birth. To guarantee that preterm infants receive the necessary neonatal expert care immediately after birth, good clinical practice recommends moving both the mother and the baby to a maternity with a specialized neonatal facility in concert with neonatal experts before the actual birth.[256] However, high-risk pregnancies and newborns are sometimes not identified in advance, leading to birth in a non-specialized facility. To approximate the proportion of preterm and at-risk newborns born outside a specialized facility, we used the proportion of newborns that were transferred to another national or international facility after birth.

The results presented in Figure 82 are based on PERINAT data, and show that over the observation period from 2011 to 2021, the proportion of transferred newborns was stable at

around 6–7%. Among these newborns, fewer than five were transferred to a specialized facility abroad between 2011 and 2021 (less than 0.1% of all transfers).

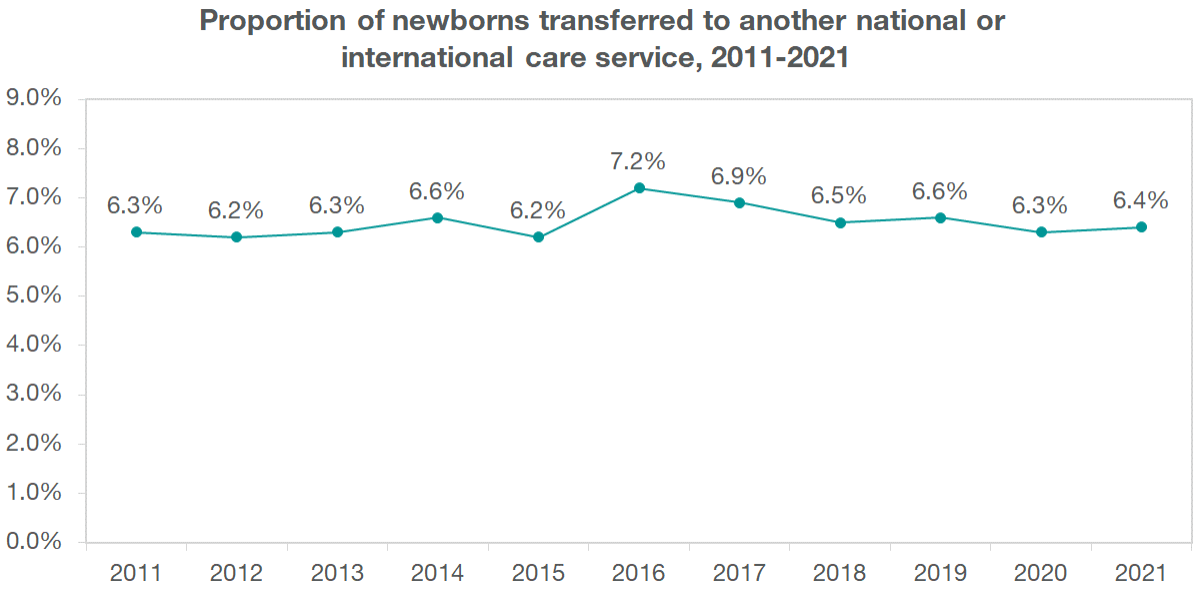


Figure 82: Proportion (%) of newborns born in Luxembourg transferred to another national or international care service, 2011-2021.

Source: PERINAT.

HOSPITALIZATIONS OF CHILDREN OUTSIDE OF LUXEMBOURG

For rare or complex care requiring specialized expertise, technologies or equipment, or in the event of saturated domestic hospital capacity, children may have to be admitted to hospitals abroad.

The number of children aged 0–12 years with hospital admissions outside of Luxembourg is defined by the number of children admitted overnight (once or several times) in a hospital abroad. Between 2011 and 2019, the proportion of resident children having been hospitalized abroad was stable at about 5 per 1000 children. The observed decrease in 2020 and 2021 is likely to have been associated with the COVID-19 pandemic (Figure 83).

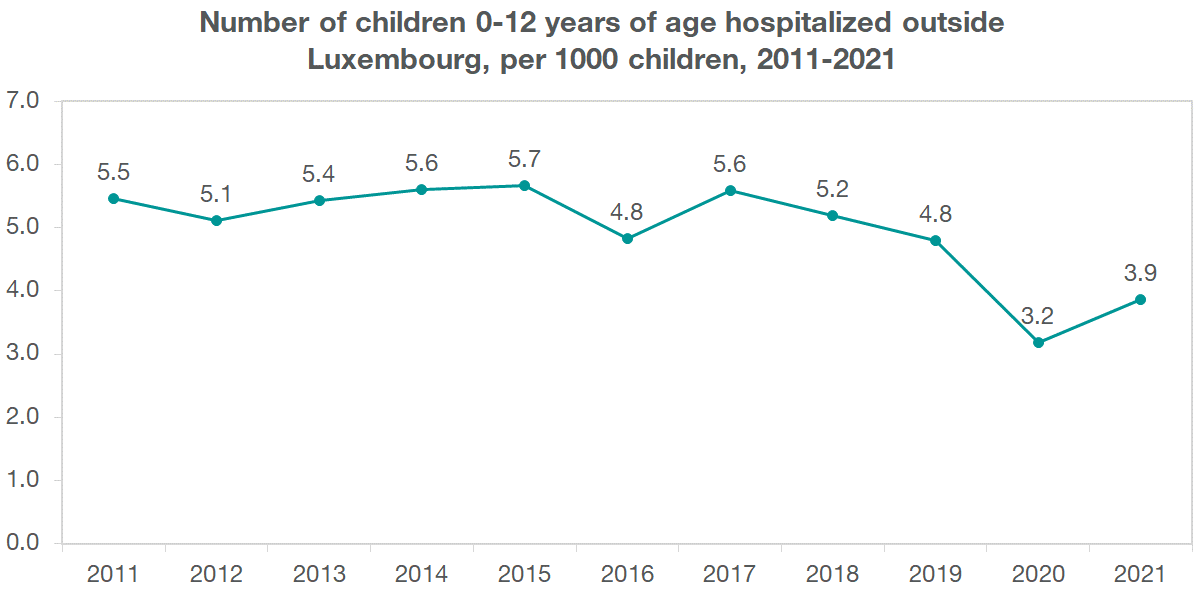


Figure 83: Number of children 0–12 years old hospitalized (once or more often) outside Luxembourg, per 1000 children 0–12 years, 2011–2021. Insured resident children are included.

Source : Social security database.

Conclusions on access to care

This chapter has analysed a variety of indicators assessing access to healthcare at the levels of primary care and hospitals.

In 2022, 82% of women received postnatal home midwife visits. Overall, most pregnant women in Luxembourg can access maternity wards within 30 minutes. Women living in the north, northeast and northwest need the longest amount of time to reach a maternity ward (more than 30 minutes). In terms of accessing paediatric practices, only people living in the north of the country have to travel more than 20 km to reach a paediatrician. This indicates that, at least in terms of distance and travel time, paediatric practices and maternity wards can be relatively easily reached.

Lastly, the use of hospitals outside the country is relatively limited, suggesting that most of the needed services can be accessed within the country.

Overall, the territorial accessibility of primary and hospital care in Luxembourg is good, based on the indicators used.

3.3 Safety of care

Ensuring safety of care is crucial for an effective and operational healthcare system. It involves deliberate measures to prevent the risk of unnecessary harm associated with the provision of healthcare services.[14] In this section, we explore the safety aspect within Luxembourg's healthcare services, encompassing both primary care and hospital-based services.

Main findings:

- The consumption of antibacterials for systemic use at the community level is increasing again in the post-pandemic period.
- The proportion of broad-spectrum antimicrobials in overall antimicrobial use has increased since 2020.
- There was a minor rise in adverse event declarations due to medication use among children aged 0–12 years from 2011–2020.
- Of the 74 medication-related adverse events declared, 30 relate to vaccines.
- The proportion of premature infants born in maternity facilities with neonatal intensive care rose from 36.7% in 2011 to 57.9% in 2021.

Primary care

PRESCRIPTIONS OF ANTIBACTERIALS FOR SYSTEMIC USE (AT THE COMMUNITY LEVEL)

The consumption of antibacterials for systemic use (the main antimicrobial groups relevant to the occurrence of antimicrobial resistance (AMR) in pathogenic bacteria from humans) is an important indicator for the prevention and control of (AMR).[258]

Antimicrobial use is a lifesaving intervention, as bacterial infections such as pneumonia, neonatal sepsis and gastrointestinal infections can severely affect the health of children. The appropriate use of antimicrobials is nevertheless very important to maintain the effectiveness of these drugs by preventing the development of bacteria resistant to antimicrobials and limiting the potential health problems associated with antimicrobials.[259,260]

To describe the use of antibacterials for systemic use at community level (outside hospitals) for children in Luxembourg, the number of reimbursed prescriptions of antibacterials for systemic use per 1000 resident children was calculated and disaggregated by age group.[128] [lvii]

In 2022, the rate of antibacterial prescriptions for children aged 0–4 years (1147 per 1000 children) was more than twice as high as for children 5–12 years old (437 per 1000 children) (Figure 84). From 2011 to 2019, the number of prescriptions per 1000 children decreased in both age groups, by 36% for 0–4 year olds and by 39% for 5–12 year olds. In 2020, prescriptions reached their lowest level, which is likely to have been as a result of the measures to curb the COVID-19 pandemic, but subsequently rebounded to levels similar to those in 2019.[262,263] The same pattern for 2020-–2022 is observed in other countries.[263,264]

[lvii] The Defined Daily Dose (DDD) is the assumed average maintenance dose per day for a drug used for its main indication in adults and is a gold standard measuring unit for international drug utilisation research.[128] Currently, there is no standard measurement for daily doses among children.[261]

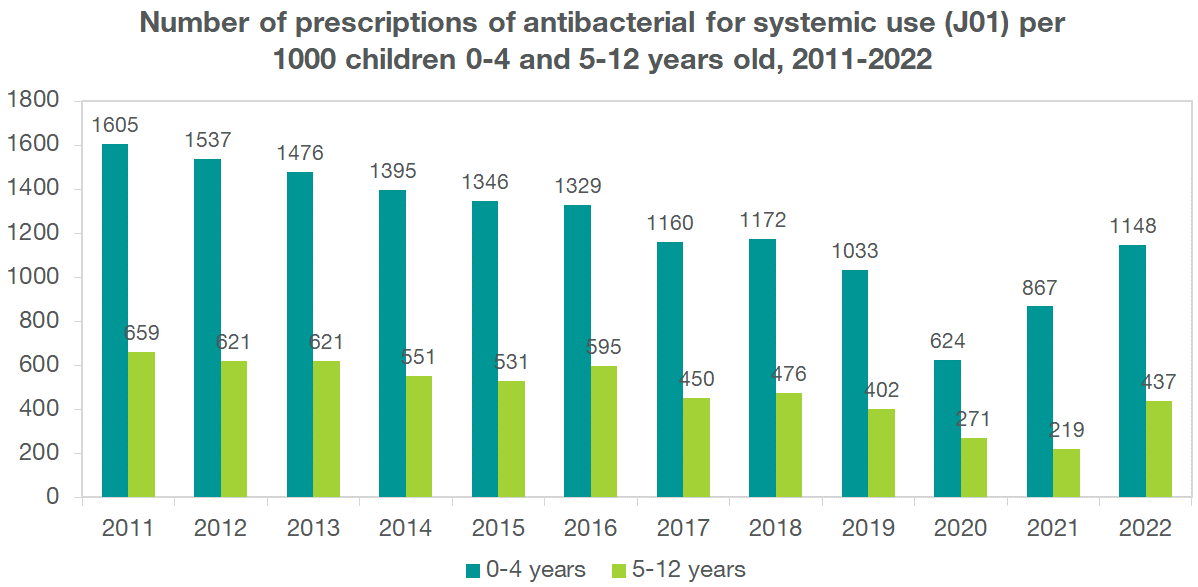


Figure 84: Number of prescriptions of antibacterials for systemic use per 1000 children 0–4 and 5–12 years old, 2011–2022, Luxembourg. Antibacterials for systemic use were grouped according to ATC classification system by WHO.[128] Prescriptions to insured resident children were included.

Source: Social security database.

