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Summary Vision Screening Data: Iceland

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Contents

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

ACT Alternating Cover Test

AR Autorefraction

AS Automated Screening

CT Cover Test

CV Colour Vision

EI Eye Inspection

EM Eye Motility

Fix Fixation

GDP Gross Domestic Product

GP General Practitioner

Hir Hirschberg test

NICU Neonatal-intensive care unit

PM Pursuit Movements

PPP Purchasing Power Parity

PR Pupillary Reflexes

RE Retinal Examination

ROP Retinopathy of Prematurity

RR Red Reflex Testing

SV Stereopsis

VA Visual Acuity

WHO World Health Organisation

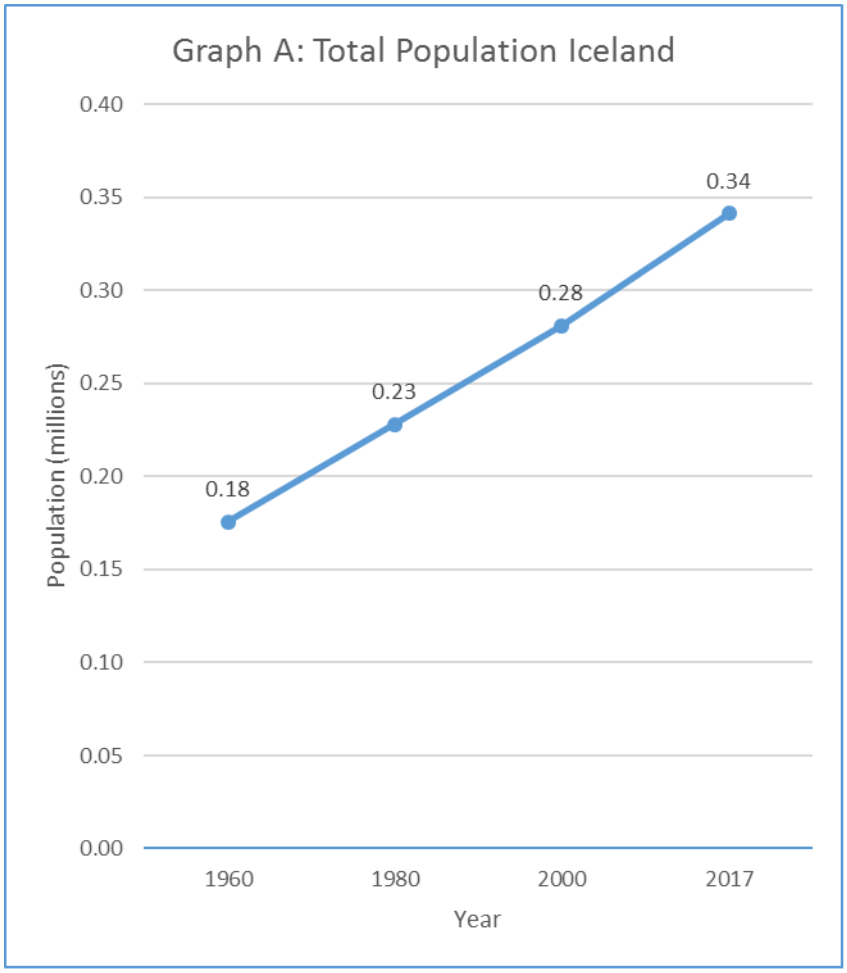
3 Population and Healthcare Overview

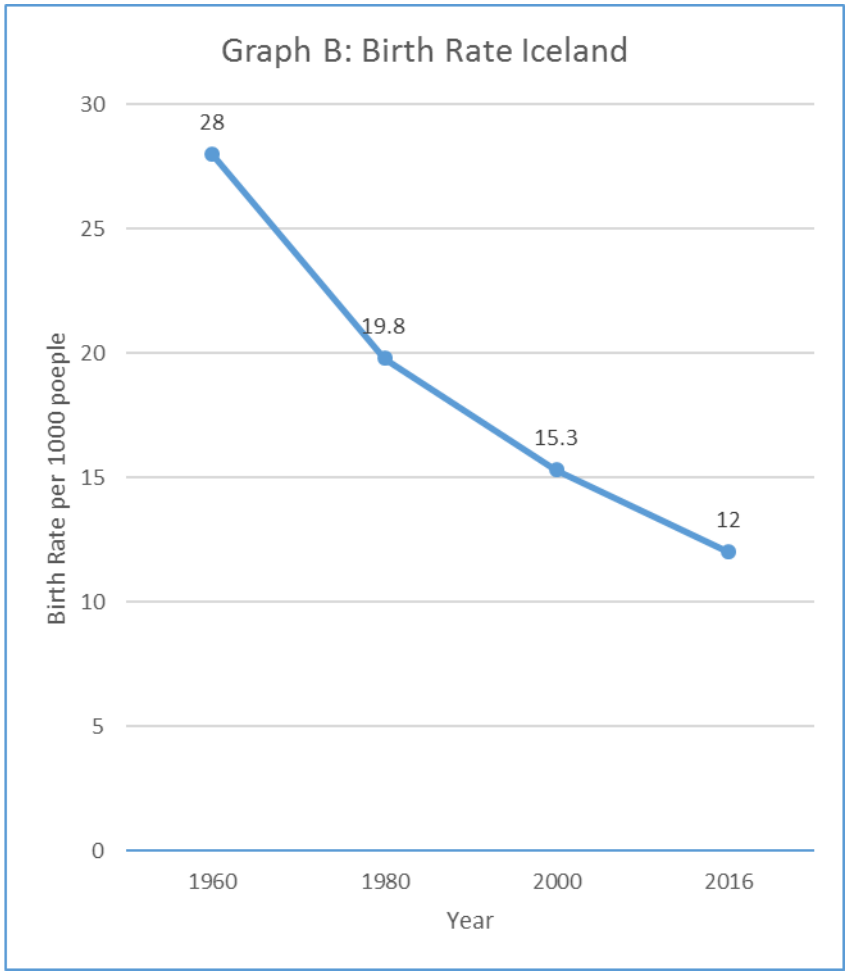
The population of Iceland is 341,284 (World Bank, 2018a) and a birth rate estimated at 12 births/1,000 population in 2016 (World Bank, 2018b). The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

Iceland has an estimated population density of 3.4 people per square kilometre in 2017 and this has increased from 1.8 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 3.64 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 1.6 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Iceland is estimated at 82.5 years (World Bank, 2018e), with a death rate of 6.9 deaths/1,000 population in 2016 (World Bank, 2018f). Iceland has a gross national income per capita (PPP int. $, 2013) of $38,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was $3,882 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 8.9% (WHO, 2016b).

Figure 1: Change in the Total Population and Birth Rate in Iceland between 1960 and 2017





Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

In Iceland, there are national guidelines for conducting vision screening. Vision screening is funded by the state and is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by ophthalmologists and the Public Health Organisation. The vision screening programme began in 1974. Between the years of 1999 and 2009, visual acuity was tested at 3.5 years and 5 years by nurses in primary healthcare centres, but since 2009 visual acuity testing has commenced in children at 4 years old; instead of at 3.5 years and again at 5 years of age. Vision screening is organised nationally, with no regional variation between protocols.

