Archives de pédiatrie 30 (2023) 48–58

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Research paper

Long-term chronic diseases and 1-year use of healthcare services by children under 18 years of age during 2018–2019: A French nationwide observational study

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ARTICLE INFO

Article History:
Received 16 March 2022
Revised 2 November 2022
Accepted 20 November 2022
Available online 5 December 2022

Keywords:
Administrative claims
Children
Healthcare use
Morbidities
Population surveillance

ABSTRACT

Objective: Among children younger than 18 years, the prevalence of long-term chronic diseases (LTDs) is not well known in France, nor the frequency of the use of healthcare services. This nationwide observational study focused on both topics over a 1-year period following the birth or birthday of French children in 2018 and compared the LTD status and use of healthcare.

Materials and methods: We selected children living in mainland France from the national health data system (SNDS). It includes data concerning the LTD status, which guarantees 100% reimbursement for related healthcare expenditures. We calculated the median and interquartile range (IQR) for the prevalence of LTDs and the rate of children using healthcare services at least once during the year.

Results: We included 13.211 million children (51.2% boys), of whom 4% had at least one LTD (boys: 4.6%, girls: 3.3%). Mental and behavioral disorders were the most frequent cause (1.6%). At least one visit to a general practitioner (GP) or pediatrician was found for 88% of children (median: 3, IQR: 2–6): 98% for children under 1 year of age and 81% for children aged 14–17 years. A pediatrician was visited by 17% of children, another specialist by 39%, a dentist by 37%, with peaks of about 60% at the ages of 6, 9, and 12 years; 8% visited a nurse and 7% visited a physiotherapist. At least one emergency department visit was recorded for 24% of children (42% <1 year) and one short-stay hospitalization (SSH) for 9%. Regional variations were observed. Children with LTDs more frequently used all services, such as specialist visits (50% vs. 40%), ED visits (32% vs. 23%), SSHs (26% vs. 8% and 15% vs. 4.0% for one night or more), and psychiatric hospital admissions (5% vs. 0.1%).

Conclusion: Most children saw a GP or pediatrician during the year and children with an LTD showed more frequent use. Nevertheless, outpatient visits appeared to be underutilized with respect to recommendations or free-of-charge prevention visits, such as for dentists. More detailed studies are required to identify factors associated with the use of healthcare services in France, for example, studies including the deprivation index and regional variations.

1. Introduction

The use of healthcare services by children varies between and within countries and depends on many factors, including health status and disease epidemiology, family sociodemographic and economic characteristics, living conditions, healthcare coverage, and healthcare supply and organization [1–7]. In the United States and England, several series of reports have provided information about multiple dimensions of healthcare use by children and adolescents [8–11]. A number of studies have focused on the impact on healthcare use of complex or chronic conditions, of which the prevalence varies according to the definitions and criteria used [12–16].

In France, nationwide general data concerning child health and healthcare use, outside the context of studies on specific diseases, are collected but are scarce. A series of representative, cross-sectional national surveys of child health have been performed at approximately 5-year intervals, focusing on three school periods (grammar, middle, and high school) [17]. These surveys have focused on statural and ponderal disorders, chronic diseases and deficiencies likely to have a deleterious effect on the everyday life and schooling of the child, dental health, and vaccination coverage, but they have not considered the use of healthcare services in their entirety. Most national

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https://doi.org/10.1016/j.arcped.2022.11.014

studies, such as perinatal surveys on population samples, target children of specific ages [18].

The French national health data system (SNDS) includes data for almost the entire French population with public universal health insurance coverage [19]. It contains information on long-term chronic diseases (LTDs), defined as potentially life-threatening or disabling diseases requiring regular, costly, long-term care. The LTD status guarantees 100% reimbursement for healthcare expenditure related to the LTD. Several studies have used SNDS data to investigate pregnancy management and changes in the rates of hospitalization of adolescents with LTDs [20,21].

Data on LTD prevalence and the use of healthcare services by children are still scarce in France, and therefore knowledge concerning healthcare use according to LTD status is limited. In this French nationwide observational study using the SNDS, our first objective was to determine the prevalence of LTDs among children. Our second objective was to determine the use of various healthcare services (outpatient visits, emergency department [ED] visits, primary diagnoses, and types of hospital) over a 1-year period by children under the age of 18 years, and, finally, to compare healthcare use between children with or without an LTD.

2. Patients and methods

2.1. Population

France has 67 million inhabitants, 14.6 million of whom were under the age of 18 years on January 1, 2019 (14 million in mainland France), according to the INSEE (*Institut National de la Statistique et des Etudes Economiques*, National Institute for Statistics and Economic Studies). This study concerned individuals under 18 years of age on December 31, 2018, living in mainland France with national health insurance coverage and at least one healthcare reimbursement from health insurance in 2018. Children of the same sex resulting from a multiple birth (twins, triplets, etc.) could not be identified unambiguously in the database and were excluded. For the sake of homogeneity, we also excluded children of different sexes resulting from a multiple birth. In addition, we excluded children whose month of birth could not be identified and those who died before the end of the 1-year study period.

2.2. Data source

The SNDS collects comprehensive, anonymous, individual data concerning all reimbursed prescriptions, examinations, and procedures performed in the outpatient setting and during hospitalization, with details of the type of health institution. The dates of the reimbursed healthcare and information about the beneficiaries themselves (date of birth, sex, town of residence, deprivation index, etc.) are also available [19]. In France, maternity and child welfare centers (PMI: *Protection maternelle et infantile*) are public and carry out medical and social prevention for mothers and their children aged under 6 years. At the end of 2019, there were 4000 fixed locations devoted to children's consultations and childcare procedures with 1700 full-time equivalent medical doctors [22]. Visits to a PMI are entered into the SNDS and can be identified using two specific codes to identify the PMI institution ("departmental child health protection service" and "establishment of child protection consultations"). Nevertheless, specific data analysis of PMI medical consultation activities was not performed because of a possible lack of completeness, as no reimbursement is needed for free visits.

The SNDS does not record medical diagnoses for medical visits or the results of clinical examinations or investigations. LTD coverage status is requested by the patient's general practitioner (GP) and guarantees 100% reimbursement for all healthcare expenditures related to the LTD for at least 5 years; it can be requested or renewed according to disease progression and clinical status. Diagnoses are made and validated after medical examinations, and, in some cases, hospitalizations or the disease/condition becoming chronic during the follow-up, by the patient's GP using national recommendations for diagnosis, treatment, and follow-up. The list of LTDs is published and activated by decree after expertise from the HAS (*Haute Autorité de Santé*, French National Authority for Health) [23,24]. A guide is also sent to the patient and information is available on the HAS website [23]. The data in the SNDS are linked to data concerning public and private hospital stays via the national hospital discharge database through a pseudonymized identification number. Hospital stays can include short-stay hospitalizations (SSHs) and stays in psychiatric hospitals or rehabilitation facilities and home hospitalization. Normal stays in hospitals/maternity units for childbirth without the need for neonatal care were excluded. Information is also collected for pediatric reanimation, neonatology, and ED visit, with or without a subsequent SSH. The primary hospital diagnoses for SSHs (including day hospitalization) and LTD diagnoses are coded according to the International Classification of Diseases 10th revision (ICD-10).

2.3. Outcomes

The primary outcome was the prevalence of at least one LTD with details concerning the disease chapter in the ICD-10 and the most frequent diagnosis. The second outcome was the frequency of outpatient visits, defined as reimbursement for a service provided by a primary healthcare professional outside the hospital, hospital outpatient consultation, and visits to an ED and hospital stay. The primary diagnosis for each SSH was also analyzed to identify the frequency of acute and chronic diagnoses. Primary diagnoses with an ICD-10 Code ranging from Z00 to Z99—"Factors influencing health status and contact with healthcare services"—concern individuals using healthcare services for examinations. We used the related diagnosis of the stay, if available, to obtain information about the diseases. Each of the second outcomes was analyzed according to the LTD status.