RATIO OF BROAD-SPECTRUM TO NARROW-SPECTRUM ANTIMICROBIAL USE (AT THE COMMUNITY LEVEL)

Antimicrobials with a broad spectrum are often preferentially used. Their overuse can nevertheless be problematic, as broad-spectrum antimicrobials have a greater potential to cause bacterial resistance compared with more targeted narrow-spectrum equivalents.[265]

The ratio of broad-spectrum antimicrobials to narrow-spectrum antimicrobials use in the community is an established indicator to assess trends of antibiotics use over time. A decreasing ratio indicates that the relative use of narrow-spectrum antimicrobials is increasing, reducing the risk of the development of antimicrobial resistance.[258]

The indicator is calculated using the ratio of the consumption of broad-spectrum penicillins, cephalosporins, macrolides and fluoroquinolones to the consumption of narrow-spectrum penicillins, cephalosporins and macrolides in the community (excluding hospital care), based on defined daily dose (DDD) [lviii] per 1000 resident children (0–4 and 5–12 years old).

In 2022, for children 0–4 years old the consumption of broad-spectrum antibiotics was 13.8 times higher than the consumption of narrow-spectrum antibiotics for children 0–4 years old. For children 5–12 years old, the figure was 26.9 times higher (Figure 85). A notable increase in the ratio can be seen since 2020. The same tendency towards broad-spectrum antibiotics use has been described in Italian paediatric primary care settings during the COVID-19 pandemic.[266] No similar shift towards broad-spectrum antibiotics to treat infections at the primary care level has been observed for the overall population of Luxembourg.[263]

[lviii] The Defined Daily Dose (DDD) is the assumed average maintenance dose per day for a drug used for its main indication in adults and is a gold standard measuring unit for international drug utilisation research.[128]

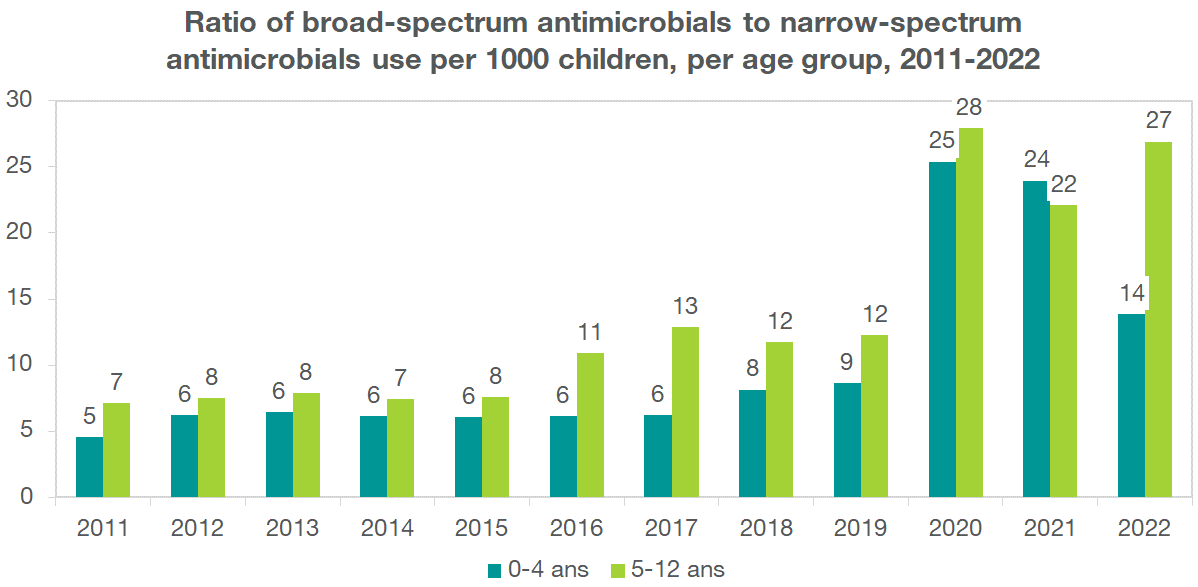


Figure 85: Ratio of consumption of broad-spectrum penicillins, cephalosporins, macrolides (except erythromycin) and fluoroquinolones expressed in DDD per 1000 children (0–4 and 5–12 years old) per day to the consumption of narrow spectrum penicillins, cephalosporins and macrolides expressed in DDD per 1000 children (0–4 and 5–12 years old) per day, in primary care. Prescriptions to resident insured children are included.

Source: Social security database. (Indicator based on ECDC, EFSA and EMA Joint Scientific Opinion[258])

ADVERSE EVENTS IN MEDICATION USE

Pharmacovigilance plays a crucial role in ensuring the safe and effective use of medications within a healthcare system. Its primary objective is to monitor and manage potential risks associated with pharmaceutical products to ensure patient safety.[267–269]

To assess the medication-related adverse events among Luxembourg children aged 0–12 years between 2011 to 2022, we used data from the European database Eudravigilance.

In total, 74 adverse event declarations were reported from 2011 to 2022. These declarations were predominantly filed by physicians (69%), followed by pharmacists (12%), other healthcare professionals (11%) and patients themselves (8%). Out of all the declarations, 41% referred to children aged 0–23 months.

Figure 86 illustrates the increase in adverse event reports from 2011 to 2022 among children aged 0–12 years. The most frequently reported types of drugs in these declarations were non-COVID vaccines (n=30), followed by COVID vaccines (n=7) and antiepileptic drugs (n=5).

Based on EudraVigilance data, similar to other countries, Luxembourg recorded a relatively small proportion of adverse events among children.

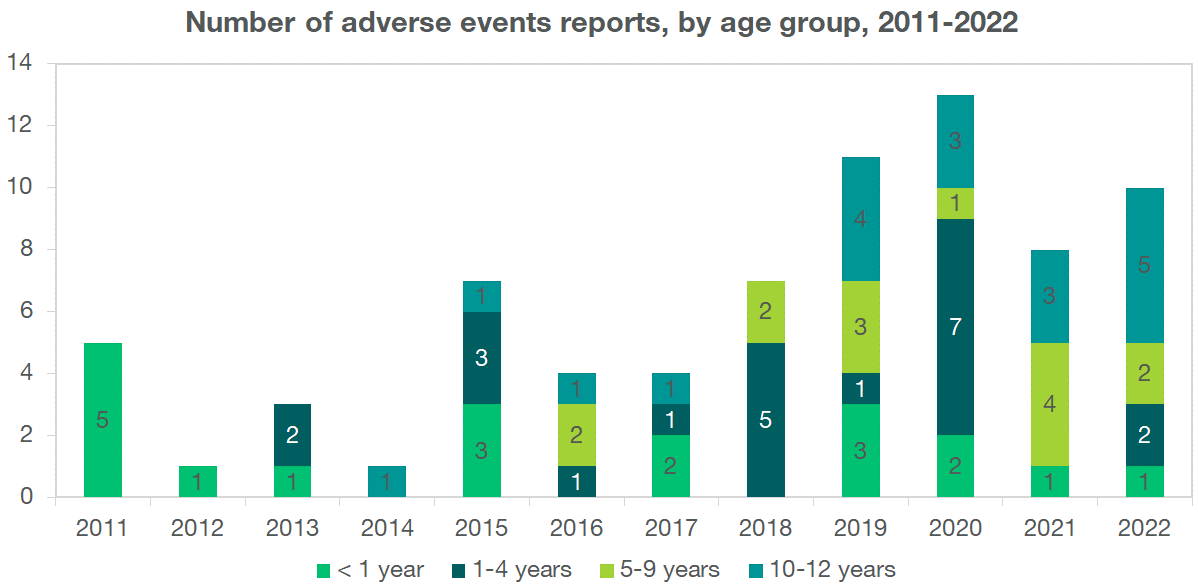


Figure 86: Number of adverse event reports among children aged 0–12, by age group, 2011-2022, Luxembourg.

Source: Health Directorate.

Hospital

PREMATURE NEWBORNS BORN IN HOSPITALS WITHOUT A NEONATAL CARE UNIT

The proportion of premature newborns born in hospitals without a neonatal care unit can be indicative of the effectiveness of the health system in identifying the risk for pre-term birth (see section 3.2, Figure 82). It is also an indicator of the safety of the birth process. In Luxembourg, the Hospital law provides women at risk of premature delivery to be followed in a hospital with a neonatal care unit before they give birth, and all very premature newborns (below 32 completed weeks of gestational age) to be born in a hospital with neonatal intensive care unit, to provide the best possible outcome.[256,270–272]

This indicator is defined and calculated as proposed by EuroPeristat.[lix] The annual numbers of extremely preterm and very preterm live and stillbirths are low. This leads to fluctuations in the observed proportion of those born in maternity units without neonatal intensive care provision.

Between 2011 and 2021, the proportion of extremely preterm newborns (22-27 weeks of gestation) born in maternity facilities without an on-site neonatal intensive care unit decreased from 45.5% (n=15/33) to 27.8% (n=10/36). The proportion of very preterm newborns (28-32 weeks of gestation), born in maternity facilities without a neonatal intensive care unit fluctuated around 20% over the observed period, ranging from 8.0% (n=<5) in 2019 to 35.9% (n=14/39).

An analysis of preterm births between 2012 and 2014 in France showed similar results to those observed for Luxembourg.[273]

[lix] The proportion (%) of preterm live and stillbirths less than 32 completed weeks of gestation that are born in a maternity unit without an on-site neonatal intensive care unit, by prematurity: extremely preterm (22-27 weeks of gestation) and very preterm (28-32 weeks of gestation), 2011–2021.
Source: PERINAT.

CAESAREAN SECTIONS

Caesarean section is a vital intervention in the presence of certain risk factors or complications to prevent adverse health events for the mother and the child. However, overuse is a concern, as caesarean section also carries risks for maternal and neonatal health, and is more expensive than vaginal delivery.[274,275] Excessive use of caesarean section can thus point to inefficient use of resources in the health system. It can also increase the health risks for both children and mothers.[58] Caesarean section rates above 9–16% of all births are indicative of overuse and are not associated with further health gains.[58,276,277]

To describe the development and current status of caesarean sections in Luxembourg, Figure 87 shows the proportion of elective/primary and emergency/secondary caesarean sections, as well as vaginal deliveries in all registered births in Luxembourg during a given year.

Since 2011, the proportion of elective/primary and emergency/secondary caesarean sections has remained stable. In 2021, some 15.5% of all deliveries in Luxembourg were categorized as elective/primary caesarean sections and 14.2% as emergency/secondary caesarean sections; thus, accounting for almost 30% of all deliveries.

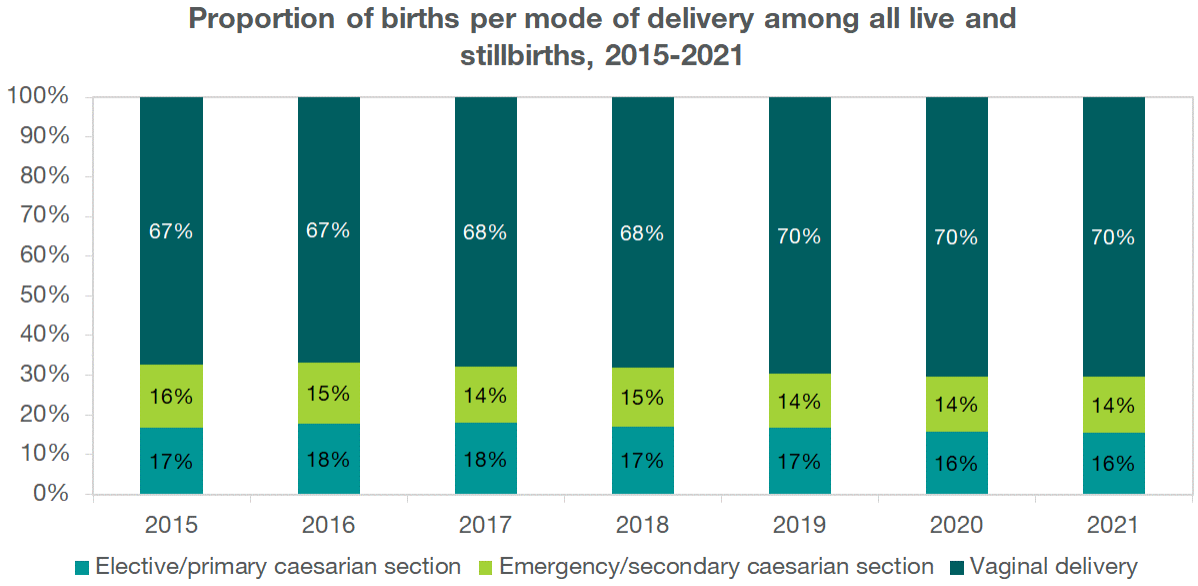


Figure 87: Proportion (%) of births per mode of delivery: elective/primary caesarean section, emergency/secondary caesarean section and vaginal delivery, among all live and stillbirths in Luxembourg, 2015–2021.

Source: EuroPeristat for 2015-2019, PERINAT 2020-2021.

