



Summary Vision Screening Data: Northern Ireland

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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	<p>The proportion of all those invited for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> • 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”. <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
Compliance with referral (percentage)	<p>The percentage of those who are referred from screening to a diagnostic assessment that actually attend the diagnostic assessment.</p> <p>Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.</p>
Coverage	<p>The proportion of those eligible for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> • 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”. <p>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.</p>
False negatives	<p>The percentage of children with a visual deficit (defined by the target condition) that receive a result of “pass” during screening.</p> <p>Example: If 100 children with visual deficit are screened, and 1 child passes the screening, the percentage of false negatives is 1%.</p>



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	<p>The percentage of children referred from screening who have a confirmed vision loss.</p> <p>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%.</p>
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	<p>The percentage of children with visual defects that are identified via the screening programme.</p> <p>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%.</p>
Specificity	<p>The percentage of children with normal vision that pass the screening.</p> <p>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%.</p>
Target condition	The visual defect you are aiming to detect via the screening programme.
Well, healthy babies	Infants who are <i>not</i> admitted into the NICU or born prematurely (born after a gestation period of less than 37 weeks).



2 Abbreviations

CHS – Child Health Surveillance

GDP – Gross Domestic Product

GP – General practitioner

NICU – Neonatal-intensive care unit

NSC – National Screening Committee

PPP – Purchasing Power Parity

ROP – Retinopathy of prematurity

UK – United Kingdom

WHO – World Health Organisation



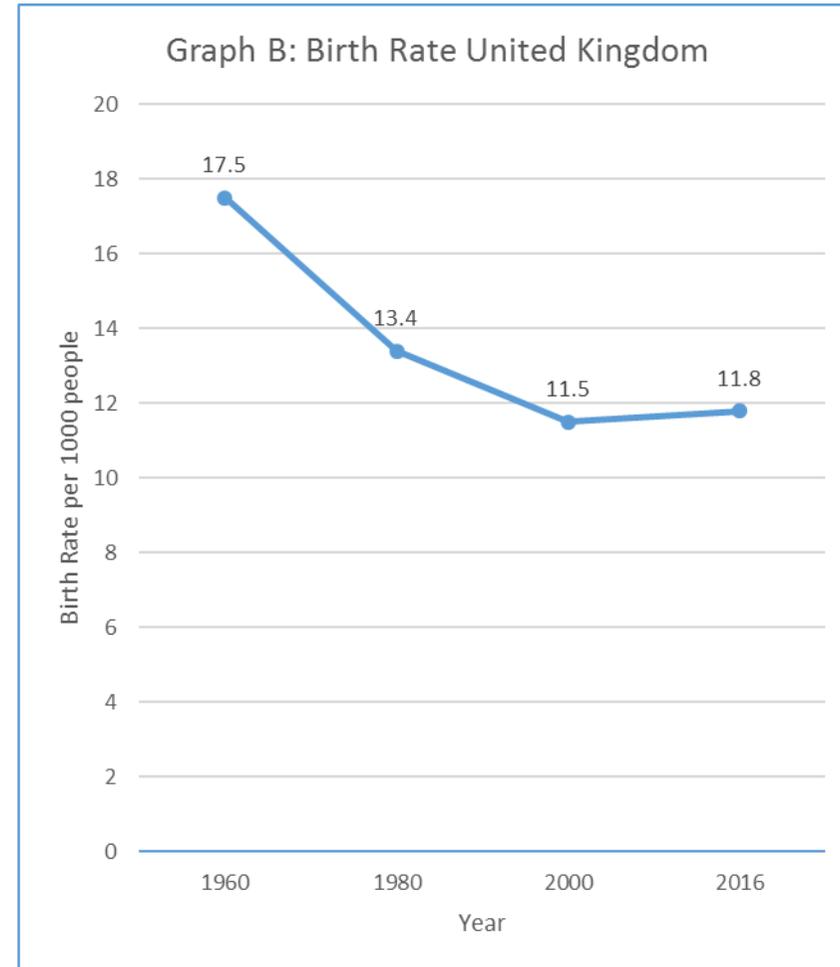
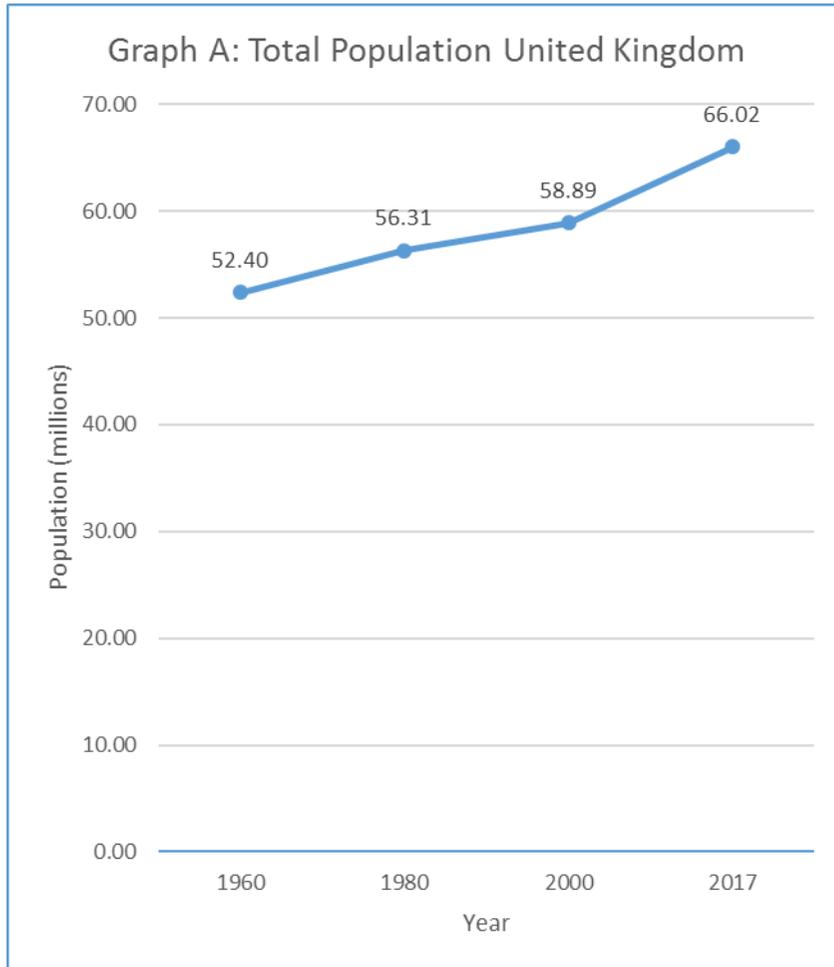
3 Population and Healthcare Overview

The population of the United Kingdom, including England, Wales, Scotland and Northern Ireland, is estimated at 66,022,273 (World Bank, 2018a) and the birth rate is estimated at 11.8 births/1,000 population in 2016 (World Bank, 2018b). Northern Ireland account for a population of 1,870,800 (McMullan, 2018). The UK has a reported population density of 272.90 people per square kilometre (World Bank, 2017).

Between 2013 and 2015, the average life expectancy in Northern Ireland was estimated at 78 years for men, and 82 years for women (Health-ni.gov.uk, 2018). The UK (there is no specific data for Northern Ireland) has a gross national income per capita (PPP int. \$, 2013) of \$35,000 and an estimated total expenditure on health per capita (Intl \$, 2014) is \$3,377 with a total current expenditure on health as percentage of GDP (2014) of 9.1% (WHO, 2016).



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





4 Vision Screening Commissioning and Guidance

Northern Ireland provides nationally organised vision screening that does not differ across the country. Vision screening is funded by the state and it is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by orthoptists and the UK National Screening Committee (UK NSC). It is not known exactly when the vision screening programme began, but it has been running for some decades. The programme has been changed since its implementation; specifically, it has been reduced so that vision screening no longer occurs at entry to secondary education at age 10 to 11 years, nor are vision screening at the two-year-old health check, this is now limited to questions about concern from parent over vision and family history conducted by health visiting nurse.