2.4. Analyses

LTD prevalence by age is expressed as the rate of at least one LTD for a specific ICD-10 chapter and detailed diagnosis. Healthcare use is expressed as the rate of individuals with at least one use of a specific healthcare service during the year following the month of their birth or birthday in 2018. The median number of annual uses of healthcare is reported, together with the interquartile range [IQR], to assess the intensity of healthcare use. Results are detailed by age, sex, and LTD status. The proportion of children with at least one visit to a GP or pediatrician according to their location (primary care, PMI, outpatient hospital services) was calculated for each location only or with others, with specific attention to PMIs. Healthcare use for a given *département* (a French administrative area equivalent to a county), after standardization for age over the entire study population, is represented on maps and the relationship between two primary care visits, ED visits, or SSHs was investigated by calculating Pearson's correlation coefficient (r). Data for the SSH primary diagnosis are expressed as a rate for the population of individuals with at least one SSH by age, sex, and LTD status.

SAS software (version 7.13, SAS Institute Inc, Cary, NC, USA) was used for statistical analysis. R software (3.4.3) was used for the analyses by *département*. The CNAM has permanent access to the pubic SNDS database by decree and with authorization from the *Commission nationale de l'informatique et des libertés* (CNIL; the French data protection authority).

3. Results

Our study included 13.211 million children (51.2% boys) under the age of 18 years living in mainland France in 2018, comprising 94% of this population.

3.1. LTD prevalence

At least one LTD was found for 4.0% of children (4.6% of boys and 3.3% of girls). This proportion increased with age (1.5% for children < 1 year of age, 5.2% for children aged 14–17 years) (Table 1). Eight of the 10 most frequent LTDs were classified as "mental and behavioral disorders" (1.6%). The most frequent LTD diagnosis was "pervasive developmental disorders" (0.53%), peaking at the age of 9–10 years and decreasing thereafter, occurring mostly for boys (78.6%) (Fig. 1). Asthma (0.24%) was the most frequent somatic LTD. The frequency of LTDs for scoliosis (0.15%) began to increase before puberty and peaked at 16 years of age, mostly for girls.

3.2. Use of healthcare services

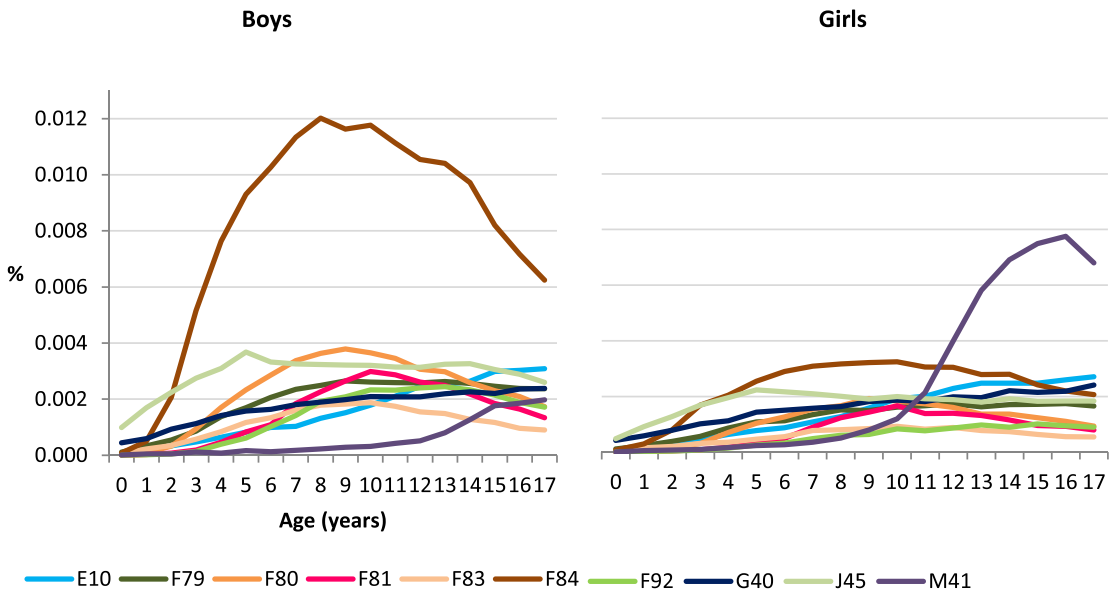
3.2.1. Outpatient visits

Over a 1-year period, 88% of children had an outpatient visit to a GP or pediatrician (GP: 84%, pediatrician: 17%), with a median of three visits (IQR: 2–6) (Table 2) that varied with age (median 11 <1 year, 2 <14 years). The proportion of children visiting a GP or pediatrician decreased slowly with age (<1 year: 98%, 14–17 years: 81%) (Fig. 2). For pediatricians, it decreased sharply and steadily (<1 year: 54%, after 10 years: <10%). No annual GP or pediatrician visit was found for 12% of children (1.8% <1 year and 18.7% 14–17 years). At least one GP or pediatrician visit in primary care was found for 88% of children (0–17 years) and a PMI for 2% (Table 3). For children younger than 6 years, at least one or more annual exclusive consultations in a PMI was found for 0.5%, regardless of visits to other healthcare professionals: 6% (14% <1 year). In total, 626,317 PMI consultations (MD or pediatrician) were entered in the SNDS for 267,000 children, for a total of 2.1% of all consultations among children under 6 years of

Table 1
The most frequent long-term disease diagnoses in children under the age of 18 years in 2018 followed up for 1 year after their birthday by age and sex.