The latest available international data in EuroPeristat is from 2019. The rates reported by Luxembourg (30.4%) and Germany (31.8%) were considerably higher than those for Belgium (21.5%) and France (20.9%). The Netherlands (17.4%) had the lowest rate of caesarean sections among live and stillbirths of all the countries that were compared (Figure 88).[58]

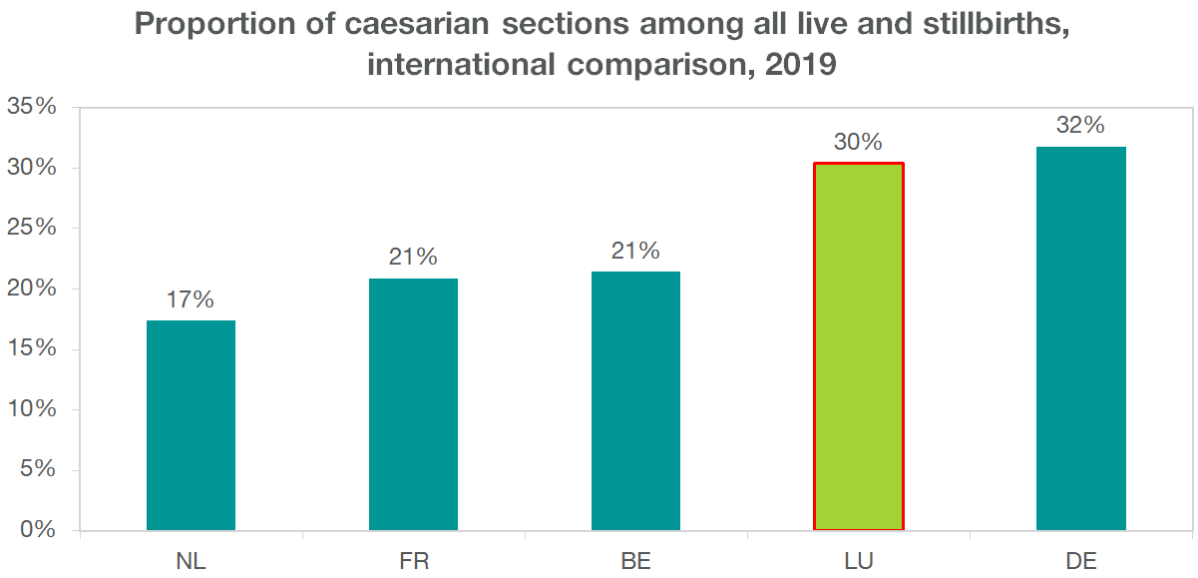


Figure 88: International comparison – Proportion (%) of caesarean sections among all live and stillbirths by country, 2019.

Source: EuroPeristat.

Conclusions on safety of care

Monitoring antimicrobial use is important, as overuse and inappropriate use increases antimicrobial resistance. The decreasing trend in the prescription rate of antibacterials for systemic use is encouraging. However, since 2020 prescription rates have increased again, and careful monitoring will be needed to assess if this continues or if rates decrease again in the future. The same is true for the recent rise in the relative use of broad-spectrum versus narrow-spectrum antibiotics for children.

Regarding pharmacovigilance, the rate of adverse events reported is low overall in Luxembourg, and comparable to neighbouring countries. The majority of adverse event declarations stem from issues related to vaccines, underscoring the importance of ongoing monitoring and safety assessment in paediatric vaccination programmes.

Over the last decade, the percentage of preterm infants born in maternity facilities with neonatal intensive care units has increased significantly. Nevertheless, there is still scope to provide premature babies with the safest possible environment, given that over 40% of all preterm infants are still born in hospitals without a neonatal intensive care unit. Luxembourg also has high numbers of caesarean sections, indicating many unnecessary surgeries that take up valuable resources without providing additional health benefits.

Lastly, there are important data gaps that prevent more extensive analysis of the safety in healthcare delivery for children in Luxembourg. This includes the possibility to assess safety in hospitals related to healthcare associated infections among paediatric patients.

Conclusion and recommendation

In this first report on the health of children in Luxembourg, the ObSanté has focused on children from birth to the end of primary school. In addition to child health and health behaviours, we have also described and assessed the specific features of the health system involved in the care for children aged 0-12 years old in Luxembourg.

Health status and health determinants

Trends in health status and behaviours

The report identified concerning trends in the health and health behaviours of children. Health behaviours are not improving and overweight is increasing.

Between 2014 and 2022, overweight and obesity among 11 to 12 year olds increased from 15% to 22% among boys, and from 11% to 16% among girls. These rates are much higher than in neighbouring countries. Healthy behaviours among 11 to 12 year olds, apart from fruit and vegetable consumption, did not improve or have even declined over the last decade. While in 2010, 68% of boys and 44% of girls reported vigorous physical activity at least four times per week, by 2022 it had decreased to 57% of boys and 36% of girls.

Chronic diseases in children, such as diabetes and cancer, have incidence and prevalence rates comparable to those in other countries. Every year, on average, one child in seven suffers a trauma requiring treatment in an emergency department. The most frequent causes of hospitalisation in children of all ages are respiratory conditions. Child mortality rates in Luxembourg are low, yet two out of three deaths are from causes considered as largely treatable or preventable.

It should be noted that anthropometric data and information on health behaviours could only be assessed among children aged 11 to 12, in the absence of available data for the other age groups.

Self-rated health

Two general measurements of health status and mental health status provided evidence about how children evaluate their own health. They indicate that a significant proportion of children, at least in this age group, are not in optimal health and experience mental health distress.

Less than half of the 11 to 12 year olds rated their health as excellent in 2022. The incidence of psychosomatic health complaints has increased, particularly among girls, of whom 43% had experienced these problems several times a week or even daily over the previous six months.

Maternal health

We also looked at maternal health and health behaviours, especially during pregnancy, given their importance for the future health of a child. The only data source for harmful behaviours such as smoking and alcohol consumption during pregnancy was self-reports by pregnant women recorded during doctor’s visits. They showed low levels of these harmful behaviours.

COVID-19

We investigated the impact of the COVID-19 pandemic on child health in Luxembourg. According to our analysis, COVID-19 did not have a large, immediate effect on children's physical health. However, further research is needed to understand the impact of this

pandemic and the accompanying measures on children's mental health and overall wellbeing and to monitor its longer-term effects, as the current evidence is unconclusive.

The health system for children

We explored several areas of the health system that play an important role in the organisation and delivery of health care and services for children.

Roles and responsibilities

We found that roles and responsibilities for children's health were spread across different ministries and bodies. Similarly, information about health programmes and services available for children was not centralized but rather spread across different sources, increasing the difficulty to access them. We did not identify a coordinated national strategy aimed at promoting and improving children's health, including children's voices, and at making health services and care as respectful as possible of their fundamental rights and interests.

Workforce and infrastructure for child health care

We found that, in Luxembourg, primary care for children up to the age of 9 is predominantly delivered by paediatricians. Relative to its population as well as to the number of children 0–18 years old, Luxembourg has more paediatricians than France, Belgium or the Netherlands, and a similar number to that in Germany. The supply of obstetrician-gynaecologists and midwives is in line with that of other countries in the region. However, the availability of healthcare professionals to meet the demand for child healthcare cannot be assessed solely based on headcounts and the numbers of services provided, as the access to services relies heavily on the distribution of providers across sectors of care as well as on the organization of care, including the proportion of paediatricians working part time.

The centralisation of complex care for mothers and children has led to the development of specialised departments at the CHL. Our analysis of the infrastructure available to provide hospital services relies mainly on the number of hospital beds. Overall, we found a relatively low density of available maternity beds compared to other high-income European countries, and a low and decreasing number of paediatric beds.

Our analysis of primary care infrastructures was limited to the digitisation of healthcare for children. We found that health care delivery is mainly based on in-person interactions, and the use of teleconsultations has remained low. This was also the case during the COVID-19 pandemic. The use of electronic health record (DSP) has become more frequent among children aged 0-12 and, and by July 2023, some 20% of 0–24 months old children had an electronic vaccination record.

Service delivery

Lastly, we looked at the actual delivery of services through the lens of their effectiveness in reaching and meeting the health needs of children and being accessible and safe, as well as their potential impact on health.

We found that the health system is effective in terms of reaching most Luxembourg children early in life, as demonstrated by the high coverage rate for neonatal screenings and vaccinations and the widespread adherence to the recommended, incentivized check-up visits before and after birth. However, participation rates in recommended screenings and

preventative visits decline among older children, both for health and dental visits, which do not carry a financial reward for attendance. The health system is also effective in preventing conditions that can be at least partially averted, such as low birth weight, and maternal, neonatal and child mortality. The reduction in hospital admission rates for children observed in recent years tends to illustrate the effectiveness of preventive measures and primary care for children.

Demonstrating that the healthcare system has a positive impact on children's health, and quantifying this impact, however, requires more in-depth analysis because of the various factors outside the healthcare system that are likely to affect children's health.

Looking at the accessibility of the health system for health services related to children, we noted that, overall, Luxembourg has low rates of unmet medical and dental care needs for children, also in comparison with other countries such as France, Belgium and the Netherlands. This provides evidence that a large part of the child population can access the needed services. We investigated the time needed to access maternity services by car and found that all women in child-bearing age in Luxembourg can realistically reach a maternity ward within 60 minutes. For over 90% of children, there is a paediatric practice within a 10 km radius of their home. Paediatric primary care services are also available during night times and at weekends in a specific facility in Luxembourg City. In the absence of suitable data, we were unable to measure waiting times for a consultation in a paediatric practice.

The safety of the health system was assessed by looking at the use of antibiotics over time, the reporting of adverse events in relation to medication use, and the proportion of babies born via caesarean section. We found an increase in the use of antibiotics, including broad-spectrum antibiotics, since 2020. This increases the risk of bacterial resistance to these medications. It remains unclear whether this recent increase represents a long-term trend. In Luxembourg, the reporting of adverse drug reactions in children has increased but remains relatively infrequent and comparable to the European average. Luxembourg still has very high rates of C-sections (30.4%), putting maternal and neonatal health at unnecessary risk in the absence of any medical indication for such a procedure. The C-sections levels in Luxembourg and Germany exceed those recommended by the World Health Organization, as well as being higher than the levels observed in neighbouring countries.

Equity issues

Equity is implicit in our government's commitment to universal health coverage and quality care. Hence, the health system and other institutions should aim at, and provide everyone with, the same possibilities to attain their full potential for health and well-being. This aspiration implies equitable access to health care and services for all sections of the population, regardless of their economic situation, age, gender, nationality or any other characteristic.

This section examines how disparities in socioeconomic status and demographic factors correspond with variations in health behaviours and outcomes and the accessibility and provision of health services. Significant disparities are indicative of health inequities in Luxembourg, highlighting systematic differences in the opportunities for different population groups within the country to achieve optimal health.

Health status and determinants

We found that health status—and even more so, health behaviour—differs in line with household income.

Across different indicators, such as physical activity, fruit and vegetable consumption, daily breakfast consumption, and tooth brushing, children who rated their household as economically less well-off, less frequently reported healthy behaviours. Many of these differences further increased between 2014 and 2022. For other determinants, such as migration, the differences in health behaviours were not as clear-cut.

The differences by socioeconomic status were also reflected in the reported health status of children. We found a clear gradient in overweight and obesity and self-reported health, with children from average and less well-off families reporting much lower levels of good health than children from well-off families. The gradient reappeared in the reporting of multiple subjective health complaints—a measurement of psychosomatic complaints. More than 60% of children from families that were not well-off reported multiple subjective health complaints compared with around 30% of children from well-off families.

Overweight and obesity are also more prevalent among children from migrant families.

There are likely to be effects on children's long-term health that relate to health behaviours and being overweight during childhood. These effects potentially increase the risk of diseases such as type 2 diabetes during adult life, especially if being overweight continues into adulthood.[278,279] Similarly, healthy behaviours such as physical activity may not only improve children's immediate development, but also are associated with continued healthy behaviours and physical activity in adulthood.[280–282]

Health system

Assessing inequities in the access to and the quality of health services is difficult. For example, poorer people tend to be in worse health and therefore require more frequent use of health services than people with higher incomes. Conversely, well-off families may more easily overcome any barriers to accessing healthcare. Measurements of health service use purely based on the frequency of use for certain services may therefore produce a biased picture, if they do not take into account the different needs for health system use among different populations.[283] Based on the evidence for unmet medical and dental needs, which are very low even for the relatively poor households in Luxembourg, we did not find strong evidence for inequities in the access to healthcare.

