Summary Vision Screening Data: Luxembourg

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1. Glossary of Terms: Vision Screening

Abnormal test result	A test result where a normal "pass" response could not be detected under good conditions. The result on screening equipment may indicate "no response," "fail," or "refer."
Attendance rate	The proportion of all those invited for screening that are tested and receive a result: • Invited for screening includes all those that are offered the screening test. • Tested and receive a result could be a "pass" or "referral to diagnostic assessment". Attendance rate provides information on the willingness of families to participate in screening.
Compliance with referral (percentage)	The percentage of those who are referred from screening to a diagnostic assessment that actually attend the diagnostic assessment. Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.
Coverage	The proportion of those eligible for screening that are tested and receive a result: • Eligible for screening includes those within the population that are covered under the screening or health care programme. • Tested and receive a result could be a "pass" or "refer to diagnostic assessment". Factors such as being offered screening, willingness to participate, missed screening, ability to complete the screen, and ability to document the screening results will influence the coverage.
False negatives	The percentage of children with a visual deficit (defined by the target condition) that receive a result of "pass" during screening. Example: If 100 children with visual deficit are screened, and 1 child passes the screening, the percentage of false negatives is

	1%.
False positives	The percentage of children with normal vision that are referred from screening to a diagnostic assessment.
Guidelines	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
Vision screening professional	A person qualified to perform vision screening, according to the practice in the country or region.
Inconclusive test result	A test result where a normal "pass" response could not be detected due to poor test conditions or poor cooperation of the child.
Invited for screening	Infants/children and their families who are offered screening.
Outcome of vision screening	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of children detected, etc.
Untreated amblyopia	Those children who have not received treatment for amblyopia due to missed screening or missed follow-up appointment.
Persistent amblyopia	Amblyopia that is missed by screening, or present after the child has received treatment.
Positive predictive value	The percentage of children referred from screening who have a confirmed vision loss. For example, if 100 babies are referred from screening for diagnostic assessment and 10 have normal vision and 90 have a confirmed visual defect, the positive predictive value would be 90%.
Prevalence	The percentage or number of individuals with a specific disease or condition. Prevalence can either be expressed as a percentage or as a number out of 1000 individuals within the same demographic.
Programme	An organised system for screening, which could be based nationally, regionally or locally.
Protocol	Documented procedure or sequence for screening, which could include which tests are performed, when tests are performed, procedures for passing and referring, and so forth.
Quality assurance	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
Referral criteria	A pre-determined cut-off boundary for when a child should be re-tested or seen for a diagnostic assessment.

Risk babies / Babies at-risk	All infants that are considered to be at-risk or have risk-factors for vision defects/ophthalmic pathology according to the screening programme. Two common risk factors are admission to the neonatal-intensive care unit (NICU) or born prematurely. However, other risk factors for visual defects may also be indicated in the screening programme.
Sensitivity	The percentage of children with visual defects that are identified via the screening programme. For example, if 100 babies with visual defects are tested, and 98 of these babies are referred for diagnostic assessment and 2 pass the screening, the sensitivity is 98%.
Specificity	The percentage of children with normal vision that pass the screening. For example, if 100 babies with normal vision are tested, and 10 of these babies are referred for diagnostic assessment and 90 pass the screening, the specificity is 90%.
Target condition	The visual defect you are aiming to detect via the screening programme.
Well, healthy babies	Infants who are *not* admitted into the NICU or born prematurely (born after a gestation period of less than 37 weeks).