		Age (years)					
	Total	<1	1	2–4	5–9	10–13	14–17
N (millions)	13.211	0.674	0.699	2.166	3.756	2.993	2.924
%	100	5.1	5.3	16.4	28.4	22.7	22.1
Characteristics	%	%	%	%	%	%	%
Sex							
Male	51.2	51.3	51.2	51.3	51.3	51.1	50.8
At least one long-term chronic disease	4.0	1.5	1.9	2.6	3.9	4.8	5.2
In boys	4.6	1.6	2.1	3.1	4.9	5.7	5.7
In girls	3.3	1.3	1.7	2.2	3.0	3.9	4.7
Long-term chronic diseases (ICD-10)							
Mental and behavioral disorders	1.62	0.050	0.14	0.63	1.82	2.32	2.11
Pervasive developmental disorders	*0.53*	*0.0077*	*0.040*	*0.33*	*0.71*	*0.71*	*0.51*
Specific developmental disorders of speech and language	*0.17*	*0.0012*	*0.0067*	*0.070*	*0.24*	*0.25*	*0.17*
Unspecified mental retardation	*0.16*	*0.011*	*0.029*	*0.078*	*0.18*	*0.21*	*0.21*
Specific developmental disorders of scholastic skills	*0.12*	*0.00*	*0.0020*	*0.018*	*0.13*	*0.21*	*0.14*
Mixed disorders of conduct and emotions	*0.10*	*0.00*	*0.002*	*0.014*	*0.10*	*0.16*	*0.15*
Mixed specific developmental disorders	*0.088*	*0.0061*	*0.019*	*0.045*	*0.11*	*0.13*	*0.085*
Hyperkinetic disorders	*0.083*	*0.00*	*0.00*	*0.0064*	*0.11*	*0.15*	*0.076*
Specific personality disorders	*0.070*	*0.00*	*0.00*	*0.0046*	*0.044*	*0.10*	*0.15*
Congenital malformations, deformations, and chromosomal abnormalities	0.65	0.64	0.73	0.77	0.66	0.59	0.59
Congenital malformations of cardiac septa	*0.081*	*0.093*	*0.10*	*0.11*	*0.075*	*0.062*	*0.083*
Other specified congenital malformation syndromes affecting multiple systems	*0.061*	*0.047*	*0.054*	*0.069*	*0.068*	*0.060*	*0.052*
Congenital deformities of feet	*0.060*	*0.11*	*0.11*	*0.10*	*0.061*	*0.041*	*0.026*
Down syndrome	*0.055*	*0.056*	*0.066*	*0.067*	*0.060*	*0.048*	*0.046*
Other congenital malformations of heart	*0.025*	*0.029*	*0.033*	*0.032*	*0.026*	*0.021*	*0.021*
Endocrine, nutritional, and metabolic diseases	0.35	0.10	0.13	0.19	0.29	0.47	0.52
Type 1 diabetes mellitus	*0.15*	*0.002*	*0.015*	*0.047*	*0.11*	*0.22*	*0.28*
Diseases of the nervous system	0.35	0.10	0.14	0.24	0.34	0.41	0.47
Epilepsy	*0.17*	*0.043*	*0.059*	*0.11*	*0.17*	*0.20*	*0.23*
Diseases of the respiratory system	0.25	0.083	0.15	0.24	0.29	0.27	0.26
Asthma	*0.24*	*0.074*	*0.13*	*0.22*	*0.27*	*0.26*	*0.24*
Diseases of the musculoskeletal system and connective tissue	0.25	0.010	0.020	0.045	0.10	0.31	0.62
Scoliosis	*0.15*	*0.00*	*0.0049*	*0.010*	*0.031*	*0.19*	*0.44*
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	0.12	0.090	0.094	0.12	0.12	0.12	0.13
Sickle-cell disorder	*0.045*	*0.051*	*0.048*	*0.051*	*0.044*	*0.044*	*0.040*
Neoplasms	0.12	0.033	0.057	0.090	0.12	0.14	0.17
Diseases of the digestive system	0.11	0.031	0.059	0.074	0.084	0.13	0.19
Diseases of the circulatory system	0.09	0.084	0.099	0.10	0.09	0.09	0.10
Certain conditions originating in the perinatal period	0.08	0.19	0.22	0.15	0.063	0.038	0.027
Disorders related to short gestation and low birth weight. not elsewhere classified	*0.039*	*0.12*	*0.15*	*0.082*	*0.028*	*0.011*	*0.005*
Injury, poisoning and certain other consequences of external cause	0.071	0.019	0.046	0.059	0.047	0.050	0.15
Diseases of the genitourinary system	0.046	0.015	0.018	0.036	0.047	0.054	0.057
Diseases of the eye and adnexa	0.033	0.013	0.015	0.025	0.036	0.040	0.040
Certain infectious and parasitic diseases	0.024	0.016	0.024	0.028	0.019	0.017	0.037
Diseases of the ear and mastoid process	0.016	0.005	0.007	0.010	0.017	0.021	0.020
Diseases of the skin and subcutaneous tissue	0.013	0.002	0.004	0.007	0.012	0.015	0.024
Factors influencing health status and contact with health services	0.028	0.068	0.083	0.039	0.016	0.020	0.023
Contact with and exposure to communicable diseases	*0.013*	*0.065*	*0.076*	*0.030*	*0.0019*	*0.00*	*0.0018*

ICD-10: diagnosis and chapter of the International Classification of Diseases 10th Revision.



Diagnosis codes of the ICD 10th	
E10 Type 1 diabetes mellitus	F84 Pervasive developmental disorders
F79 Unspecified mental retardation	F92 Mixed disorders of conduct and emotions
F80 Specific developmental disorders of speech and language	G40 Epilepsy
F81 Specific developmental disorders of scholastic skills	J45 Asthma
F83 Mixed specific developmental disorders	M41 Scoliosis

Fig. 1. Prevalence of the 10 most frequent long-term disease diagnoses among children under 18 years of age in 2018 by sex and age. ICD 10th: diagnosis chapter codes of the International Classification of Diseases 10th Revision.

age. Other specialists were visited by 39% of children, including ophthalmologists (25%), dermatologists or ENT specialists (7% each), or a psychiatrist (1%). The rate increased between the ages of 0 and 6 years (<1 year: 15.2%, 5–9 years: 43.2%). However, this rate continued to increase beyond the age of 6 years for girls, but not boys, when the two sexes were considered separately (Fig. 2). A similar difference between the sexes was observed for visits to a GP, but at later ages, as for nurses. At least one visit to the dentist took place for 37% of children of all ages. It increased after the age of 5 years, reaching a plateau of approximately 45%, with peaks of approximately 60% at the ages of 6, 9, and 12 years, and a lower decrease of visits from 15 years on.

3.2.2. *Emergency department and hospital use*

At least one ED visit was found for 24% of children during the year (approximately 40% between 0 and 2 years of age, followed by a plateau of 20% after 5 years) (Table 2, Fig. 2) and was followed by an SSH for 3.4% (15% for those <1 year of age). At least one SSH was observed for 8.8% of children (4.5% staying one night and more and 4.9% for less than one night). The most frequent principal diagnoses belonged to the digestive system chapter of the ICD-10 for girls (22.4% of girls with at least one stay) and the respiratory system category for boys (17.5%) (Table 4).

For infants under the age of 1 year, at least one SSH was recorded for 26.6%, with 11% having at least one stay in a neonatology department and 4% in a neonatology unit with intensive care or reanimation facilities (Table 3). A condition classified in the perinatal period diagnosis chapter was the most common (41.1%). These conditions included disorders related to short gestation periods and low birth weight not classified elsewhere in the ICD-10 classification (10.4%) and respiratory distress of newborns (7%). Diseases of the respiratory system, and acute bronchiolitis (18.2%) in particular, were the second most frequent diagnoses. The frequency of SSHs decreased to 9.7% between the ages of 2 and 4 years (Fig. 2). For this age group, an SSH was noted more frequently for boys than for girls (Fig. 2) and the most frequent primary diagnoses were chronic diseases of the tonsils and adenoids (16.6%), redundant prepuce, phimosis, and paraphimosis (26% of boys hospitalized at the age of 2 years), and non-suppurative otitis media (8.7%) (Table 4, Fig. S1). The frequency of SSHs continued to decrease steadily to 5.1% in the 10- to 13-year age group before subsequently increasing in the 14- to 17-year age group (10.7%), with a large increase in the frequency of diagnoses for embedded and impacted teeth (33.5%). At least one stay in a psychiatric hospital was found for 0.31% of children, which increased with age, and in rehabilitative care for 0.23%, which also increased with age (Table 2, Fig 2)

3.2.3. *Disparities among* départements

Differences between *départements*, after age standardization, were found for the percentage of children with at least one visit to a GP or pediatrician (83% to 91%), another specialist (28% to 47%), a dentist (31% to 45%), or an ophthalmologist (15% to 32%) and for rates of SSH (7% to 11%) or visits to the ED without hospitalization (13% to 37%) (Fig. 3). Seeing a GP or a pediatrician was inversely correlated with visiting an ED without an SSH (correlation coefficient r=−0.30, p = 0.003) but did not correlate with SSHs (r = 0.18, p = 0.07). Seeing another specialist was inversely correlated with hospitalization (r=−0.27, p = 0.008) and visiting an ED without an SSH (r=−0.25, p = 0.02).

3.3. *Use of healthcare services by LTD status*

Children with LTDs used healthcare services with a higher frequency than children without (Table 2, Fig. 4). A GP or pediatrician was visited by 90.1% vs. 87.9% of those without an LTD (median number of visits: 4 vs. 3), 49.8% vs. 39.0% saw another specialist

Table 2
Frequency of outpatient or hospital healthcare service visits by children under the age of 18 years in 2018 followed up for 1 year after their birth or birthday by age group, sex, and LTD.