Overall, we found clear indications of differences in terms of health outcomes and health behaviours relative to differences in household income. Less can be said about inequities in the use of the health system.

Of course, we only assessed a very limited number of indicators in this report, with a focus on the health system that provides curative and preventative services to the population. Because the health of children is affected by many other factors, such as family setting, school, public spaces and the exposure to pollutants, the worse levels of health among children from less well-off families may well be a result of these external factors, rather than inequities in the use and the quality of health services.

Data gaps and limitations

Throughout the report, we have identified gaps in data that prevented the calculation of specific indicators, or restricted us from providing results for a specific population group.

1. One of the main gaps involves the lack of systematically collected data about the physical and mental health and health behaviours among children under 11 years of age. The HBSC survey is one study that does systematically collect data about children. Unfortunately, it only does so for school children 11 years old and above. As a result, the current report does not show results for health behaviours and overweight/obesity among children younger than 11 years of age. In addition, the HBSC study is only conducted in school classes that follow the Luxembourg curriculum.
2. While well-child visits and screening programmes are available for all children throughout infancy and childhood, the amount of actionable data from these is low. We were unable to assess the rate of hearing or visual impairment, and the rate of chronic diseases, as well as physical or mental health limitations among children 0–12 years old.
3. A further limitation in terms of information reflects the mode of data collection on maternal health behaviours. Currently, the only available source of information is based on doctors and midwives asking women about their frequency of smoking and alcohol consumption throughout a pregnancy. Given the stigma around these behaviours, it is possible that risky behaviours are underreported. To a lesser extent, this is also true for the behaviours children report in surveys.
4. Importantly, many assessment areas of this report relied primarily on indicators based on administrative data from the national health insurance and are therefore not completely representative of the entire population living in the territory of Luxembourg. Health services provided to populations insured by other schemes (for example, employees of international organizations and their children) were not included. In 2022, some 11 900 people living in Luxembourg worked for international institutions.[284] Our data also excludes health information for marginalized populations excluded from social security. Médecins du Monde carries out most of the consultations for people living in the territory of Luxembourg but without official residency. In 2021, some 1391 people attended Médecins du Monde.[285]
5. A lack of information on the patient experience of children and parents prevented us from assessing the perceptions and views of those who used the Luxembourg health system. We therefore do not know whether children and parents experience it as meeting their needs, or if there are specific groups that differ from the rest of the population in this regard.

A way forward

The report has clearly identified differences in health and health behaviours between children from rich and poor backgrounds. The report has further shown that overweight and obesity are problems becoming increasingly prevalent in Luxembourg. Given that health problems and health behaviours during childhood can be strong predictors of health during adulthood, there is a need to put in place early and effective prevention and treatment. To finish the report, we provide recommendations based on the findings of this report, highlighting areas that require urgent action and how more coordinated approaches and better data can support policy making that improves child health.

Recommendations to improve child health and its monitoring

1. Tackling child obesity

There is an urgent need to counteract the increase in overweight and obesity, and to foster and support better health behaviours among children. This would not only improve their current health, but would also lay the foundations for a healthy adolescent and adult life, particularly—although not only—for those with an economically disadvantaged background.

2. A plan towards the health and wellbeing of children

The multidimensional aspects of child health, as illustrated in the report, underline the need for improved coordination between institutions to ensure that programmes and interventions consider the needs of different populations.

A national plan towards child health would allow common goals to be established for the promotion, protection and improvement of the health of all children. This could best be achieved through multisectoral efforts. Strategic alignment beyond the health system is needed to address the different determinants of child health, including—but not limited to—socioeconomic, demographic, commercial and environmental factors, as well as in homes, schools and municipalities. By recognizing the existence of inequities in child health, such a plan could include health policies and interventions aimed at reducing disparities while benefiting all children, whatever their background.

3. Filling data gaps on child health

There is a need to address data gaps and foster research into child health in Luxembourg. In particular, data concerning the health and health behaviours of children under 11 years old is lacking. In addition, data is needed to allow for the quantitative evaluation of preventive programmes.

As a first step, improved data quality and information systems would enable the more systematic secondary use of data. In this regard, the health data collected by school medical services represents a very rich resource to monitor the health of the relevant children. For example, anthropometric data collected throughout childhood could contribute to monitoring the health status of children and informing effective public health interventions and prevention programmes.

Similarly, the collection and accessibility of data on screening outcomes, diagnoses and the reasons for consultations at the primary care level are important. This would allow a richer and more accurate assessment of the health outcomes among children. It would also enable evaluation of the effectiveness of existing programmes and interventions and addressing questions regarding the efficient use of resources.

The implementation of an integrated information system would not only allow monitoring and evaluation of preventive programmes, but would also improve their implementation. This would allow the possibility to implement the 1-3-6 principles: initial screening, followed by diagnosis confirmation within 3 months and intervention time within 6 months of life, as recommended in many countries and by the WHO for screening programmes among children.[286,287] It could also allow equity to be improved, by ensuring specific attention is paid to more vulnerable children

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List of indicators

Figure / Table	Liste of indicators and their specifications	Source of data
HEALTH STATUS and DETERMINANTS		
	Health determinants	
Fig 2	Proportion (%) of newborns by feeding practice at the time of discharge from maternity in Luxembourg, 2011 to 2021. Feeding practices are categorised as exclusive breastfeeding, baby formula feeding, and mixed breastfeeding and baby formula. The indicator includes resident and non resident newborns.	PERINAT
Fig 3	Proportion (%) of 11-12 year old schoolchildren who reported eating fruits and vegetables daily, by gender, 2014-2022, Luxembourg.	HBSC
Fig 4	Proportion (%) of 11-12 year old schoolchildren who reported eating fruits and vegetables daily, by perceived wealth, 2014-2022, Luxembourg. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
	International comparison – Proportion (%) of 11 year old schoolchildren who reported eating fruits daily, by country 2018.	HBSC
	International comparison – Proportion (%) of 11 year old schoolchildren who reported eating vegetables daily, by country 2018.	HBSC
	Proportion (%) of 11-12 year old schoolchildren who reported eating breakfast every school day, by gender 2022, Luxembourg.	HBSC
Fig 5	Proportion (%) of 11-12 year old schoolchildren who reported eating breakfast every school day, by perceived wealth, 2014-2022, Luxembourg. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
	Proportion (%) of 11-12 year old schoolchildren who reported eating breakfast every school day, by family structure 2022, Luxembourg. Family structure is categorised as family with two parents present in the household AND "other" family structure, that combines single parent household and living with other caretakers than parents.	HBSC
Fig 6	International comparison - Proportion (%) of schoolchildren aged 11 years who reported eating breakfast every school day, by country, 2018.	HBSC
	Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by gender, 2022, Luxembourg.	HBSC
	Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by migration background, 2022, Luxembourg. Migration background is categorised as no migration background, the child itself migrated to Luxembourg and one or both of the parents immigrated to Luxembourg (the latter category is not displayed for this indicator)	HBSC
	Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by family structure, 2022, Luxembourg.	HBSC

	Family structure is categorised as family with two parents present in the household and "other" family structure, that combines single parent household and living with other caretakers than parents.	
Fig 7	Proportion (%) of 11-12 year old schoolchildren who reported brushing their teeth twice a day or more, by perceived wealth, 2014-2022, Luxembourg. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
	International comparison – Proportion (%) of 11 year old schoolchildren who reported brushing their teeth twice a day or more, by country, 2018.	HBSC
Fig 8	Proportion (%) of 11-12 year old schoolchildren reporting vigorous physical activity at least four times per week, by gender, 2010-2022, Luxembourg.	HBSC
Fig 9	Proportion (%) of 11-12 year old schoolchildren reporting vigorous physical activity at least four times per week, by perceived wealth, 2014-2022, Luxembourg. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
	Proportion (%) of 11-12 year old schoolchildren who report vigorous physical activity at least four times per week , by migration background, 2022, Luxembourg. Migration background is categorized as no migration background, the child itself migrated to Luxembourg and one or both of the parents immigrated to Luxembourg.	HBSC
Fig 10	International comparison – Proportion (%) of schoolchildren aged 11 years reporting vigorous physical activity at least four times per week, by country, 2018.	HBSC
Fig 11	Proportion (%) of 11-12 year old schoolchildren who reported drinking alcohol in past 30 days, by gender, 2010-2022, Luxembourg.	HBSC
Fig 12	International comparison – Proportion (%) of schoolchildren aged 11 years who report drinking alcohol in past 30 days, by country, 2018.	HBSC
	Number of resident adolescent mothers, below 15 years of age, within the years 2011-2019, Luxembourg.	PERINAT
Fig 13	Proportion (%) of women who reported smoking during the third trimester of pregnancy among all women with live or still birth and had available information perteining to smoking during the first trimester of pregnancy, 2011-2021, Luxembourg. Women were categorized as daily-, occasional-, or no smoking. Resident and non resident women were included.	PERINAT
Fig 14	Proportion (%) of women who reported exposure to passive smoking during pregnancy among all women with live or still birth and had available information perteining to smoking during last trimester of pregnancy, 2011-2021, Luxembourg. Women were categorized by frequency of exposure to passive smoking: never, occasionally or daily. Resident and non resident women were included.	PERINAT
Fig 15	Proportion (%) of women who reported alcohol consumption during pregnancy among all women with live or still birth and had available information perteining to alcohol consumption, 2011-2021, Luxembourg. Women were categorized by frequency of alcohol consumption: never, occasionally or daily. Resident and non resident women were included.	PERINAT
Fig 16	Proportion (%) of women with gestational diabetes among all women that gave birth in Luxembourg, 2014 to 2021. Resident and non-resident women are included.	PERINAT
	Key physical health outcomes	

	Fetal mortality rate in Luxembourg: number of fetal deaths, per 1000 live and stillbirths, 2012 – 2020 (2011-2021 data presented as a 3-year centred moving average). The numerator includes fetal deaths with a gestational age of 22 weeks or more, or if gestational age is unknown with a birth weight of 500 g or above. The denominator includes all live births and stillbirths, independent of their gestational age and weight. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.	National register of causes of death; STATEC. Indicator computed by ObSanté.
Fig 18	Perinatal mortality rate in Luxembourg: number of fetal and early neonatal deaths, per 1000 live and stillbirths, 2012 – 2020 (2011-2021 data presented as a 3-year centred moving average). Early neonatal deaths are defined as deaths that occurred up to 6 completed days of life after birth. The numerator includes fetal and early neonatal deaths with a gestational age of 22 weeks or more, or if gestational age is unknown with a birth weight of 500 g or above. The denominator includes all live births and stillbirths, independent of their gestational age and weight. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.	National register of causes of death; STATEC. Indicator computed by ObSanté.
Fig 19	Neonatal mortality rate in Luxembourg: number of neonatal deaths, per 1000 live births, by early and late neonatal deaths, 2012 – 2020 (3-years centred moving average based on data 2011-2021). Neonatal deaths are defined as deaths that occurred during the first 27 completed days. Early neonatal deaths occur during the first 6 days of life, and late neonatal deaths occur between the 7th and 27th completed day of life. Early neonatal deaths are restricted to a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. The number of neonatal deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.	National register of causes of death; STATEC. Indicator computed by ObSanté.
Fig 20	Distribution (%) of early neonatal mortality rate per 1000 live, by gestational age at delivery, 2011-2021, Luxembourg. Gestational age is categorized as full or post term (37-41 weeks), moderate to late preterm (32-36 weeks), very preterm (28-31 weeks9, extremely preterm (22-27 weeks). Early neonatal deaths occurred during the first 6 days of life and inclusion is restricted to those with a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. The number of early neonatal deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident). The number of live births is based on resident newborns.	National register of causes of death; STATEC. Indicator computed by ObSanté.
Fig 21	Infant mortality rate in Luxembourg: number of deaths in resident children less than 1 year of age, per 1000 live births, 2012 – 2020, (2011-2021 data presented as a 3-year centred moving average). Included are infant deaths of residents in or outside the country and live births residents in or outside the country.	Eurostat.
Fig 22	International comparison – Infant mortality rate: number of deaths in children less than 1 year of age, per 1000 live births, by country, 2021. *LU : 3-year moving average for 2020 based on datat from 2019 to 2021.	Eurostat.
Fig 23	International comparison – Under-five mortality rate: Probability of dying before age 5 per 1000 live births, by country, 2021.	WHO - Global Health Observatory
Fig 24	Mortality rate among children aged 5-9 in Luxembourg: probability of children 5 years old dying before reaching the age of 10 years, per 1000 children aged 5 years, 2021.	WHO - Global Health Observatory
Tab 1	Avoidable mortality rate in Luxembourg, stratified by treatable and preventable mortality and by sex: number of deaths per 100,000 children aged 0-12 years old, 2011–2021. Causes of death were categorised as per the OECD/Eurostat lists of preventable and treatable causes of death (January 2022 version) . Children who deceased in less than 7 days following live birth were restricted to those with a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident).	National register of causes of death; STATEC. Indicator computed by ObSanté.