The vision screening programme has been reviewed twice, once in 2005 and again in 2013. Revisions are funded by the state and decided upon by the UK NSC with guidance from external review and stakeholder. There are methods for quality monitoring imposed by the government through service audits; this is not published or widely available, but the outcomes of the vision screening are entered into the Child Health Surveillance (CHS) system in Northern Ireland.

There is no published research concerning the vision screening programme in Northern Ireland. There has been no cost-effectiveness or effectiveness of the vision screening programmes in Northern Ireland.

Vision screening is conducted by paediatricians, specialist nurses, orthoptists and healthcare support workers. There are approximately 700 vision screening professionals per million population. Nurses are general professionals that do not screen, but could do so with additional training. All training for nursing, optometry, orthoptics and medicine is accredited and/or certified by relevant professional bodies. Vision screening in Northern Ireland uses school nurses (registered nurses) and not lay screeners. Nurses are given a short one-day training on vision screening led by orthoptists. No additional training is required for optometrists or orthoptists involved in current Northern Ireland school vision screening protocols.

Optometrists are the most likely professionals to prescribe glasses for children under 7 years of age, either in hospitals or community practices. Ophthalmologists can prescribe glasses and some paediatric ophthalmologists will do their own refraction, however, most would pass on to the hospital optometrist instead. Other treatment options include patching, penalisation with glasses, atropine, cataract surgery and strabismus surgery, where appropriate. All eligible children are offered treatment.



5 Screening programme

The target conditions of vision screening are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. 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 tests conducted at this age include eye inspection, fixation, red reflex testing and retinal examination to screen for ROP.

5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, general practitioner (GP), or a specialist nurse at a hospital, the home of the child or GP clinic. The tests conducted at this age include eye inspection, fixation and red reflex testing. Paediatricians carries out a check for red reflex before babies leave the hospital. At 6 to 8 weeks, babies attend a visit with the GP to check for red reflex. The specialist nurse visits every month and performs gross inspection for strabismus and asks parents if they have any concerns about their babies' vision. It is not known how many inconclusive or abnormal tests necessitate referral for further diagnostic examination.

5.3 Vision screening - 3 months to 36 months

Infants aged 3 to 36 months are screened by a specialist nurse at 2 years of age in the home of the child. Eye inspection is performed and a questionnaire to ask parents about concerns regarding their child's vision and family history. The specialist nurse checks if the child opposes occlusion of either eye at this age. One abnormal or one inconclusive test necessitate referral for further diagnostic examination.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by a specialist nurse in schools. The test conducted at this age is a visual acuity measurement. One screening visit is conducted at age 4 to 5 years by the school nurse. The optotype chart used is the crowded Keeler logMAR test with 4 letters per line, ranging from -0.3 to 0.8 logMAR acuity scores). Monocular acuity is measured using this chart, with naming or matching. Visual acuity is not tested at any other age. The child fails vision screening if monocular acuity is worse than 0.2 logMAR (0.63 decimal, 6/9.5 Snellen) in either eye. One abnormal or one inconclusive test necessitates referral for further diagnostic examination.



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

Table 1	Paediatrician	Ophthalmologist	GP	Specialist nurse
Preterm babies	x	✓	x	x
0 to 3 months	✓	✓	✓	✓
3 to 36 months	x	x	x	✓
3 to 7 years	x	x	x	✓



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

Table 2	Eye inspection	Red reflex testing	Fixation	ROP	Visual acuity
Preterm babies	✓	✓	✓	✓	×
0 to 3 months	✓	✓	✓	×	×
3 to 36 months	✓	×	×	×	×
3 to 7 years	×	×	×	×	✓



Table 3: Location of vision screening for each age group

Table 3	Hospital	Home	GP clinic	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 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 is conducted in Northern Ireland.