		Age (years)						Sex		LTD	
	Total	<1	1	2–4	5–9	10–13	14–17	Boys	Girls	With	Without
N (millions)	13.211	0.674	0.699	2.166	3.756	2.993	2.924	6.758	6.453	0.525	12.687
Outpatient visits											
GP or pediatrician%	88.0	98.1	97.7	94.7	88.5	84.6	81.3	87.7	88.4	90.1	87.9
Median [IQR]	3 [2–6]	11 [8–14]	7 [5–10]	4 [3–7]	3 [2–5]	2 [1–4]	2 [1–4]	3 [2–6]	3 [2–6]	4 [2–7]	3 [2–6]
GP%	83.6	86.4	88.4	87.4	83.6	82.1	80.4	83.3	83.9	86.5	83.5
Median [IQR]*	3 [2–5]	7 [3–11]	6 [3–9]	4 [2–6]	3 [2–4]	2 [1–4]	2 [1–4]	3 [2–5]	3 [2–5]	3 [2–6]	3 [2–5]
Pediatrician%	17.3	54.1	45.1	31.4	16.2	7.9	2.6	17.6	16.9	16.9	17.3
Median [IQR]	2 [1–4]	8 [3–10]	4 [2–6]	2 [1–4]	1 [1–2]	1 [1–2]	1 [1–2]	2 [1–4]	2 [1–4]	2 [1–4]	2 [1–4]
Dentist%	37.3	0.16	1.6	12.7	50.8	49.9	42.2	36.6	38.0	38.9	37.2
Median [IQR]	1 [1–2]	1 [1–1]	1 [1–1]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]
Physiotherapist%	7.1	27.1	11.4	2.3	2.1	7.1	11.3	6.6	7.6	16.5	6.7
Median [IQR]	8 [4–15]	6 [3–11]	4 [2–8]	5 [2–12]	8 [4–16]	10 [5–17]	10 [5–17]	8 [4–15]	8 [4–15]	20 [8–40]	8 [4–14]
Midwife%	0.92	13.6	0.10	0.037	0.013	0.059	0.92	0.70	1.2	0.45	0.94
Median [IQR]	1 [1–2]	1 [1–2]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]
Nurse%	8.1	3.5	5.2	5.7	6.1	7.4	14.8	7.7	8.5	19.6	7.6
Median [IQR]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–3]	1 [1–2]	1 [1–2]	2 [1–7]	1 [1–2]
Specialists (other than pediatricians)%	39.5	15.2	19.3	30.9	43.2	43.4	47.4	38.1	40.9	49.8	39.0
Median [IQR]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–3]	1 [1–2]
Ophthalmologist%	24.7	4.4	6.9	15.8	31.3	30.1	26.4	22.8	26.8	31.3	24.5
Dermatologist%	7.1	2.7	2.8	3.5	6.1	8.0	12.0	6.4	7.8	6.9	7.1
ENT specialist%	7.0	5.2	7.5	12.3	8.5	4.5	4.1	7.5	6.5	8.8	7.0
Surgeon%	4.2	2.5	3.3	3.0	2.7	4.4	7.5	4.9	3.5	6.6	4.1
Psychiatrist%	1.0	0.053	0.12	0.58	1.1	1.2	1.4	1.2	0.85	3.3	0.92
At least one ED visit											
All ED visits%	23.6	42.3	39.1	29.2	19.7	19.7	20.5	24.4	22.7	31.7	23.2
Median [IQR]*	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]	1 [1–2]
ED with SSH admission%	3.4	14.9	7.5	3.7	2.0	1.9	2.8	3.6	3.2	9.0	3.1
ED with SSH > 1 night%	2.9	13.4	6.3	3.1	1.6	1.6	2.3	3.0	2.7	8.1	2.6
ED without SSH admission%	21.9	35.6	35.9	27.3	18.5	18.6	19.0	22.6	21.2	27.5	21.7
Hospital stays											
All types%	9.1	26.8	12.7	9.9	6.2	5.5	11.1	10.0	8.2	32.0	8.2
SSH%	8.8	26.6	12.7	9.7	5.8	5.1	10.6	9.6	7.9	26.5	8.0
Median [IQR]*	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–1]	1 [1–2]	1 [1–1]
SSH stay≥1 night**%	4.5	24.5	7.6	4.2	2.5	2.5	3.8	4.7	4.2	15.1	4.0
SSH stay< 1 night**%	4.9	4.0	6.2	6.2	3.7	3.0	7.4	5.6	4.2	16.5	4.4
Pediatric reanimation%	0.091	0.70	0.16	0.080	0.047	0.046	0.047	0.10	0.079	1.2	0.047
Neonatology%	0.57	11.2	0.021					0.61	0.53	0.79	0.56
Neonatology-intensive care%	0.21	4.0	0.00					0.23	0.18	0.64	0.19
Psychiatric hospital%	0.31	0.093	0.025	0.13	0.32	0.30	0.56	0.38	0.24	5.0	0.12
Median [IQR]*	2 [1–2]	1 [1–2]	1 [1–2]	2 [1–2]	2 [1–2]	2 [1–2]	1 [1–3]	2 [1–2]	1 [1–3]	2 [1–3]	1 [1–2]
Rehabilitation care%	0.23	0.087	0.10	0.11	0.17	0.30	0.36	0.23	0.22	3.6	0.087
Home hospitalization%	0.043	0.53	0.026	0.016	0.010	0.011	0.031	0.044	0.042	0.37	0.029

GP: general practitioner; SSH: short-stay hospitalization, LTD: long-term disease, IQR: interquartile range, ED: emergency department.
* The median and IQR were always calculated for children with at least one visit or hospitalization.
** Children could be counted in both categories if they had more than one SSH stay.

(psychiatrist: 3.3% vs. 0.9%), 16.5% vs. 6.7% saw a physiotherapist, and 19.6% vs. 7.6% saw a nurse. These higher frequencies for children with LTDs were found for all ages, except for GP visits before 4 years of age, but since birth for pediatricians and other specialists. A low frequency was observed for dentists for all ages (Fig. 4). The proportion of children with at least one ED visit was also higher (31.7% vs. 23.2%, respectively; 5.3% of the total children visiting the ED at least once during the year had an LTD). The difference was even greater for ED visits followed by an SSH for more than one night (8.1% vs. 2.6%, respectively; 11.2% of the total had an LTD).

The frequency of SSHs was higher for children with an LTD (26.5% vs. 8.0%), as well as for SSHs of less than one night (Table 2). Among all children with at least one SSH, 12% had an LTD. Hospitalization in pediatric reanimation and neonatology units was also higher for children with an LTD. Children with LTDs had more hospitalizations, mainly SSHs for the youngest. Certain diagnoses of SSH were more frequent among children with an LTD than those without: endocrine, nutritional, and metabolic diseases (14% vs. 1.4%), congenital malformations (12% vs. 4%), mental disorders (7% vs. 2%), diseases of the nervous system (11% vs. 2%), neoplasms (5% vs. 1%), and diseases of the blood (6% vs. 0.5%) (Table 4).

At least one admission to a psychiatric hospital was noted for 5.0% of children with LTDs (vs. 0.1% of children without). In addition, a higher proportion of children with LTDs had stays in rehabilitation centers (3.6% vs. 0.1%) or were hospitalized at home (0.4% vs. 0.03%).

4. Discussion

This national observational study on the annual use of healthcare services, chronic long-term diseases (LTDs), and hospital diagnoses of children under 18 years of age in Metropolitan France in 2018 included 13.211 million children (4% with LTD, such as a psychiatric disease). Frequent use of healthcare service was observed for emergency department visit: 24% of children for at least one visit in the year (42% <1 year) and one short-stay hospitalization (9%). According to recommendations, the follow-up of children by a GP and pediatrician appears to be adequate after the first year. Children with LTDs more frequently used all services compared with children without an LTD, such as specialist visits (50% vs. 40%) and ED visits (32% vs. 23%). Regional variations were also observed.