The procedures for vision screening can be found in the national general health screening guidelines. The Directorate of Health regularly updates the guidelines for general screening in children, including vision screening. Updates were completed in 1996, 2009, 2010, 2013 and the last update was in 2016. Regarding the vision screening, recommendations are made by ophthalmologists. The programme has not changed since 2009. There are no methods for quality monitoring of vision screening imposed by the government.

Vision screening is performed by paediatricians, general practitioners (GP) and nurses. It is not known how many vision screening professionals there are per million people. No general professionals have been identified that do not screen, but could do so with additional training. There are specific guidelines in place for nurses, paediatricians and GPs to follow concerning vision screening. It is not known if there is any specific training to perform vision screening.

There has been no cost-effectiveness analysis of the vision screening programme and there have been no other studies on the effectiveness of the vision screening programme in Iceland.

5 Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital cataract, amblyopia, reduced visual acuity, refractive error, colour vision defects, and strabismus. 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 up to the age of 3 months are screened by an ophthalmologist in a hospital. The vision screening tests conducted are designed to detect retinopathy of prematurity (ROP). There are no guidelines concerning the number of repeated screens before referral, this is at the discretion of the screener.

5.2 Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by either a nurse, paediatrician or a GP in a primary healthcare centre. The vision screening tests conducted include eye inspection, fixation, red reflex testing, cover test, alternating cover test and eye motility. It is only the paediatrician who performs fundus red reflex examination to diagnose a white pupil, the rest of the tests are performed by both paediatrician or a nurse. The sequence of eye screening tests are:

- 5 days old: Paediatrician – eye inspection, red reflex testing
- 6 weeks old: Nurse and pediatrician or GP - eye inspection, red reflex test, fixation, cover test, alternating cover test and eye motility
- 9 weeks old: Nurse - eye inspection, red reflex test, fixation, cover test, alternating cover test and eye motility

There are no defined guidelines on how many abnormal and how many inconclusive tests necessitate referral for further diagnostic examination.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either a paediatrician, GP, or a nurse in primary health care centre.