	Proportional distribution (%) of causes of avoidable deaths by age group, within the years 2011 -2021, Luxembourg. Age was categorised as 0-11 months and 1-12 years old. Causes of death were categorised as per the OECD/Eurostat lists of preventable and treatable causes of death (January 2022 version) . Children who deceased in less than 7 days following live birth were restricted to those with a minimal gestational age of 22 weeks, or if gestational age is unknown to a minimum birth weight of 500 g or above. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident).	National register of causes of death; STATEC. Indicator computed by ObSanté.
Fig 25	Proportion (%) of schoolchildren aged 11–12 years who rated their health as excellent, by gender, 2010-2022, Luxembourg. Self-rated health was assessed on a four-point scale, ranging from 1 “excellent” to 4 “poor”. The results presented show the proportion of adolescents who consider their health to be excellent.	HBSC
Fig 26	Figure 26 Proportion (%) of schoolchildren aged 11–12 years who rated their health as excellent, by perceived wealth, 2014-2022, Luxembourg. Self-rated health was assessed on a four-point scale, ranging from 1 “excellent” to 4 “poor”. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
Fig 27	International comparison – Proportion (%) of 11 year old schoolchildren who rate their health as excellent, by country, 2022. Self-rated health was assessed on a four-point scale, ranging from 1 “excellent” to 4 “poor”.	HBSC
Fig 28	Proportion (%) of schoolchildren aged 11–12 who were overweight (including obesity), by gender, 2010-2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce (doi.org/10.1111/j.2047-6310.2012.00064.x).	HBSC
Fig 29	Proportion (%) of schoolchildren aged 11–12 years who were overweight (including obesity), by perceived wealth, 2014-2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce (https://doi.org/10.1111/j.2047-6310.2012.00064.x). Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
Fig 30	Proportion (%) of schoolchildren aged 11–12 years who were overweight (including obesity), by migration background, 2014-2022, Luxembourg. BMI cut-off values as defined by the International Obesity Taskforce (https://doi.org/10.1111/j.2047-6310.2012.00064.x). Migration background is categorised as no migration background, the child itself migrated to Luxembourg and one or both of the parents immigrated to Luxembourg.	HBSC
Fig 31	International comparison – Proportion (%) of schoolchildren aged 11 years who were overweight (including obesity), by country, 2018. BMI cut-off values as defined by the WHO were used (https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age).	HBSC
	Proportion (%) of schoolchildren cycle 1.2 and 2.1, with untreated caries on either milk (primary) and/or permanent teeth, at national level, by school class and by regional directorate of primary education (n=14), schoolyear 2022/2023, Luxembourg.	Health Directorate
Fig 32	Incidence of diabetes mellitus Typ 1 in 0-14 year old insured resident children, per 10 000 children, 2012-2022, Luxembourg. The incidence is calculated based on reimbursement data from the National Health Fund for insulin and analogues for injection (ATC A10A). The first prescription were taken into account, with a minimum Defined Daily Dose (DDD) of 60. (Defined Daily Dose : The assumed average maintenance dose per day for a drug used for its main indication in adults.)	Social security database

	Prevalence of diabetes mellitus Typ 1 in 0-14 year old resident insured children, by gender, per 10 000 children, 2022, Luxembourg. The prevalence is calculated based on reimbursement data from the National Health Fund for of insulins and analogues for injection (ATC A10A). Prescriptions with a minimum Defined Daily Dose (DDD) of 60 were taken into account. (Defined Daily Dose The assumed average maintenance dose per day for a drug used for its main indication in adults.)	Social security database
Fig 33	Annual hospitalization rate (with AND without overnight stay) per 1000 children 0-12 years of age, by the 10 main ICD-10 chapters and by age group, 2019, 2021 and 2022, Luxembourg. The indictaor includes resident insured children. The International Statistical Classification of Diseases (ICD-10 version 2019) is used to classify diagnosis at discharge. Age is categroized as <1 year and 1-12 years. The year 2020 is excluded due to incomplete coding linked to the COVID-19 pandemic.	Social security database. Indicator computed by ObSanté.
	see also Table 13 (Appendix)	
Fig 34	International comparison – Age standardised (World Standard Population) annual incidence of childhood cancer between the age of 0 and 14 years, per 1,000,000 children, by country. Sources: LU: Incidence des cancers de l'enfant au Luxembourg : Données du Registre National du Cancer, 2014-2022. (www.rnc.lu), FR: Registre National des Cancers de L'Enfant (rnce.inserm.fr), BE: Cancer in children and adolescents in Belgium 2004-2020, Belgian Cancer Registry, Brussels, 2023 (https://kankerregister.org/), NL: https://ecis.jrc.ec.europa.eu, CH: Temporal trends in incidence of childhood cancer in Switzerland, 1985–2014. Sommer et al. (Incidence des cancers de l'enfant au Luxembourg : Données du Registre National du Cancer, 2014-2022. Couffignal S, Jacobs J. Bulletin Epidémiologique. Luxembourg: Luxembourg Institue of Health (LIH) ; Septembre 2023. 21p)	Bulletin Epidémiologique. Luxembourg Institue of Health (LIH) ; Septembre 2023
Tab 2	Distribution (n and %) of the main diagnostic groups for childhood cancers in resident children aged 0-14 years at the time of diagnosis, 2014-2022, Luxembourg. Classification of cancer types according to the diagnostic groups of the International Classification of Childhood Cancer, 3rd edition, update 2017. Source: National Cancer Registry. Incidence des cancers de l'enfant au Luxembourg : Données du Registre National du Cancer, 2014-2022. Couffignal S, Jacobs J. Bulletin Epidémiologique. Luxembourg: Luxembourg Institue of Health (LIH) ; Septembre 2023. 21p	Bulletin Epidémiologique. Luxembourg Institue of Health (LIH) ; Septembre 2023
Fig 35	Estimated incidence of injuries per 1000 children aged 0-14 years, requiring treatment in a hospital emergency department, 2013-2020, Luxembourg. Only resident children are included.	RETRACE; STATEC
Fig 36	Estimated incidence of injuries per 1000 children aged 0-14 years, requiring treatment in a hospital emergency department, by gender and age group, 2018-2020, Luxembourg. Age is categorized as 0-4 years, 5-9 years and 10-14 years. Only resident children are included.	RETRACE; STATEC
	Proportional distribution (%) of estimated number of injury cases in resident children 0-14 years old, by mechanism of injury and by age group, 2018-2019, Luxembourg. The mechanism of injury is the process by which an injury occurs. Road traffic injury: all accidents involving means of transport (car, bicycle, lorry, etc) and that take place on a public street; Falls; Cuts/puncture wounds: cuts by sharp objects and puncture wounds by objects under the skin; Poisoning: intoxication by alcohol, drugs or chemical substances; Burn/scald: includes burns by hot substances or objects as well as chemical products. Age is categorized as 0-4 years and 5-14 years.	RETRACE
	Number of accidents at home or at school and/or during leisure activities during the past 12 months, resulting in an injury that required treatment in a hospital, per 100 000 children age 0-14 years. European Core Heath Indicators 29_b (https://webgate.ec.europa.eu/dyna/echi/)	European Core Heath Indicators 29_b

		(https://webgate.ec.europa.eu/dyna/echi/)
	Mental health	
Fig 37	Proportion (%) of 11-12 year old schoolchildren reporting multiple health complaints, by gender, 2010-2022, Luxembourg. The indicator captures children who reported experiencing two or more complaints several times a week or even daily over the previous six months.	HBSC
Fig 38	Proportion (%) of 11-12 year old schoolchildren reporting multiple health complaints, by perceived wealth, 2014-2022, Luxembourg. The indicator captures children who reported experiencing two or more complaints several times a week or even daily over the previous six months. Self-perceived wealth of the family was assessed by rating on a five-point scale; answers 1-2 were combined to not well off, 3 classified as average, and 4-5 as well off.	HBSC
Fig 39	International comparison – Proportion (%) of 11 year old children who report multiple health complaints, by country, 2022. The indicator captures children who reported experiencing two or more complaints several times a week or even daily over the previous six months.	HBSC
Tab 3	Relative distribution (%) of hospitalisations with overnight stay among resident insured children 0-12 years, due to mental and behavioural disorder, by ICD-10 sub-chapters (Chapter V mental and behavioural disorders), 2019, 2021 and 2022, Luxembourg. The International Statistical Classification of Diseases (ICD-10 version 2019) is used to define the diagnosis at discharge. Only diagnosis within the chapter V of mental and behavioural disorders (F0-F99) were considered and classified according to ICD-10 sub-chapters. The year 2020 is excluded due to incomplete coding linked to the COVID-19 pandemic.	Social security database.Computed by ObSanté.
Fig 40	Rates of hospitalization with overnight stay due to mental and behavioural disorders in resident insured children 0-12 years old per 1 000 children, 2012-2022, Luxembourg. Only diagnosis within the chapter V of mental and behavioural disorders (F0-F99) of the International Statistical Classification of Diseases (ICD-10 version 2019) were included. The year 2020 has not been considered for indicators based on the ICD-10 coding, as data is incomplete following the exemption from coding that was granted, due to the COVID-19 pandemic.	Social security database.Computed by ObSanté.
Fig 41	Incidence of attention-deficit/hyperactivity disorder (ADHD)-treatment (methylphenidate) among resident insured children 5-14 year old, per 1000 children, 2012-2022, Luxembourg. Prescriptions with a minimum Defined Daily Dose (DDD) of 60 per prescription were considered (Defined Daily Dose : The assumed average maintenance dose per day for a drug used for its main indication in adults).	Social security database.
	Prevalence of attention-deficit/hyperactivity disorder (ADHD)-treatment among resident insured children 5-14 years old, per 1 000 children, 2022, Luxembourg. Prescriptions of methylphenidate with a minimum Defined Daily Dose (DDD) of 60 per prescription are considered (Defined Daily Dose : The assumed average maintenance dose per day for a drug used for its main indication in adults).	Social security database.
	The effects of COVID-19 among children in Luxembourg	
Fig 42	Weekly SARS-CoV-2 incidence per 100 000 resident insured children 0-12 years of age, from March 2020 to May 2022, Luxembourg. SARS-CoV-2 infections were included when confirmed by a PCR detection test performed in Luxembourg between March 2020 to May 2022. Also considered as infections were children hospitalized with a clinical confirmation of COVID-19. (As per definition also	Directorate of Health; Social security database.

	deaths due to COVID-19 were to be included. During the observation period, there were no deaths due to COVID-19 among children in Luxembourg (n=0)) Age is categorised as 0-2 years, 3-5 years. 6-8 years, 9-12 years.	
	Number of deaths due COVID-19 registered among children 0-12 years old in Luxembourg, 2020-2021. The number of deaths is limited to those that occurred on the territory of Luxembourg (resident and non-resident	National register of causes of death.
Tab 4	Coverage (%) of COVID-19 vaccination among children 0-14 years old in Luxembourg, by dose administered and age group, by April 2023 Source: Directorate of Health, Rapport sur l'effectivité vaccinale contre la COVID-19 au Luxembourg - Mise à jour du rapport - 31.03.2023 (https://sante.public.lu/fr/publications/r/evaluation-de-leffectivite-vaccinale-contre-covid19-miseajour-31mars2023.html)	Rapport sur l'effectivité vaccinale contre la COVID-19 au Luxembourg - Mise à jour du rapport - 31.03.2023
	see also Table 14 (Appendix)	
Fig 43	Proportion (%) of 6-16 year old children in Luxembourg who reported frequent negative emotions and worries during the pandemic, by gender and age group 2021, Luxembourg. Age was categorised as 6-11 years and 12-16 years. Source: COVID Kids II (Kirsch, C. et al., The impact of the Covid-19 pandemic in Luxembourg in 2021: Children aged 6-16 share their subjective well-being and experiences. First findings of the project COVID-Kids II. University of Luxembourg. 2022)	COVID Kids II
Fig 44	Proportion (%) of 6-16 year old schoolchildren that engaged "often" or "very often" in particular leisure activities during the COVID-19 confinement in 2020 (March to May 2020), Luxembourg. Categories of primary and secondary schoolchildren are presented. The list of Particular leisure activities included: Play, Read/Write, Arts, TV, Videaogames, Sports, Outdoors, Doing nothing. Source: Kirsch, C. et al., Subjective well-being and stay-at-home-experiences of children aged 6-16 during the first wave of the COVID-19 pandemic in Luxembourg: A report of the project COVID-Kids. University of Luxembourg.	COVID-Kids
HEALTH SYSTEM FOR CHILDREN		
	Health workforce	
Fig 46	International comparison – Number of paediatricians per 1000 inhabitants and primary care system in 2021, by country. For Luxembourg, pediatricians active in primary and hospital care are included, if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	LU: Social security database, STATEC, computed by ObSanté; BE, FR, NL : OECD; CH*: Jenni et al.183. Source for type of primary care system: Models of Child Health Appraised (MOCHA) study.
Fig 47	Number of paediatricians per 1000 inhabitants in Luxembourg, 2012-2022 (the total number of paediatricians per year is shown in brackets).	Social security database; STATEC.