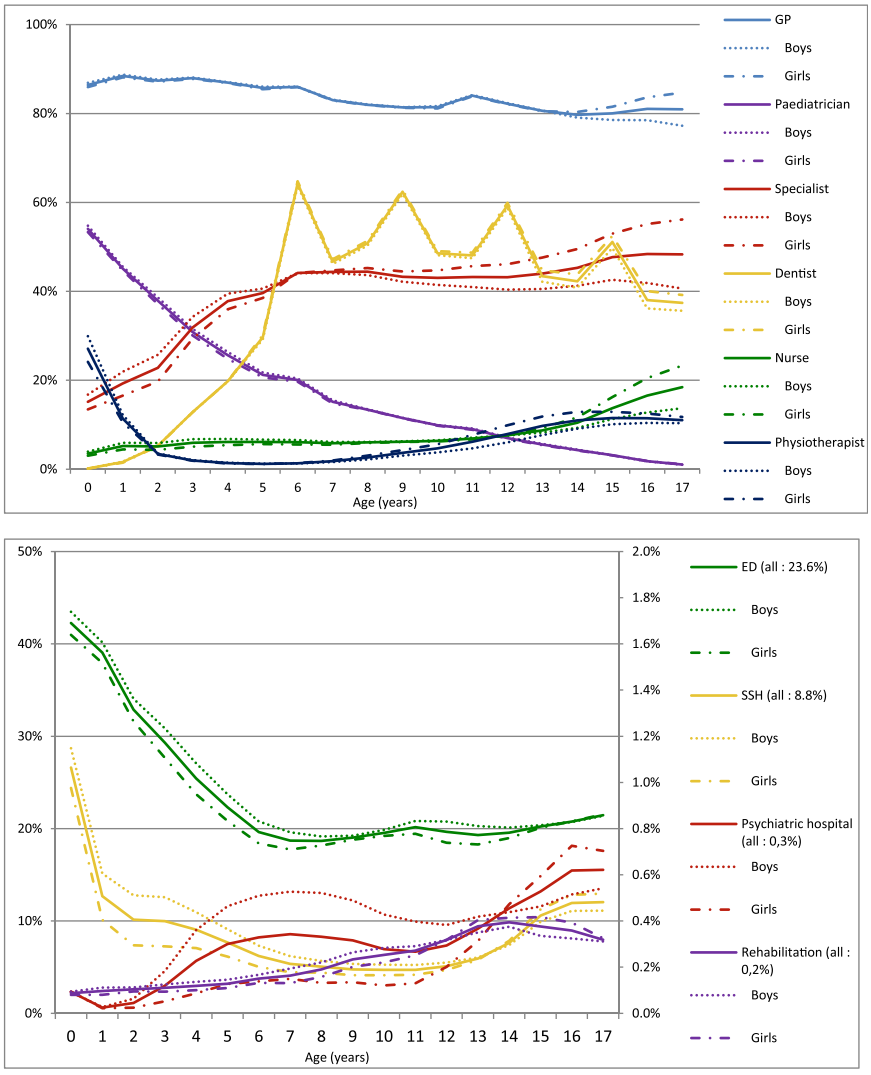


Fig. 2. Frequency of children under 18 years of age with at least one visit to a healthcare service followed up for 1 year after their birth or birthday in 2018 by age and sex. GP: general practitioner; ED: emergency department; SSH: short-stay hospitalization.

Table 3
At least one annual visit to a GP or pediatrician by the place of visit (primary care or maternity and child welfare clinic) and their association for children under the age of 18 years in 2018 followed up for 1 year after their birth or birthday.

	Total	Age (years)						Sex		LTD	
		<1	1	2–4	5–9	10–13	14–17	Boys	Girls	With	Without
N (millions)	13.211	0.674	0.699	2.166	3.756	2.993	2.924	6.758	6.453	0.139	1.019
Place of visit	%	%	%	%	%	%	%	%	%	%	%
PC only	86.2	85.9	88.8	90.6	88.2	84.6	81.2	85.9	86.6	89.1	86.1
PMI only	0.2	1.0	0.9	0.4	0.0	0.0	0.0	0.2	0.2	0.1	0.2
PC + PMI	1.8	12.9	8.7	3.8	0.3	0.0	0.0	1.9	1.8	1.4	1.9
At less one visit in											
PC	88.0	98.8	97.5	94.4	88.5	84.6	81.2	87.8	88.4	90.5	88.0
PMI	2.0	13.9	9.6	4.2	0.3	0.0	0.0	2.1	2.0	1.5	2.1

GP: general practitioner; PC: primary care; PMI: maternity and child welfare clinic; LTD: long-term disease.

4.1. Chronic long-term diseases

Information about diseases in children is generally obtained through parent-reported data, including a broad definition of symptoms and common chronic diseases, such as in primary-care diagnosis databases and school surveys [17,25,26]. A study of individuals aged 17 years or younger seen at US primary-care clinics between 2016 and 2018 reported that the six most frequently identified chronic conditions were obesity/being overweight (36.7%), eczema (15.8%), asthma (12.7%), food allergies (4.7%), attention deficit-hyperactivity disorder (4.1%), and hypertension (4.1%) [26]. A definition for special healthcare needs was proposed in the United States: children with a chronic physical, developmental, behavioral, or emotional condition requiring health and related services of a type or amount beyond that required by children generally [27]. Three national surveys using different methodologies reported prevalence rates ranging

Table 4
Frequency of ICD-10 chapter and most frequent short-stay hospitalization primary diagnoses for children under the age of 18 years in 2018 among those admitted at least once by age group, sex, and LTD.