The tests conducted include eye inspection, fixation, red reflex testing, cover test, alternating cover test and eye motility; this is recommended at every visit. The sequence of vision screening are:

- 3 months old: Nurse and pediatrician or GP.
- 5 months old: Nurse

- 6 months old: Nurse
- 8 months old: Nurse
- 10 months old: Nurse and pediatrician or GP
- 12 months old: Nurse
- 18 months old: Nurse and pediatrician or GP
- 2.5 years old: Nurse

5.4 Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened by a nurse in a primary healthcare centre or schools. The tests conducted include eye inspection, fixation, eye motility, cover test, alternating cover test, visual acuity measurement and stereopsis (Titmus or Lang). The visual acuity measurement and stereopsis are both conducted from 4 years of age. The same optotype charts are used and all visual acuity measurements are conducted by nurses.

The optotype charts used for visual acuity measurement include Lea symbols (logMAR) and HOTV (Crowded linear test): referral criteria are visual acuity of less than 0.8 decimal (0.3 logMAR, 6/12 Snellen). Visual acuity is measured again at school age (6 years) with referral criteria of less than 1.0 decimal (0.00 logMAR, 6/6 Snellen), and again at 9, 12 and 14 years of age (referral criteria of less than 1.0 decimal (0.00 logMAR, 6/6 Snellen).

Referral for further diagnostic examination is necessitated after one abnormal test result. It is not known how many inconclusive test results determine the need for referral for further diagnostic examination.

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

Table 1	Paediatrician	Nurse	Ophthalmologist	GP
Preterm babies	×	×	✓	×
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	ROP	EI	Fix	RR	EM	CT	ACT	VA	SV
Preterm babies	✓	×	×	×	×	×	×	×	×
0 to 3 months	×	✓	✓	✓	✓	✓	✓	×	×
3 to 36 months	×	✓	✓	✓	✓	✓	✓	×	×
3 to 7 years	×	✓	✓	×	✓	✓	✓	✓	✓

***Key**: ROP: Retinopathy of prematurity; EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; CT: Cover test; ACT: Alternating cover test; VA: Visual acuity measurement; Stereopsis*

Table 3: Location of vision screening for each age group.

Table 1	**Primary Healthcare Centre**	**Hospital**	**School**
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. No automated screening devices are used in primary healthcare centres in Iceland.

7 Provision for Visually Impaired

There are no special schools for blind or severely visually impaired children in Iceland, all children attend regular mainstream primary school and get support from The National Institute for the Blind, Visually Impaired and Deafblind. Support is provided in the form of refunds for glasses, optical aids technology and special reading material. The costs per child for these additional services are unknown.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of treated or untreated amblyopia by the age of 7 years is unknown, there are no published studies on this issue. The prevalence of persistent amblyopia (missed by screening or failed treatment) by the age of years is also unknown. The prevalence of strabismus is unknown, there has been no study investigating this. There is no data available concerning the incidence of the four types of amblyopia (strabismic, refractive, combined mechanism and deprivation), per age, per year in Iceland.

8.2 Coverage

It is estimated that between 90% and 100% of children are invited for vision screening in Iceland; administrative personnel send invitations. The coverage of vision screening, before the age of 7 years, is estimated at 95%. The coverage of visual acuity measurements as part of vision screening, before the age of 7 years, is estimated that 95% and of those 95% attend this appointment.

8.3 Screening evaluation

The percentage of false negatives for vision screening is estimated at less than 10%. The percentage of false positives is estimated at 10%.. The positive predictive value (PPV) of a refer result is not known. The sensitivity and specificity of vision screening is unknown

8.4 Treatment success

There is no data concerning the percentage of infants treated for strabismus or amblyopia. It is estimated that there have been 17 children diagnosed and treated for congenital cataract since 2001. Ophthalmologists are the only professionals who prescribe glasses for children under the age of 7 years. Other treatment options include patching, strabismus surgery and cataract surgery. All children that fail vision screening are referred to an ophthalmologist for treatment. Iceland have the capacity to treat all children and the costs are covered by the state, very few children are not treated.

9 Costs of vision screening in children

9.1 Cost of vision screening

The salary costs per year for vision screening professionals is not provided. The cost to train general preventative child healthcare screening professionals that have been specified, between leaving secondary education to qualification, is not provided. The total screening costs, per year, for vision screening and the total costs, per child per year, for vision screening is not provided.

9.2 Cost of treatment for amblyopia

The estimated costs for treatment of typical patients, with refractive amblyopia and strabismic amblyopia including follow up is unknown.

9.3 Cost of Treatment for strabismus

The estimated costs for strabismus surgery including follow up is unknown.

9.4 Cost of treatment for cataract

The estimated costs for congenital cataract surgery, glasses, patching and follow-up of deprivation amblyopia are not available.

Vision screening is free of charge for parents, there is no financial reward when children do attend and no penalty when they do not.

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