	Pediatricians active in primary and hospital care are included, if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	Indicator computed by ObSanté.
Fig 48	Number of paediatricians per 1000 children under 18 years old in Luxembourg, 2012-2022. Pediatricians active in primary and hospital care are included, if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	Social security database; STATEC. Indicator computed by ObSanté.
Fig 49	International comparison – Number of obstetrician-gynaecologists per 1000 inhabitants in 2021 (or latest years available), by country. For Luxembourg, obstetrician-gynecologists active in primary and hospital care are included, if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	LU: social security database; STATEC. Indicator computed by ObSanté; for DE, CH, BE, BE, FR, NL: OECD.
Fig 50	Number of obstetrician-gynaecologists per 1000 inhabitants in Luxembourg, 2012-2022 (the total number of gynaecologists per year is shown in brackets). Obstetrician-gynaecologists active in primary and hospital care are included, if salaraied, or if 500€ billed for health services to the National Health Fund per month, 6 months in a given year.	Social security database; STATEC. Indicator computed by ObSanté.
Fig 51	Number of child psychiatrists per 1000 children under 18 years of age,in Luxembourg, 2012–2022 (the total number of child psychiatrists per year is shown in brackets). Child psychiatrists active in primary and hospital care are included, if salaried or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	Social security database; STATEC. Indicator computed by ObSanté.
Fig 52	International comparison – Number of dentists, including orthodontists and oral surgeons per 1000 inhabitants in 2021, by country. For Luxembourg dentists, including orthodontists and oral surgeons are included if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	LU: Social security database,STATEC, Indicator computed by ObSanté; DE, CH*, BE, BE, FR, NL: OECD. (*data from 2019)
Fig 53	Number of dentists, including orthodontists and oral surgeons per 1000 inhabitants in Luxembourg, 2012-2022 (the total number of child psychiatrists per year is shown in brackets). Dentists, including orthodontists and oral surgeons are included if salaried, or if a minimum of 500€ were billed for health services to the National Health Fund per month, during 6 months in the running year.	Social security database; STATEC. Indicator computed by ObSanté.
Fig 54	International comparison - Number of midwives per 1000 live births in 2020 (or latest year available), by country.	LU: Registre des professions de santé du Ministère de la Santé (Rapport Général de la Sécurité Sociale 2022); BE,CH,DE,FR, NL: OECD

	Number of pediatric nurses in Luxembourg, 2019-2020.	LU: Registre des professions de santé du Ministère de la Santé (Rapport Général de la Sécurité Sociale 2022).
Fig 55	Number of services provided by paediatricians for children aged 0-12 years, 2012-2022, Luxembourg. Services provdied to insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
Fig 56	Number of services provided by general practitioners for children aged 0-12 years, 2012-2022, Luxembourg. Services provided to insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
Fig 57	Number of services provided by dentists, orthodontists and oral surgeons, for children aged 0-12 years, 2012-2022, Luxembourg. Services provdied to insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
Fig 58	Proportion (%) of child consultations provided by paediatricians for children 0–12 out of the total number of consultations provided by GPs and paediatricians in Luxembourg, 2022. Consultations provided to insured resident and non-resident children are included. Age categories <1 years, 1-3 yearsm 4-9 years and 10-12 years.	Social security database. Indicator computed by ObSanté.
Fig 59	Number of visits provided by paediatricians and general practitioners for children, by age categories, 2012-2022, Luxembourg. Visits provided to insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
Fig 60	Number of visits, by type of service, provided by paediatricians and general practitioners for children 0-12 years old, 2022, Luxembourg. This indicator includes visits provided to insured resident children only.	Social security database. Indicator computed by ObSanté.
Fig 61	Proportion (%) of insured children (up to age 4) according to their recurring pattern of outpatient visits with the same practitioner, selected specialties, 2012-2022, Luxembourg. Insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
Fig 62	Monthly distribution (%) of services provided by paediatricians, dentists and general practitioners, for insured children 0-12, based on the total yearly services, 2012-2022, Luxembourg. Services provided to insured resident and non-resident children are included.	Social security database. Indicator computed by ObSanté.
	Infrastructure	

Tab 6	Number of installed inpatient beds in maternity units in Luxembourg, 2021.	Carte sanitaire 2021 edition
Tab 7	Number of installed inpatient beds in intensive and non-intensive neonatology departments in Luxembourg, 2017 and 2021.	Carte sanitaire 2017, 2021 edition
Tab 8	Number of installed inpatient beds in paediatrics departments in Luxembourg, 2017 and 2021.	Carte sanitaire 2017, 2021 edition
Fig 63	Number of resident insured 0-12 year old children with an electronic health record (DSP), by DSP activity status, 2016–2022, Luxembourg.	Agence eSanté
	Proportion (%) of resident children 0-14 years old, having an electronic vaccination record (CVE), July 2023, Luxembourg. Age categories 0-23 months, 2-6 years, 7-14 years.	Agence eSanté
Fig 64	Proportion (%) of all consultations for children that were carried out as teleconsultation by general practitioners and paediatricians in Luxembourg, 2020-2022. Age was categorised as 0-4 years, 5-12 years and all 0-12 years. The analysis includes consultations to insured resident and non resident children. This indicator is based on practitioners with significant activity. Certain criteria were therefore applied: practitioners having a supplier code allocated by the National Health Fund and aged between 25 and 74 years during the reference year; in the case of self-employment, the net amount invoiced during the year is equal to or greater than the average annual minimum social salary; only practitioners who have the same status (as active) during the 12 months of the corresponding year were considered.	Social security database. Indicator computed by ObSanté.
	Proportion (%) of general practitioners and pediatricians who provided 10 or more teleconsultations per year to children 0-12 years old , 2020-2022, Luxembourg. Consultations to insured resident and non-resident children were included.	Social security database. Indicator computed by ObSanté.
SERVICE DELIVERY		
	Effectiveness	
Fig 65	Distribution (%) of timing of first antenatal visit, by trimester of pregnancy, 2011-2022, Luxembourg. Trimesters are defined as 1st trimester 1 - 93 days of gestation, 2nd trimester 94 - 186 days, 3rd trimester 187-280 days. Included are all resident and non resident women that gave birth in Luxembourg and that had available information perteining to timing of first antenatal visit.	PERINAT
Fig 66	Distribution (%) of first antenatal visit, by trimester of pregnancy and by family structure, 2019-2021, Luxembourg. Trimesters are defined as 1 - 93 days of gestation, 2nd trimester 94 - 186 days, 3rd trimester 187-280 days. Included are all resident and non resident women that gave birth in Luxembourg and that had available information perteining to timing of first antenatal visit and family structure, within the years 2019-2021. Family structure is categorised as living with a partner or family AND living alone or in an institution.	PERINAT
Fig 67	Proportion (%) of insured women who gave birth in Luxembourg and who completed the five recommended prenatal visits, respectively the first postnatal visit in line with the national schedule and received a prenatal- respectively birth allowance (“prime pre-natale , prime de naissance”), 2011-2021. *Data gap for disbursed allowances for prenatal visits for 2014. Insured resident women were included in the analysis. (http://cae.public.lu/en/allocations.html)	Children Future Fund (CAE), social security database

Fig 68	Proportion (%) of children that completed all well-child visits at the age of 24 months, in line with the national recommendations, and received a postnatal allowance (“allocation postnatale”), 2011-2019, Luxembourg. Insured resident children were included in the analysis. (http://cae.public.lu/en/allocations.html)	Children Future Fund (CAE), social security database
	Coverage (%) of hearing test in newborns that were born in Luxembourg and resident newborns that were born aborad, 2011-2022.	Health Directorate
Fig 69	Coverage (%) of screening with speech and language with hearing test in resident children 30 months old in Luxembourg, 2011-2022.	Health Directorate
	Coverage (%) of hearing test in 5-6 year old schoolchildren (cycle 1.2) in Luxembourg, 2011-2022. Between March 2020 and September 2021 the screening programme in schools was interrupted due to the COVID-19 pandemic.	Health Directorate
Fig 70	Coverage (%) of the two recommended preventive dental visits in children 2 to 4 years of age, in the birth cohort 2009-2019, Luxembourg. The category of first dental visit is defined as one dental visit coded as DE2 or DC1 at age of 30 to 36 months. The category of second dental visit is defined as one dental visit coded as DE2 or DC1 at age 42 to 48 months. The indicator includes insured resident children only.	Social security database. Indicator computed by ObSanté.
Fig 71	Coverage (%) of the two recommended preventive dental visits in insured children 2 to 4 years of age, in the 2018 birth cohort, by migration background, Luxembourg. The analysis includes insured resident children. The category dental visit coded as DE2 or DC1 at age of 30 to 36 months and coded as DE2 or DC1 at age 42 to 48 months are considered. Migration background if both parents were born outside of Luxembourg. No migration background if one or both of the parenrs were born in Luxembourg. In the absence of information on the parents’ birth country, the definition was based on the individual’s birth country.	Social security database. Indicator computed by ObSanté
Fig 72	Coverage (%) of the two recommended preventive medical visits in children 2 to 4 years of age, in the birth cohorts 2011-20219, Luxembourg. The analysis includes insured resident children. The category of first medical visit include those coded as E18 at the age of 30 to 36 months and the second medical visit includes those coded as E19 at the age of 42 to 48 months.	Social security database. Indicator computed by ObSanté
Fig 73	Proportion (%) of children aged 25-30 months old with complete vaccination as per the national vaccination schedule for children by age 2 years, 2018, Luxembourg.	Vaccination coverage survey, Health Directorate, 2018
Tab 9	International comparison – Vaccination coverage estimates (WHO/UNICEF Estimates of National Immunization Coverage) for one year old children in 2022, by country	WHO (https://immunizationdata.who.int/)
	Number of notified diphtheria, measles, Haemophilus influenza type b (Hib) invasive infection, Meningococcal invasive disease cases in children 0-12 years old, 2011-2022. Up to 2019, cases from mandatory notification by physicians upon biological confirmation, except for clinical menigitis cases. Since 2020, clinical cases are reported by the physicians and biological confirmation is reported by laboratories. (reference: https://legilux.public.lu/eli/etat/leg/loi/2018/08/01/a705/jo)	Directorate of Health
	Maternal mortality rate in Luxembourg: Number of maternal deaths per 100 000 live births, within the years 2011-2021. Included are deaths of woman while pregnant or within 42 days of the termination of pregnancy, irrespective of the duration and site of the pregnancy, for any cause related to or aggravated by the pregnancy or its management. Death caused by accidental or incidental causes are excluded. Deaths that occurred on the territory of Luxembourg are included. For the number of live births of only residents are included.	National register of causes of death; STATEC. Indicator computed by ObSanté