		Age (years)						Sex		LTD	
	Total	<1	1	2–4	5–9	10–13	14–17	Boys	Girls	With	Without
N (millions)	1.158	0.179	0.089	0.211	0.218	0.153	0.308	0.648	0.509	0.139	1.019
ICD-10 diagnosis*											
	%	%	%	%	%	%	%	%	%	%	%
Diseases of the digestive system	19.1	5.4	3.8	5.7	11.5	20.0	45.5	16.5	22.4	14.1	19.8
Embedded and impacted teeth	*9.9*	*0.00*	*0.0079*	*0.068*	*0.62*	*6.3*	*33.5*	*7.6*	*12.7*	*3.6*	*10.7*
Acute appendicitis	*1.7*	*0.00*	*0.027*	*0.29*	*2.3*	*4.8*	*2.3*	*1.8*	*1.7*	*0.66*	*1.9*
Dentofacial anomalies [malocclusion]	*1.5*	*0.00*	*0.0056*	*0.021*	*0.19*	*1.3*	*4.6*	*1.1*	*1.9*	*0.72*	*1.6*
Dental caries	*1.0*	*0.00*	*0.028*	*1.3*	*2.7*	*1.3*	*0.37*	*1.0*	*1.0*	*1.8*	*0.92*
Diseases of the respiratory system	17.0	27.0	24.2	29.9	19.4	7.9	3.2	17.5	16.4	11.6	17.7
Chronic diseases of tonsils and adenoids	*6.2*	*0.023*	*3.6*	*16.6*	*12.0*	*3.4*	*0.69*	*6.2*	*6.1*	*2.6*	*6.7*
Acute bronchiolitis	*3.3*	*18.2*	*4.8*	*0.38*	*0.022*	*0.0052*	*0.00*	*3.4*	*3.1*	*1.3*	*3.5*
Asthma	*2.6*	*1.7*	*6.5*	*5.3*	*2.9*	*1.6*	*0.43*	*2.9*	*2.2*	*2.6*	*2.6*
Acute nasopharyngitis	*0.83*	*3.7*	*1.4*	*0.55*	*0.14*	*0.049*	*0.022*	*0.80*	*0.86*	*0.56*	*0.86*
Injury. poisoning and certain other consequences of external causes	11.2	5.4	10.6	8.8	12.5	16.2	13.0	12.1	10.1	7.6	11.7
Intracranial injury	*2.1*	*3.3*	*3.7*	*2.1*	*1.9*	*1.8*	*1.0*	*2.1*	*1.9*	*0.93*	*2.2*
Fracture of forearm	*1.4*	*0.01*	*0.1*	*0.6*	*2.7*	*3.9*	*1.2*	*1.8*	*0.9*	*0.5*	*1.6*
Symptoms, signs and abnormal clinical and laboratory findings. not elsewhere classified	9.2	11.2	11.5	8.5	8.4	11.2	7.4	8.2	10.4	12.3	8.8
Abdominal and pelvic pain	*1.6*	*0.28*	*0.21*	*0.59*	*1.9*	*3.5*	*2.5*	*1.2*	*2.2*	*1.3*	*1.7*
Fever of other and unknown origin	*1.2*	*3.7*	*2.5*	*1.4*	*0.72*	*0.35*	*0.16*	*1.2*	*1.3*	*1.3*	*1.2*
Convulsions. not elsewhere classified	*1.0*	*0.60*	*3.8*	*1.9*	*0.71*	*0.41*	*0.21*	*1.0*	*1.0*	*1.3*	*0.94*
Diseases of the genitourinary system	8.9	5.1	13.4	17.2	10.2	6.1	4.7	13.0	3.8	5.3	9.4
Redundant prepuce. phimosis and paraphimosis	*5.5*	*0.22*	*10.1*	*14.5*	*7.5*	*2.8*	*1.0*	*9.8*		*1.9*	*6.0*
Acute tubulo-interstitial nephritis	*1.4*	*4.1*	*2.4*	*1.1*	*0.92*	*0.39*	*0.43*	*0.92*	*1.9*	*0.91*	*1.4*
Conditions originating in the perinatal period	6.4	41.1	0.37	0.13	0.056	0.014	0.00	6.3	6.6	2.8	6.9
Disorders related to short gestation and low birth weight. not elsewhere classified	*1.6*	*10.4*	*0.055*	*0.0086*	*0.00*	*0.00*	*0.00*	*1.6*	*1.7*	*1.0*	*1.7*
Respiratory distress of newborns	*1.1*	*7.0*	*0.0079*					*1.1*	*1.0*	*0.59*	*1.2*
Neonatal jaundice from other and unspecified causes	*0.47*	*3.0*	*0.00*					*0.47*	*0.46*	*0.084*	*0.52*
Certain infectious and parasitic diseases	6.1	10.4	18.3	8.6	4.6	2.5	1.4	5.9	6.5	4.2	6.4
Other gastroenteritis and colitis of infectious and unspecified origin	*2.7*	*4.4*	*9.0*	*4.2*	*2.0*	*1.0*	*0.42*	*2.6*	*2.9*	*1.7*	*2.9*
Viral and specified intestinal infections	*1.8*	*3.7*	*6.9*	*2.5*	*0.86*	*0.33*	*0.095*	*1.7*	*1.9*	*0.93*	*1.9*
Factors influencing health status and contact with health services	5.8	7.5	4.1	4.5	7.1	6.9	4.6	6.0	5.5	9.5	5.3
Other orthopedic follow-up care	*1.5*	*0.018*	*0.10*	*0.42*	*1.8*	*3.1*	*2.5*	*1.8*	*1.2*	*1.3*	*1.5*
Congenital malformations. deformation and chromosomal abnormalities	5.4	5.7	9.0	5.2	6.8	6.9	2.5	6.1	4.4	11.8	4.5
Undescended testicle	*1.0*	*0.30*	*2.1*	*1.5*	*1.8*	*1.2*	*0.10*	*1.8*		*0.81*	*1.0*
Other congenital malformations of ear	*0.75*	*0.015*	*0.050*	*0.026*	*1.2*	*2.2*	*0.81*	*0.55*	*1.0*	*0.25*	*0.82*
Diseases of the ear and mastoid process	4.5	1.1	9.2	10.0	6.9	2.6	0.76	4.6	4.4	3.3	4.7
Non-suppurative otitis media	*3.3*	*0.47*	*7.1*	*8.7*	*5.0*	*1.0*	*0.16*	*3.4*	*3.2*	*2.1*	*3.5*
Diseases of the musculoskeletal system and connective tissue	3.4	0.40	1.7	1.7	2.5	5.4	6.4	3.0	3.9	5.8	3.1
Internal derangement of knee	*0.56*	*0.00*	*0.00*	*0.0090*	*0.056*	*0.41*	*1.8*	*0.44*	*0.68*	*0.32*	*0.58*
Diseases of the skin and subcutaneous tissue	3.0	0.73	1.7	1.8	2.4	4.4	5.3	2.9	3.1	2.2	3.1
Nail disorders	*0.83*	*0.0067*	*0.011*	*0.039*	*0.19*	*2.1*	*1.9*	*0.94*	*0.70*	*0.53*	*0.87*
Pilonidal cyst	*0.55*	*0.0073*	*0.012*	*0.0081*	*0.011*	*0.22*	*1.9*	*0.44*	*0.68*	*0.32*	*0.58*
Endocrine. nutritional and metabolic diseases	2.9	1.0	1.8	1.7	4.2	5.8	2.7	2.5	3.4	14.0	1.4
Type 1 diabetes mellitus	*0.85*	*0.0067*	*0.12*	*0.33*	*1.1*	*2.2*	*1.1*	*0.80*	*0.92*	*6.7*	*0.051*
Mental and behavioral disorders	2.7	0.18	0.56	1.2	2.9	4.8	4.8	2.4	3.1	7.0	2.2
Diseases of the nervous system	2.7	1.0	1.7	2.4	4.0	4.3	2.4	2.6	2.8	10.8	1.6
Neoplasms (malignant or benign)	1.5	0.71	1.1	1.3	1.9	2.3	1.6	1.3	1.8	4.6	1.1
Diseases of the eye and adnexa	1.3	0.39	1.3	1.3	2.7	1.6	0.73	1.2	1.5	1.7	1.3
Diseases of the blood. blood-forming organs and disorders involving the immune mechanism	1.2	0.54	1.1	1.3	1.7	1.6	1.0	1.1	1.3	6.1	0.53
Diseases of the circulatory system	1.1	0.41	0.40	0.62	1.6	2.0	1.2	1.1	1.1	2.0	0.94
Pregnancy. childbirth and the puerperium	0.55					0.027	2.0		1.2	0.25	0.59
Medical abortion	*0.32*					*0.021*	*1.2*		*0.74*	*0.14*	*0.35*

ICD-10: diagnosis chapter codes of the International Classification of Diseases 10th Revision; LTD: long-term disease.

from 13% to 19% in the beginning of the 2000s [12]. Recently, various versions of complex chronic-condition classification systems, pediatric medical complexity algorithms, and children with disabilities algorithms have been applied to claims data and the prevalence has been estimated to be from 0.67% to 11.44%, but all predicted higher healthcare utilization and in-hospital mortality [16].