2. Abbreviations

GDP Gross Domestic Product

GP General Practitioner

NICU Neonatal-intensive care unit

PPP Purchasing Power Parity

ROP Retinopathy of Prematurity

VA Visual Acuity

WHO World Health Organisation

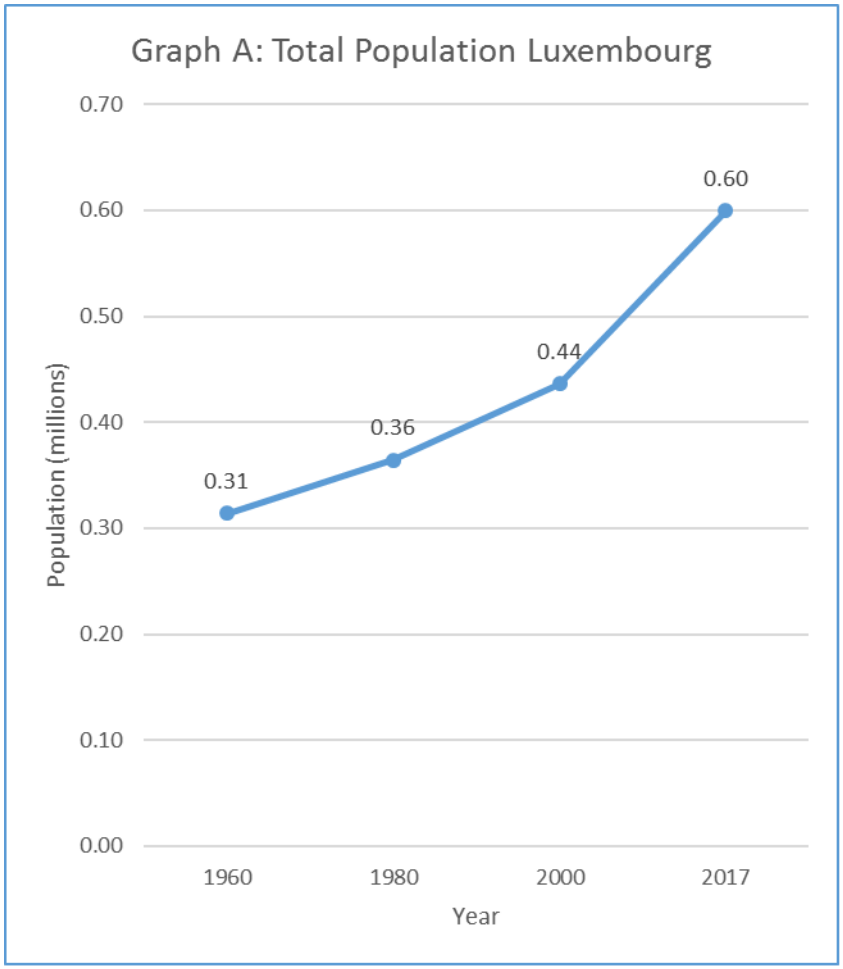
3. Population and Healthcare Overview

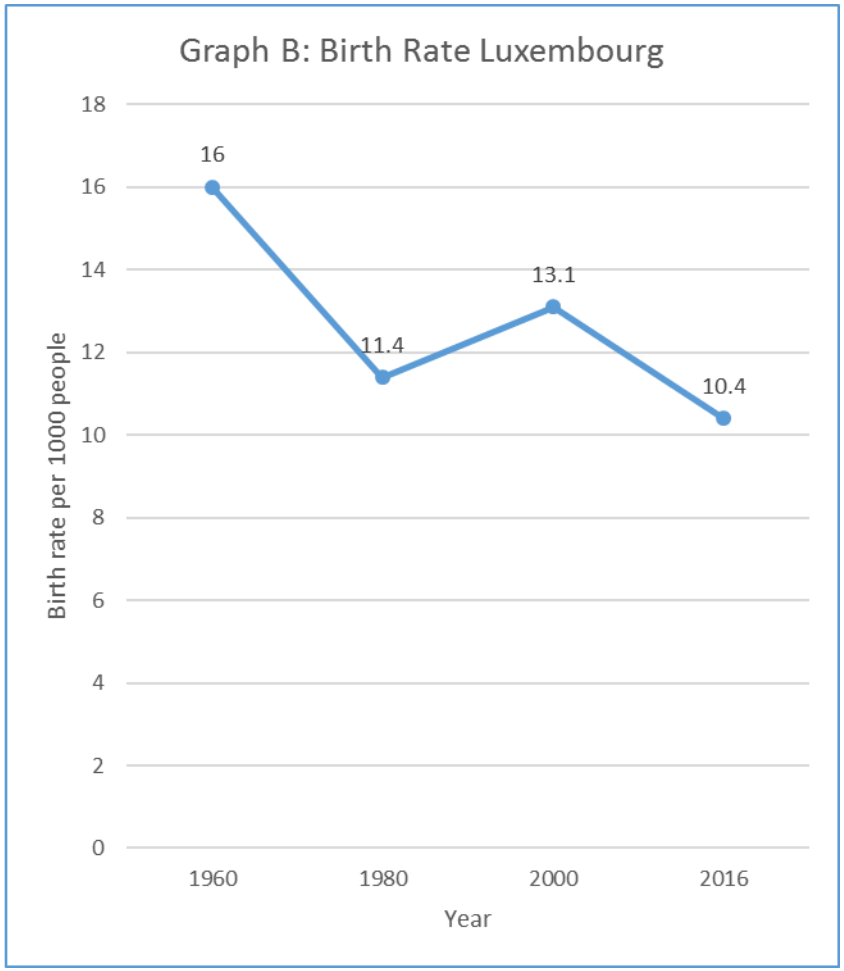
The population of Luxembourg is 599,449 (World Bank, 2018a) and the birth rate was estimated at 10.4 births/1,000 population in 2016 (World Bank, 2018b). The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

Luxembourg had an estimated population density of 232 people per square kilometre in 2017 and this has risen from 169 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 1.13 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 2.1 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Luxembourg is estimated at 82.3 years (World Bank, 2018e), with a death rate of 6.8 deaths/1,000 population in 2016 (World Bank, 2018f). Luxembourg has a gross national income per capita (PPP int. $, 2013) of $59,750 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was $6,812 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 6.9% (WHO, 2016b).