Fig 74	Distribution (%) of live births by birth weight, 2011-2021, Luxembourg. Resident and non-resident newborns are included. Birth weight was categorised as <2500g, 2500-4499g, 4500g and above.	EuroPeristat for 2011-2019, PERINAT 2020-2021.
Tab 10	Number of hospitalisations, per 1000 children 0-12 years old, by type of stay, 2012-2022, Luxembourg. Type of stay is categorised as with overnight and as without overnight. Hospitalisations of resident insured children are included.	Social sceurity database. Indicator calculated by the ObSanté
Tab 11	Number of hospitalisations, per 1000 children 0-11 months old, by type of stay, 2012-2022, Luxembourg. Type of stay is categorised as with overnight and as without overnight stay. Hospitalisations of resident insured children are included.	Social sceurity database. Indicator calculated by the ObSanté
Fig 75	Proportion (‰) of newborns with an Apgar score <7 at 5 minutes, per 1000 live births in Luxembourg, 2011-2021. The indicator includes resident and non-resident newborns. The Apgar scoring system is divided into five categories: heart rate, respiratory rate, muscle tone, reflexes, and skin colour. Each category receives a score of 0 to 2 points. At most, a child will receive an overall score of 10; a score between 7 and 10 at 5 minutes is reassuring. A score of 4-6 is “moderately abnormal” and a score of 0-3 is concerning. .	PERINAT
	Access	
Fig 76	Proportion of women using at-home midwife visits per household income, April-December 2022, in Luxembourg. First quintile: lowest income, fifth quintile: highest income. Home visits of resident insured women are included, for the denominator only women that gave birth in Luxembourg were included. The billing code has been introduced in April 2022.	Social security database
Fig 77	Distribution of paediatric practices in Luxembourg (left) and crow flies distance between children 0-12 years old and the closest paediatric practice, 2022 <=5 km (green), >5 and <=10 km (blue), and >10 km (red). A denser colour indicates an area that is more densely populated by children.	eSanté.lu, RNPP 2023. Computed by ObSanté.
Tab 12	Distribution (%) of resident children 0-12 years old according to the crow flies distance to the next paediatric practice in Luxembourg, 2022. Source: eSanté.lu, RNPP. Indicator computed by ObSanté	eSanté.lu, RNPP 2023. Computed by ObSanté.
Fig 78	Number of medical visits in the national paediatric on-duty medical centre (Maison médicale pédiatrique de garde) in Luxembourg Centre, by month, February to December 2022. Count of single visits of resident and non-resident children aged 0-18 years old.	Health Directorate
Fig 79	International comparison – Proportion (%) of children below 16 years with unmet needs for dental care, by household income, 2021. Children are categorised according to the household equivalised income as either below or above 60% of the national median income . The equivalised income is calculated by dividing the household’s total income from all sources by its equivalent size (cf. equivalence scale).	EU-SILC
Fig 80	International comparison – Proportion (%) of children below 16 years with unmet needs for medical care, by household income, 2021. Children are categorised according to the household equivalised income as either below or above 60% of the national median income. The equivalised income is calculated by dividing the household’s total income from all sources by its equivalent size (cf. equivalence scale).	EU-SILC

Fig 81	Travel time by car to access maternity wards in Luxembourg (left) for women aged 15–49 years, 2023. <30 min (green), >30 and <=60 min (blue) and >60 min (red). A denser colour indicates an area that is more densely populated by women 15–49 years. Travel time was used for peak hours, with an arrival time defined as 8 a.m at the nearest maternity ward. Distribution (%) of resident women aged 15–49 years according to the travel time to the next maternity ward in Luxembourg, 2023.	eSanté.lu, RNPP 2023. Indictaor computed by ObSanté
Fig 82	Proportion (%) of newborns born in Luxembourg transferred to another national or international care service, 2011-2021. Over the observation period, fewer than five children were transferred outside Luxembourg, all of them were above 32 weeks of gestational age. The analysis includes resident and non-resident newborns.	PERINAT
Fig 83	Number of children 0–12 years old hospitalized (once or more often) outside Luxembourg, per 1000 children 0–12 years, 2011–2021. Insured resident children are included.	Social security database
	Safety of care	
Fig 84	Number of prescriptions of antibacterial for systemic use (J01) per 1 000 children 0-4 and 5-12 years old, 2011-2022, Luxembourg. Prescriptions to insured resident children were included. Antibacterials for systemic use we grouped according to ATC classification system by WHO (https://www.who.int/tools/atc-ddd-toolkit/atc-classification).	Social security database.
Fig 85	Ratio of consumption of broad-spectrum penicillin's, cephalosporin's, macrolides (except erythromycin) and fluoroquinolones (J01(CR+DC+DD+(F-FA01)+MA)) expressed in DDD per 1,000 children (0-4 and 5-12 y old) per day to the consumption of narrow spectrum penicillin's, cephalosporin's and macrolides (J01(CA+CE+CF+DB+FA01)) expressed in (DDD per 1,000 children (0-4 and 5-12 y old) per day), in primary care, 2011-2022, Luxembourg. Prescriptions to incured resident children were included.	Social security database. Indicator based on ECDC, EFSA and EMA Joint Scientific Opinion
Fig 86	Number of adverse event reports among children aged 0–12, by age group, 2011-2022, Luxembourg. Age categories: 0-11 months, 1-4 years, 5-9 years, 10-12 years.	Health Directorate (EudraVigilance)
	The proportion (%) of preterm live and stillbirths less than 32 completed weeks of gestation that are born in a maternity unit without an on-site neonatal intensive care unit, by prematurity: extremely preterm (22-27 weeks of gestation) and very preterm (28-32 weeks of gestation), 2011–2021.	PERINAT
Fig 87	Proportion (%) of births by mode of delivery: elective/primary caesarian section, emergency/secondary caesarian section, vaginal delivery, among all live and stillbirths in Luxembourg, 2015–2021. Includes all births by resident and non-resident women.	EuroPeristat for 2011-2019, PERINAT 2020-2021.
Fig 88	International comparision - Proportion (%) of caesarean section among all live and still births by country, 2019. Elective/primary and emergency/secondary caesarean sections among resident and non-resident women were included.	EuroPeristat
APPENDIX		
Tab 13	Annual hospitalization rate (with and without overnight stay) among resident insured children 0–12 years of age, per 1000 children by main diagnostic groups (ICD-10 chapters) and by age group, 2019, 2021 and 2022, Luxembourg. The table provides information in regards to all diagnostic categories of the International Statistical Classification of Diseases (ICD-10 version 2019). The same indicator is illustrated in Figure 33, but limited to the 10 most frequent diagnostic categories Age is categroized as <1 year and 1-12 years. The year 2020 is excluded due to incomplete coding linked to the COVID-19 pandemic. Resident insured children are included.	Social security database. Indicator computed by ObSanté.

Tab 14	Proportion (%) of children 0-12 years of age vaccinated against COVID-19, between 01.03.2020 and 16.05.2022. Only children having received at least two doses (or one dose of Johnson&Johnson vaccine) were included.	Directorate of Health; Social security database

Data sources

The specifics of the main data sources are detailed below:

The **Health Behaviour in School-aged Children (HBSC)** survey is one of the main data sources to describe the health behaviours of children. It is conducted every four years, using a nationally representative sample of children aged 11 to 18 years in state schools in Luxembourg. It provides self-reported information on children's' health and wellbeing, their health-related behaviours and environmental conditions. Over 50 countries conduct HBSC studies in collaboration with the World Health Organization Regional Office for Europe.[83] As we were interested in children up 12 years of age, we only used information for 11 and 12 year old children in the HBSC data. Where possible, we investigated trends of each outcome from 2010 to 2022, for girls and for boys. This data was extracted from the national HBSC dashboard.[27] The Luxembourg HBSC team also provided us with results for our indicators that were disaggregated by the self-perceived wealth of the family (rated on a five-point scale: answers 1–2 were combined to 'not well-off', 3 classified as 'average' and 4–5 as 'well-off'), the migration status (no migration background, one or both of the parents migrated to Luxembourg or the child itself migrated to Luxembourg), and the family structure (family with two parents present in household or other family structure) for the years 2014–2022. Those results were provided to us by the national HBSC committee. The respective sample sizes were 2037 children in 2022, 2280 in 2018 and 1890 in 2014. For international comparisons, we used data from 2018, which is the last year for which data from other European countries was available (at the time of writing of this report) in the HBSC study. Further, because international data is only available for 11 year olds, the international comparisons exclude 12 year old children.[22,83]

Administrative social security data from the **General Inspectorate of Social Security (IGSS)** covers everybody insured in the national public social security system. Part of this is the national health insurance (*assurance maladie-maternité*, AMM), which is compulsory for everyone who is economically active or receiving replacement income from the state. It covers family members, including—among others—minors who have no other health insurance coverage and those who are voluntarily insured. The results on health outcomes based on data from the social security database focus on residents who are affiliated to the AMM or to a foreign health insurance scheme. Thus those results exclude information on residents (and their co-insured family members) who are employees of international institutions such as the European Parliament, and who are insured by other specific insurance schemes. Further, it does not include information on people who are ineligible to receive assistance from social welfare offices—generally people living in the national territory without any official residence.

Availability of IGSS microdata on the microdata platform on Labour and Social Protection (LMDP):

Pseudonymized data on patients, healthcare providers, medical procedures and hospitalizations for the period from 2012 to 2022 was made available to the ObSanté through the LMDP, applying a set of procedures in order to comply with the requirements of the General Data Protection Regulation (GDPR).[288] Available records included the insured population from 0 to 12 years of age, and all healthcare professionals registered with the CNS for all specialties

except geriatrics and tropical medicine as defined in the '*Règlement grand-ducal du 10 juillet 2011 fixant la liste des spécialités en médecine et médecine dentaire reconnues au Luxembourg*' and practising in Luxembourg, as well as all reimbursed medical procedures and hospitalizations that took place in Luxembourg and concerned the targeted age group. The available records were filtered to include only resident children in our analyses, where applicable. To allow for a robust estimation of the size of the resident target population affiliated with social security, we considered monthly affiliations per person in the database. This enabled us to compute, for each person, the degree of affiliation for the considered calendar year. For example, a person being affiliated for 6 months in 2012 was considered as 0.5 persons in the given year. The populations we analysed were stratified by age group, canton of residence, migration background, and per-year quintile of equivalized household income. The equalized income is that compared with the total income of a household—after tax and social contributions—that is available for spending or saving, divided by the number of household members converted into equalized adults. This variable is calculated and provided by the IGSS.[§§§§§§§§§§§§§§§] A migration background was assigned if both an individual's parents were born outside of Luxembourg. In the absence of information on the parents' birth country, the definition was based on the individual's birth country. In cases where this information was also missing, the parents' nationalities were considered, and if this was not available, the individual's own nationality defined the migration background. Using these criteria, all individuals were unambiguously identified as either having or not having a migration background.

Data was handled on the secure processing environment of the IGSS. The summarized results were then exported after further proportionality and GDPR compliance checks by the IGSS, for integration in this report.

Further indicators based on social security data were calculated and the results were made available by the IGSS for this report in fully anonymized aggregated form. For this set of indicators, the age of children was calculated on the first of January for each year. The total number of resident insured children corresponds to the annual average of the twelve situations at the end of the month. Indicators based on the consumption of pharmaceuticals include those purchased in a community pharmacy.

Indicators based on ICD-10 codes related to hospitalizations are those recorded in the Documentation and Classification of Hospitals Stays (*Documentation et Classification des Séjours Hospitaliers,* DCSH) at the IGSS.[289] The year 2020 was not considered for indicators based on the ICD-10 coding of the DCSH, as the data was incomplete.

Value and limitation of IGSS data:
Using administrative social security data allowed the analysis of trends since 2012, as well as comparisons of results across different population groups. However, the data was primarily

[§§§§§§§§§§§§§§§] Household members are made equivalent by weighting each according to their age, using the modified OECD equivalence scale (1.0 for the first adult; 0.5 for the second and each subsequent person aged 14 and over; 0.3 for each child aged under 14) and according to the number of months present in the national system of social protection during the year. The equivalized disposable income of a person who lives in a household in which there is also at least one person not affiliated to the Luxembourg social security system (international civil servant for example) will not be calculated and will be categorized as missing.

collected for billing purposes and thus does not provide information that would have been irrelevant for its primary purpose; for example, information about comorbidities is absent. Further, the validity of the data depends on the accuracy of billing codes given by the service providers.

The **Surveillance de la Santé Périnatale au Luxembourg,** (Perinatal Health Monitoring System) collects and reports data on all births that took place during a given year in the territory of Luxembourg. The Perinatal Health Monitoring System does not include any data that could identify an individual. Data collection starts at the first prenatal consultation and ends when the newborn is discharged from the maternity unit or neonatal unit. All maternity hospitals and self-employed midwives participate and provide the required information with regard to all births, as well as with regard to the health of the mother. It is an exhaustive registry that reports all core and recommended indicators to the European Euro-Peristat project. The presented indicators include data on births between 2011 and 2021 with the exception of home births, for which data was not yet available for 2021 and therefore is only complete up to the end of 2020. Where of interest, indicators were further stratified using data for the three years 2019 to 2021 (that is, by maternal family structure). The data part of the Euro-Peristat core indicators (proportion of live births weighing <2,500 g; rate of caesarean section) were available and extracted from the corresponding website for the years 2015–2019. The core indicators for the years 2020–2021 were calculated and provided to us by the Perinatal Health Monitoring System. For any international comparisons, we used data from 2019, which is the last year for which data covering other European countries is available from Euro-Peristat. All the outcomes presented here were provided to us by the Luxembourg Institute of Health (LIH), which operationalizes the Surveillance on Perinatal Health under the governance of the Ministry of Health, Health Directorate and for all parties of the steering committee. The reports of the Perinatal Health Monitoring System (https://susana.lu/web/Accueil.aspx) are available online, as well as the data and reports from EuroPeristat (https://www.europeristat.com/index.php).