Compared to the aforementioned studies, the prevalence of LTDs of 4.0% (children aged 0–17 years) reported here may be considered as relatively low. Analyses of LTDs focus specifically on a stable national list rather than algorithms for chronic diseases. LTDs require regular, costly, long-term care, and may be potentially life-threatening or disabling. Moreover, the French specificity is that the LTD status guarantees 100% reimbursement and is defined by decree. However, the prevalence of LTDs, which varies according to the LTD diagnosed, may be underestimated. Indeed, certain patients may not yet have been diagnosed or may have had low-intensity symptoms, with little or no use of healthcare services at the onset of their disease, and may have been eligible for access to free healthcare without

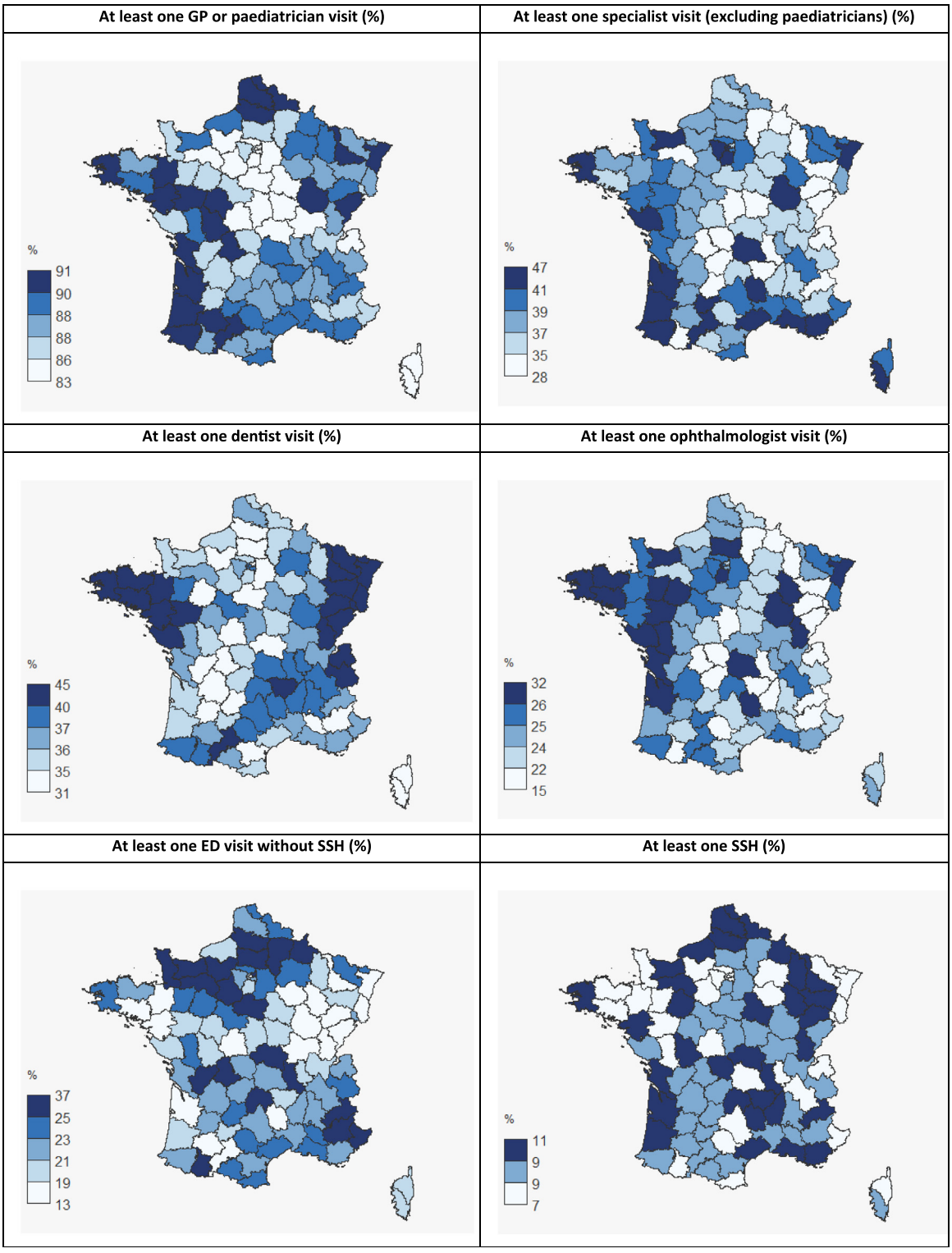


Fig. 3. Frequency of children under 18 years of age in 2018 using outpatient or hospital healthcare services at least once during the year by *département* of residence, with standardization for age. GP: general practitioner; ED: emergency department; SSH: short-stay hospitalization.

the need for LTD registration or had a primary LTD related to another LTD. Nevertheless, this underestimation is unlikely to concern patients with the most severe conditions or disease progression, who have greater healthcare needs. Finally, parents may refuse to apply for an LTD status for their children, for example, for psychiatric diseases. However, in this study, we found that children hospitalized with a diagnosis of chronic disease more often had an LTD status as observed, for example, for type 1 diabetes.

Among the two LTDs with the highest prevalence, disorders of psychological development increased and then decreased after the age of 14 years for both sexes, possibly due to a cohort effect, with fewer LTD diagnoses or reports 10 or more years ago. This could also be due to changes in the guidelines for requesting LTD status. Two regional French autism spectrum disorder registries reported an increasing prevalence of autistic disorders and a prevalence of approximately 0.6% for 8-year-old children born during 2007–2009,

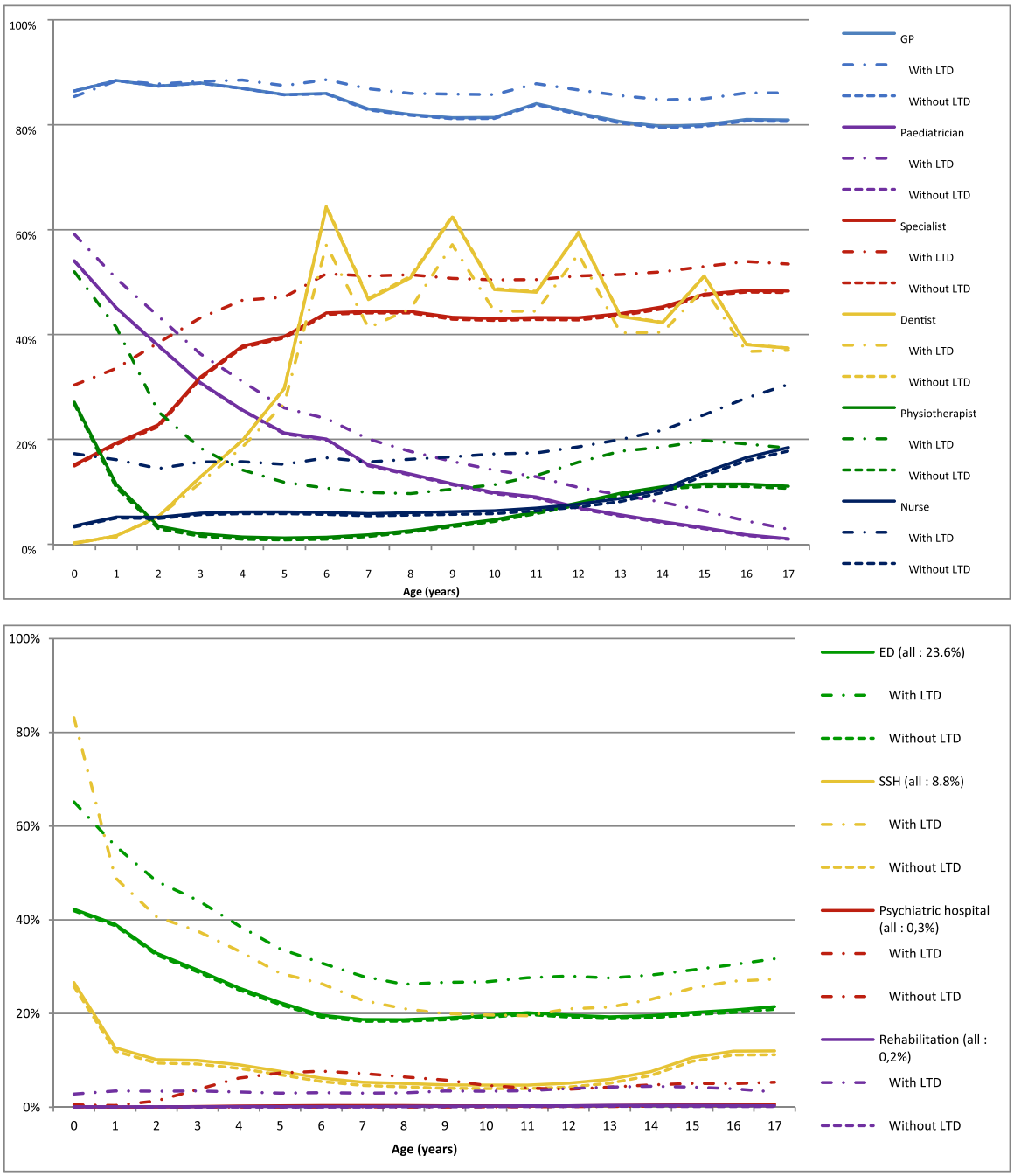


Fig. 4. Frequency of children under 18 years of age with at least one healthcare service visit followed up for 1 year after their birth or birthday in 2018 by long-term disease status and age. GP: general practitioner; ED: emergency department; SSH: short-stay hospitalization; LTD: long-term disease.

a value close to that of our national study (5–9 years: 0.71%) [28]. Concerning dorsopathies, a study in Germany found a higher prevalence of outpatient visits for scoliosis (2.3% before 15 years of age) and dorsalgia (1.7%), mostly in girls, as found in our study [29].