Figure 1: Change in the Total Population and Birth Rate in Luxembourg between 1960 and 2016/2017





Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

Vision screening is organised nationally with no regional variation in protocols. It is funded by the state. It is not embedded into a general preventative child healthcare system. The content of the vision screening programme is decided upon by the Health Directorate, Orthoptic Service. Vision screening was implemented for pre-school children in 1969 and for infants in 1971.

Review of the vision screening programme, how revisions are funded and how and when they take place is not defined. Since its implementation, the vision screening programme has changed in terms of the ages that screening takes place and the use of an autorefractor. The date for these changes is not known.

In Luxembourg, vision screening takes place at the headquarter of the Orthoptic Service and in 7 other locations rented by the Orthoptic Service, including kindergartens, public schools and schools. The professionals that perform vision screening are orthoptists and nurses. However, there are only nine orthoptists active in the screening programme. No other general professionals have been identified that do not screen, but could do so with additional training. There is no organised, specific training in order to perform vision screening.

There are no methods for quality monitoring for vision screening set-out by the government. No research concerning the vision screening programme in Luxembourg has been identified. There has been no cost-effectiveness analysis, or any other studies on the effectiveness of vision screening programme.

5 Screening programme

The target conditions screened for by vision screening include retinopathy of prematurity (ROP), amblyopia, reduced visual acuity, refractive error, colour vision defects, manifest and leatent strabismus, and anisocoria. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child as shown in Tables 1, 2 and 3 respectively. Specific details of the screening offered within each age group are described more fully in sections 5.1 to 5.4 below.

5.1 Vision screening – Preterm babies

Preterm babies are checked by an ophthalmologist during their stay in the hospital if risk factors due to prematurity are fulfilled. These factors are not known. The child is referred for further diagnostic examination when any pathology is apparent.

5.2 Vision screening - Birth to 3 months

The tests conducted on well, healthy babies up to the age of 3 months include Hirschberg and pupillary reflexes. These tests are performed by a paediatrician in either a hospital or a doctor's office during 3 first general health check-ups; less than 48 hours after birth, at age 1to10 days and 3to 8 weeks. The check-ups are mandatory. The child is referred for further diagnostic examination when any pathology is apparent.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened at 10 months of age by an orthoptist at a governmental department. The tests used at this age include ocular motility assessment, Hirschberg test, cover test, alternating cover test, stereopsis using the Lang 1 Test and autorefraction using PlusOptix (10 months-48 months). The referral criteria at this age category is not known.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened three times by an orthoptist at either a governmental department within the orthoptic service at 36 months to 4 years of age or school from 4 years to 6 years of age. The screening takes place at 36 months, 5 to 5 years of age and 5 to 6 years of age. The tests used within this age group include ocular motility assessment, Hirschberg test, cover test, alternating cover test, visual acuity measurement, stereopsis using the Lang 1 Test, colour vision, automated screening (PlusOptix at 36 months to 4 years of age). Visual acuity is measured for the first time at 36 months using the Rossano-Weiss, Tumbling E and Multivisus (computerised) optotype charts. These are all linear uncrowded tests.

If a child is not screened for visual acuity at 36 months, they are tested at 48 months by an orthoptist at governmental departments. The visual acuity measurement is repeated at ages 4 to 5 years and 5to 6 years.

At 36 months, the referral criteria is hyperopia, astigmatism or anisometropia over 1.5 diopters, strabismus, heterophoria, exophthalmia, a difference in reflexes on the autorefractor, or visual acuity different in both eyes of less than 0.6 decimal (0.2 logMAR, 6/9.5 Snellen). I

At 48 months, the referral criteria is hyperopia, astigmatism or anisometropia over 1.5 diopters, strabismus, heterophoria, exophthalmia, negative stereopsis, or visual acuity of less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen)).