7 Provision for Visually Impaired

There is one school in Northern Ireland for blind or severely visually impaired children. The costs per child for these schools is not known. Children who are visually impaired but attend regular mainstream primary school are supported through qualified teachers for visually impaired children and children may be awarded a classroom assistant if necessary.



8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The data in this sub-section has been retrieved from “A Prospective Study of Refractive Error amongst Northern Ireland schoolchildren”. This is a thesis by Dr Karen Breslin (2012) which is available in the British Library. The data is otherwise unpublished. It states that the prevalence of treated or untreated amblyopia is 3.39% at age 9-10 years and 2.10% at age 15-16 years. The prevalence of persistent amblyopia not known. The prevalence of strabismus is approximately 3% at age 6-7 years and 12-13 years. The incidence of the four types of amblyopia (refractive, strabismic, combined-mechanism and deprivation) are 37% strabismus; 32% refractive; 26% combined-mechanism; 5% deprivation.

8.2 Coverage

It is estimated that between 90 and 100% of children are invited for and attend vision screening (100% of babies are checked for red reflex before being discharged from hospital and 4-5 year olds are screened in school). Invitations are sent by either the state or a health nurse using letters.

The percentage of compliance with referral after an abnormal screening results is suggested to be poor; nearly 20% have been found to fail to attend (O’Colmain et al., 2016).

8.3 Screening evaluation

Saunders et al. (2016) found that when considering screening in relation to identifying risk factors of refractive error and strabismus:

- The percentage of false positives from vision screening was 46.8%
- The percentage of false negatives from vision screening was 9.8%
- The positive predictive value of a ‘refer’ result was 54.4%
- The sensitivity and specificity of vision screening was:

N=295	Strabismus	Significant Refractive Error	Needing Clinical Intervention
Sensitivity (%)	80.0	71.4	70.0
Specificity (%)	74.4	82.5	83.5



8.4 *Treatment success*

No data available concerning the percentage of children treated for congenital eye disorders. Saunders et al., (2016) investigated the visual profile of children (n=295) passing or failing a UK school vision screening protocol and found that 8.9% of children who failed the vision screening protocol were found to have a strabismus; this was 3.2% of all the children who took part in the study. The percentage of children treated for strabismus before the age of 7 years in a study of 1,582 children was 3.98% (Donnelly et al., 2005). There is no specific data available concerning the percentage of children treated for amblyopia before the age of 7 years, however, Donnelly et al. (2005) found that 12.5% of children within a school year group in Northern Ireland had a visual disorder of strabismus, anisometropia, ametropia and organic defects. This is suggested as a possible proxy for amblyopia treatment.



9 Costs of vision screening in children

9.1 Cost of vision screening

The salary costs (range) per year for vision screening professionals is estimated at £21,478 - £37,176 (23,831.99 - 41,250.49 Euros*) depending on personnel. The salary costs per hour are calculated as £8 - £13.50 (8.88 - 14.98 Euros*)

Bursaries to help to pay university fees are available for nurses and a limited numbers of orthoptists. University fees in Northern Ireland are approximately £4,300 (4,771.28 Euros*) per year for studying medicine and optometry. In the UK (where many professionals train prior to working in Northern Ireland) the fees per year are approximately £9,000 (9,986.40 Euros*). Most degrees are 3-4 years of study, but Medicine is at least a five-year programme.

It is not known exactly how much is spent on vision screening per year or per child-per year, however it is estimated that £1.7 million (1,886,320 Euros*) is spent at a regional level per year on maternal and child healthcare screening (this covers more than just vision screening).

9.2 Cost of treatment for amblyopia

The estimated costs for treatment of typical patients with refractive and strabismic amblyopia, including follow-up are not fully known. The cost of glasses provided by the NHS cost approximately £40-£60 (44.38 - 66.58 Euros*) depending on the amount refractive error.

9.3 Cost of Treatment for strabismus

No data available.

9.4 Cost of treatment for cataract

The costs for a child are not known, however, the cost of cataract surgery for an adult in the National Health Service (NHS) is estimated to be £1000 (1,109.60 Euros*); this is likely to be more for a child.

*Currency conversion as of 30/12/2018



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