4.2. Healthcare use

In France, parents are offered 100% coverage by national health insurance for certain recommended healthcare visits for their children. During the first year of life, 11 examinations are recommended, a number fairly close to the number of visits to a GP or pediatrician in this study (median: 11 and the first quartile: 8) and 98% of children had at least one consultation. For children between the ages of 1 and 2 years, two consultations are covered and 98% of children had at least one visit during the year considered; 25% of these children had at least five visits, suggesting an adequate number of visits. For 3- to 6-year-olds, one visit per year is covered, amounting to four visits in total for this age group. At least one visit was noted for 95% of children aged 2–4 years (median: 4). Thereafter, an examination every 2 years is planned until the age of 16 years. Over the course of 1 year, the 5- to 18-year age group had a high frequency of at least one visit during the year (between 80% and 90% of the individuals in this group), with a median of two visits. Thus, although it was not possible to determine whether the visits attended by the children fit into the framework of recommended and reimbursed visits, overall, the follow-up of children appears to be adequate after the first year. However, certain infants had no reimbursed visits to a GP. The reason for this observation may be different for the youngest and the oldest

children. Before 6 years of age, it could be partially due to the lack of entry of medical PMI consultations for children with exclusive visits to a PMI (only 1% among a total frequency of 14% with or without a primary care visit). We found that 626,300 PMI consultations for 267,000 children were entered, i.e., only 45% of the 1383,000 consultation reported by a survey [22]. Concerning all consultations with a GP or pediatrician in the year of follow-up, the 626,300 consultations entered totaled 2.1% vs. 4.7% from the national survey. An analysis of the ELFE population cohort was performed specifically for a report on infant health [30,31]. This analysis for the first year of life indicated a frequency of at least one PMI consultation in 2011 for 9% of children younger than 1 year (14% in this study).

The questionnaire results for the 2003 KIDSCREEN study of children of 8–18 years of age from 11 European countries showed that, among all countries considered, including France, 65% of children had visited a healthcare professional (other than a dentist) as an outpatient in the preceding year (approximately 85% for a GP or pediatrician in this study) [1]. In England, 70% of the 0- to 15-year-olds living in Northwest London in 2019 had seen their GP at least once during the year [8]. In south Italy, the parents of 68% of children between 5 and 18 years of age in 2014 (16% with chronic conditions) stated that their child had visited their GP or a pediatrician in the previous year [3].

Concerning physiotherapist visits, there was an initial peak in the frequency for children under the age of 1 year (27%) and a second peak for children aged 14–17 years (11%), suggesting specific features of care for these two periods related to specific diseases. For nurses, an increase in consultation frequency was also observed during and after adolescence. No specific LTD was linked to these increases, but many diseases could be involved.

Girls were more likely than boys to have had at least one visit with a specialist after the age of 10 years and with a GP after the age of 14 years. This finding may reflect a higher frequency of visits to ophthalmologists and dermatologists, and perhaps to gynecologists for contraception and pregnancy, childbirth and postpartum care, and medical abortion, as indicated by the primary diagnoses for SSHs. The frequency of midwife consultations increased slightly after the age of 14 years, probably due to gynecological or pregnancy follow-up. The increase in frequency of psychiatric hospitalization for girls may be due to an increase in or the onset of classically described psychiatric symptoms (eating disorders) and trends were observed in the variation of other psychiatric symptoms, mostly with decreasing trends for boys.

In France, dental care is the specific responsibility of dentists. A European comparative study placed France at approximately the average for national mean DMFT scores (decayed, missing, and filled teeth), which are used to estimate the degree to which teeth are affected by dental caries [32]. A specific French health insurance program (M'T dents, 2007) covers the costs of dental visits for children aged 6, 9, 12, and 15 years. At these visits, advice is provided concerning hygiene and oral health and the program also covers subsequent visits if care is deemed necessary. This program was expanded to cover a visit for 3-year-olds in 2019. The program probably accounts for the observed peaks in the frequency of dental visits at these ages. Overall, 37% of the under-18 years visited a dentist during the year studied, but the frequency of dental visits was approximately 50% between the ages of 5 and 13 years, and 42% between the ages of 14 and 17 years, for which the principal diagnosis for SSH admission was embedded and impacted teeth.

More than 25% of ED visits concerned children under the age of 15 years in France, and the probability of being hospitalized after the ED visit was 10% [33]. We found that approximately 25% of children under the age of 18 years had at least one ED visit and 3% had one ED visit followed by an SSH admission, these rates being highest for the youngest children. In England, the ED visit rate for 0- to 15-year-olds from Northwest London in 2019 was similar to that reported here (24%) [8]. In the United States, between 2010 and 2014, 12% of children aged 17 years or younger visited the ED at least once in a year (18% for those under the age of 3 years) [4].

Between 2009 and 2012, hospital admission rates for children aged 0–19 years standardized per 100 person-years in seven European countries ranged from 9.4 for Spain to 19.6 for Germany; France was in sixth position with a rate of 13.5 [2]. In south Italy, 13% of children aged between 5 and 18 years in 2014 visited an ED and 5% were admitted to the hospital, a value lower than that reported here for a population including children aged 0–4 years (24% and 9%, respectively) [3].

In the United States, between 2010 and 2016, the number of admissions of children under the age of 17 years decreased by 21% and the percentage of children with complex chronic conditions increased by 6%, together with readmission rates [4].

4.3. LTDs and healthcare use

In our study, children with LTDs, as expected, visited GPs, specialists, physiotherapist, nurses, and EDs more often than those without, except for dentists, and they had more hospitalizations of various types, with variations depending on their age. Children with LTDs, many of which were psychiatric, were more frequently admitted to psychiatric hospitals or had an SSH with a diagnosis of mental and behavioral disorders. These children also had a higher frequency of outpatient psychiatrist visits. However, consultations at three types of free medical-psycho-pedagogical support institutions or centers showed an active list of 700,000 children in 2016, thus giving an underestimation of use by children in our study.

Greater use of healthcare services has also been found in studies of children with complex chronic conditions or special healthcare needs but, as we mentioned, they were based on various definitions and algorithms defined for the general population or in-hospital patients, showing an increase in costs [11,16]. A number of studies have also reported an increase in the annual proportion of ED visits and hospital admissions for this population as well as an increase in readmissions [8,34].

5. Conclusion

Most children saw a GP or pediatrician during the year and children with an LTD showed more frequent use of healthcare services. Nevertheless, outpatient visits may be underutilized with respect to recommendations or free-of-charge prevention visits, such as for dentists. Moreover, a high proportion of children had at least one ED admission (42% before 1year). Thus, strategies need to be considered concerning the lack of certain data for primary care. In addition, more detailed studies are required to identify the factors associated with the use of each type of healthcare service in France such as ED, including the level of social deprivation and regional variations.

Funding

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.arcped.2022.11.014.

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