Table 1: Healthcare professionals who conduct vision screening in each age group

Table 1	**Paediatrician**	**Ophthalmologist**	**Nurses**	**Orthoptist**
Preterm babies	✓ In certain cases	✓ In certain cases	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	×	×	×	✓
3 to 7 years	×	×	×	✓

Table 2: Vision screening tests used in vision screening for each age group

Table 2	**Eye motility**	**Hirschberg**	**Pupillary reflexes**	**Cover test**	**Alternating cover test**	**Visual acuity measurement**	**Stereopsis**	**Colour vision**	**Automated screening**
Preterm babies	No protocol	No protocol	No protocol	No protocol	No protocol	No protocol	No protocol	No protocol	No protocol
0 to 3 months	×	✓	✓	×	×	×	×	×	×
3 to 36 months	✓	✓	×	✓	✓	×	✓	×	✓
3 to 7 years	✓	✓	×	✓	✓	✓	✓	✓	✓ Only up to 48 months

Table 3: Location of vision screening for each age group

Table 3	**Hospital**	**Doctor's office**	**School**	**Governmental Department**
Preterm babies	✓	×	×	×
0 to 3 months	✓	✓	×	×
3 to 36 months	×	×	×	✓
3 to 7 years	×	×	✓	✓

6 Automated Screening

Automated vision screening is achieved using handheld, portable devices designed to detect presence of refractive error in infants from 6 months of age. It provides objective results and is used to detect amblyopic risk factors. This differs from other methods used to screen children for amblyopia which focus on detection of the actual condition and the resulting visual loss.

Automated refraction screening is used in the context of vision screening in combination with other tests on all children between 10-48 months. These tests are eye motility, Hirschberg test, cover test, alternating cover test, visual acuity measurement, stereopsis and colour vision.

If a child is screened at 36 months, the referral criteria from the automated screening is hyperopia, astigmatism or anisometropia over 1.5 dioptres.

If a child is screened at 48 months, the referral criteria is hyperopia, astigmatism or anisometropia over 1.5 dioptres).

In Luxembourg, PlusOptix is used – with each device costing 7,800 Euros. There is no specific timescale on when the devices are scheduled to be replaced.

7 Provision for Visually Impaired

There is one school in Luxembourg for blind or severely visually impaired children. The number of students is 141. The costs per child for this school is not known and it is not known what special support is offered to visually impaired children who attend mainstream primary school.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of treated, persistent (missed by screening or failed treatment) or untreated amblyopia by the age of 7 years in Luxembourg is unknown. The prevalence of strabismus is reported by the country representative as 1.6% at the age of 4 to 6 years. There is no data available concerning the incidence of the four types of amblyopia (strabismic, refractive, combined mechanism and deprivation).

8.2 Coverage

Ninety-nine percent of children aged 10 months are invited for vision screening. Sixty percent of these children attend the appointments. The rate of attendance is 70% for the all children aged between 10 and 48 months. Children are referred after 1 or 2 abnormal or inconclusive test results; this is determined by the screener. All children aged 4 and 5 years, are invited for the screening in schools.

8.3 Screening evaluation

There is no information pertaining to the percentage of compliance with referral after an abnormal screening test result, as there is no registration or documentation of non-attendance. There is no information concerning the percentage of false negative following vision screening. The percentage of false positive referrals for vision screening is estimated at 10%, with a positive predictive value of a refer estimated at 80%. There is no data available about the sensitivity or specificity of vision screening in Luxembourg.

8.4 Treatment success

There is no data regarding:

- the percentage of infants treated per year for congenital eye disorders (including congenital cataract)
- the percentage of screened children treated for strabismus or amblyopia before age 7 years
- the percentage of all children treated for strabismus or amblyopia before age 7 years

The percentage of all children treated for amblyopia at the ages of 4 to 6 years is reported as 0.4%. The percentage of children aged 5 to 6 years wearing glasses is reported as 13.4%.

Only ophthalmologists prescribe glasses for children under the age of 14 years. Other treatment options may include patching, penalisation with glasses and cataract surgery when indicated. All eligible children are offered treatment.

9 Costs of vision screening in children

9.1 Cost of vision screening

Vision screening professionals in Luxembourg are estimated to earn an annual salary of 50,000 Euros. The salary costs per hour are not known. It is not known how much it costs to train general preventative child health care screening professionals, between leaving secondary education to qualification. It is not known the total screening costs per year for vision screening are, or what the total costs per child per year for vision screening are, nationally.

9.2 Cost of treatment for amblyopia

The estimated costs of treatment for typical patients with refractive amblyopia and strabismic amblyopia, including follow-up, are not known.

9.3 Cost of Treatment for strabismus

The estimated costs for strabismus surgery, including follow-up, are not known.

9.4 Cost of treatment for cataract

The estimated costs for congenital cataract surgery, including follow-up of deprivation amblyopia, are not known.

There is a financial reward of 580 Euros if the child takes part in 6 general check-ups at the paediatrician: the first one has to take place within 48 hours after birth. The other five have to take place at ages: 1 to 10 days, 4 to 6 months, 9 to 12 months, and 21 to 24 months. There is no penalty for non-attendance. Vision screening is not obligatory in Luxembourg.

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