The **Surveillance de la mortalité** (Monitoring of Causes of Death) is based on the register of causes of death. This uses encoded data from death certificates, which are mandatory for all deaths occurring on national territory (factual death). Thus, the registry does not provide information for the cause of death of Luxembourg residents who die outside the country. In the registry, causes of death are coded according to the International Statistical Classification of Diseases and Related Health Problems (ICD) drawn up by the World Health Organization (WHO). The data presented in this report was coded according to ICD-10 (10th revision), and the causes of death are presented in this report by allocating the principal causes of death to the 22 disease groups (chapters) and subchapters, as drawn up by ICD-10.[98]

The findings referring to mortality that are presented in this report rely on registry data and were produced by ObSanté based on a data request for a selection of validated variables of the registry from 2011 to 2021.

The national statistics of the Monitoring of Causes of Death are published annually by the Ministry of Health, Directorate of Health https://sante.public.lu/fr/espace-professionnel/informations-donnees.html. Further, the results are shared with Eurostat, OECD, WHO and Euro-Peristat, to produce international indicators.

Depending on the process and purpose of the analysis, different sources or inclusion/ exclusion criteria may be applied to produce mortality results. This leads to differences that can be observed in the results between some of the international databases and our report. For example, to calculate neonatal mortality, we used data sourced from the register of causes of deaths, whereas the OECD uses data from the population registry and thus includes deaths that occur outside of the country, but does not include deaths of non-residents that occur in Luxembourg. In addition, this report uses the number of live births as registered in the population registry as the denominator to calculate perinatal mortality. By comparison, Euro-Peristat uses the number of live births from the Perinatal Health Monitoring System.

The **REcueil d'informations sur les TRaumatismes et ACcidEnts" (RETRACE)** also called "Système national de surveillance des traumatismes et accidents" is an hospital emergency department-based injury registry that collaborates with the European Union Injury Data Base (EU-IDB)[110]. The RETRACE data contains information about any injury, as well as the conditions in which the trauma or accident occurred.[108] Data collection is carried out during the medical and nursing history at the time of the patient's admission to the emergency department or another hospital department (an intensive care unit in the case of direct transfer). For the years 2013 and 2018, all hospitals participated in RETRACE; however, between 2014 and 2017, and 2019 and 2020, the data is not exhaustive, as one hospital did not participate. Therefore, weighting coefficients were calculated by the RETRACE surveillance system team to produce estimates of injury data for the country for those years. The report presents the findings of the mechanism of injuries and type of lesions for the years 2013–2020. Stratifications (incidence of injuries by age group, and distribution of injuries by mechanism of injury and by type of lesion) are presented based on data for three years (2018–2020). All the indicators were produced by the RETRACE team. RETRACE is operationalized by the Luxembourg Institute of Health (LIH) for the Ministry of Health, Directorate of Health.

The **European Union statistics on income and living conditions (EU-SILC)** is the EU reference source for comparative statistics on income distribution and social inclusion at the European level. EU-SILC involves household and individual data collection regulated by legislation. A person is selected at random from the National Registry of Natural Persons, and all the members of his or her household are invited to take part in the survey once a year for four consecutive years. Data about individuals and households is sent to Eurostat by the participating countries, respecting legal deadlines and agreed guidelines and procedures. In addition to the yearly recurring questions, modules concerning specific topics are collected every three or six years The 'Health' module is added every three years (2016, 2019 and 2022).

In Luxembourg, STATEC conducts the SILC survey.

Registre National du Cancer (RNC) (National Cancer Registry) is an exhaustive record of all new cases of cancer diagnosed and/or treated in Luxembourg (https://www.rnc.lu/).

Coding is carried out in accordance with international rules (ICD-O-3, TNM 7th edition, TNM 8th edition) so that the results obtained are internationally comparable. The registration and validation rules follow the recommendations of the International Agency for Research on Cancer (IARC) and the European Network of Cancer Registries (ENCR). The RNC works in compliance with the protection of personal data. The Ministry of Health has mandated the

Luxembourg Institute of Health with the process of data collection, through to data analysis and publication.

We used data and information collected and published by the national population-based cancer registry (RNC) in the form of an epidemiological bulletin: *Incidence des cancers de l'enfant au Luxembourg: données du Registre National du Cancer, 2014-2022*.[103]

STATEC is the national institute of statistics and economic studies of the Grand Duchy of Luxembourg. STATEC works in accordance with national and European statistical legislation, and produces and disseminates data in complete neutrality. STATEC is responsible for conducting a national population census. It then produces demographic data and transmits it to Eurostat. In the current report, we used this demographic data for population age groups, births and deaths, as well as results from the SILC survey produced by STATEC.

The **Carte sanitaire** is a report that draws up a detailed inventory of the hospital sector; both from a structural point of view (an inventory of the structural and human resources, as well as their organization) and from an operational point of view (descriptions of activities and utilization rates). It is updated every two years: https://sante.public.lu/fr/espace-obsante/carte-sanitaire.html

The Carte sanitaire serves as a basis for estimating national health needs, in terms of both the number of hospitals and the number of hospital beds and services. In this report, we used data from the 2017 and 2021 editions of the Carte sanitaire with regard to the available hospital beds and the evolution of availability in maternity and paediatric wards.

Sources for the section on COVID-19

National surveillance system for SARS-CoV-2 laboratory results

All PCR test results for SARS-CoV-2, both positive and negative, were reported on a mandatory basis by all clinical laboratories in Luxembourg and centralized via secure electronic reporting in a common database at the Health Directorate for real-time management of cases.

National registry for vaccination data for COVID-19 vaccines

Vaccination data was obtained from the COVID-19 national vaccination registry, implemented as part of the national vaccination strategy.[290]. The registry collects information on individuals who have been vaccinated, as well as on the vaccines used.

For public health monitoring and research purposes, the COVID-19 surveillance data and vaccination data were linked to the national database managed by the General Inspectorate of Social Security using national identification numbers. This linkage allowed us to access pseudonymized details regarding demographic and socioeconomic status from the Social Security database (see Kerm et al. 2022[136] for details on the general methodology).

Results from published reports

National report on children in Luxembourg in 2022: Children's wellbeing in Luxembourg (Rapport national 2022 sur la situation des enfants au Luxembourg – Le bien-être des enfants des enfants au Luxembourg[152])

The data used in this report was collected as part of an international collaborative study: the International Survey of Children's Well-being (ISCWeB). The aim of this survey was to collect information on children's daily lives and activities, and on children's perception of their own life. It consisted of a questionnaire, available in three versions: one for 8 year olds, one for 10 year olds and one for 12 year olds. The main topics covered are family situation and relationships, money and household economic resources, friends, school, neighbourhood or village, , parental assistant, use of extracurricular time, personality and assessment of personal wellbeing. The questionnaire was adapted to suit the Luxembourg context, with the addition of questions about non-formal education and multilingualism.

The survey was carried out in Luxembourg on two occasions: in 2019 and in 2021. In 2019, all children aged 8, 10 or 12 living in the territory were invited to complete an online questionnaire, available in five languages (Luxembourgish, French, German, English and Portuguese). A total of 7,992 children took part (40% of those invited). To enable comparison with the 2019 data, the government invited children who had completed the first survey (7,758 children) to complete a second questionnaire in 2021. This questionnaire was identical to that in the 2019 survey, but with an additional module dedicated to the impact of the health crisis on children's lives. Children were asked to report the frequency of changes in their daily life and the frequency of certain emotions after one year of the pandemic. A total of 2119 children took part in this second evaluation, and the data from 2104 children could be analysed. In addition, a health crisis module with identical questions was also presented to parents, enabling the comparison between parents' and children's points of view.

Subjective Wellbeing and stay-at-home experiences of children aged 6–16 during the first wave of the COVID-19 pandemic in Luxembourg (Bien-être subjectif et expériences quotidiennes des enfants de 6 à 16 ans pendant la première vague de la pandémie COVID-19 au Luxembourg: Un rapport du COVID-Kids) [151]

This study aimed to explore subjective wellbeing and stay-at-home experiences during the first wave of the pandemic of children aged 6 to 16. It used a mixed-method approach, comprising a questionnaire and interviews. The interdisciplinary research team (Kirsch, Engel de Abreu and Neumann) developed a 68-item questionnaire in Luxembourgish, French, English and Portuguese. The data was collected between 6 May and 14 July 2020 via an unrestricted and anonymous, web-based survey with non-probability sampling. Data for 680 children was analysed for the purpose of the report. Moreover, 22 children aged 8 to 16 were interviewed on online platforms in May 2020. The questions in the interviews were based on an adapted version of the interview guide 'Children at home – Children talking about staying at home during corona time'.

The first wave of COVID-Kids was supplemented with a second wave in 2021: the **COVID-Kids II** study[152]. This second study explored child wellbeing and the experiences of children aged 6–16 years, with a mixed method comprising questionnaires and interviews. This included 621 child questionnaires and 22 interviews with children. Quantitative and qualitative data was collected between June and July 2021 and September and October 2021.

OKAJU, Rapport annuel 2021, Covid-19 et les droits de l'enfant[153]

This report is based on the analysis of various studies, expertise and surveys about children's health, rights and wellbeing during the pandemic. The study was carried out in Luxembourg and abroad. Activity reports from ministries, administrations, social services and other players in the field were also used. Moreover, OKAJU sought to interview key players, while others were contacted in writing. OKAJU asked them about the way they operated during the pandemic and the impact of visits, as well as their assessments and evaluations of the situation of children and young people during the pandemic.

HOSPITALIZATION RATE

Table 13 Annual hospitalization rate (with and without overnight stay) among resident insured children 0–12 years of age, per 1000 children by main diagnostic groups (ICD-10 chapters) and by age group, 2019, 2021 and 2022, Luxembourg.

The table provides information in regards to all diagnostic categories of the ICD-10. The same indicator is illustrated in Figure 33, but limited to the 10 most frequent diagnostic categories

Source: Social security database, Indicator computed by ObSanté.

	2019–2022	
	<1 year	**1–12 years**
ICD chapter	**Hospitalizations per 1000 children**	
Diseases of the respiratory system	58.2	12.5
Conditions originating in the perinatal period	45.7	0.4
Diseases of the genitourinary system	14.9	5.8
Infectious and parasitic diseases	13.6	1.8
Factors influencing health status and contact with health services	12.2	3.9
Symptoms, signs and abnormal clinical and laboratory findings	11.9	3.1
Congenital malformations and chromosomal abnormalities	8.4	2.9
Diseases of the digestive system	5.1	5.5
Injury, poisoning and consequences of external causes	4.8	6
Neoplasms	4.1	1.3
Diseases of the nervous system	3.1	2.3
Endocrine, nutritional and metabolic diseases	1.3	2.4
Diseases of the blood-forming organs and of the immune system	1.2	1.5
Diseases of the skin and subcutaneous tissue	1.2	0.8
Diseases of the ear and mastoid process	0.8	2.2
Diseases of the circulatory system	0.7	0.2
Diseases of the musculoskeletal system and connective tissue	0.5	1.3
Diseases of the eye and adnexa	0.5	0.3
Mental, Behavioural and Neurodevelopmental disorders	0.1	1

COVID-19 VACCINATION COVERAGE

Table 14 Proportion (%) of children 0-12 years of age vaccinated against COVID-19, between 01.03.2020 and 16.05.2022. Only children having received at least two doses were included.

Source: Directorate of Health; Social security database

	01/03/2020 - 16/05/2022
All children 0-12	
	26.84%
Gender	
Boys	26.83%
Girls	26.85%
Age	
Below 3	0.05%
3-5 years old	12.47%
6-8 years old	19.80%
9-12 years old	60.77%
Income (EUR)	
<25,000	22.11%
25,000-30,000	24.91%
30,000-35,000	25.06%
35,000-40,000	25.17%
40,000-45,000	26.29%
45,000-50,000	26.41%
50,000-60,000	29.85%
Income >60,000	35.42%
Canton of residence	
Capellen	30.08%
Redange	27.67%
Remich	28.50%
Vianden	30.66%
Wiltz	25.07%
Clervaux	27.64%
Diekirch	30.41%
Echternach	32.95%
Esch-sur-Alzette	23.15%
Grevenmacher	34.47%
Lux-Campagne	30.29%
Luxembourg-Ville	22.67%
Mersch	31.05%

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OBSERVATOIRE
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