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Summary Vision Screening Data: Norway

Produced as part of Work Package 3

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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

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

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

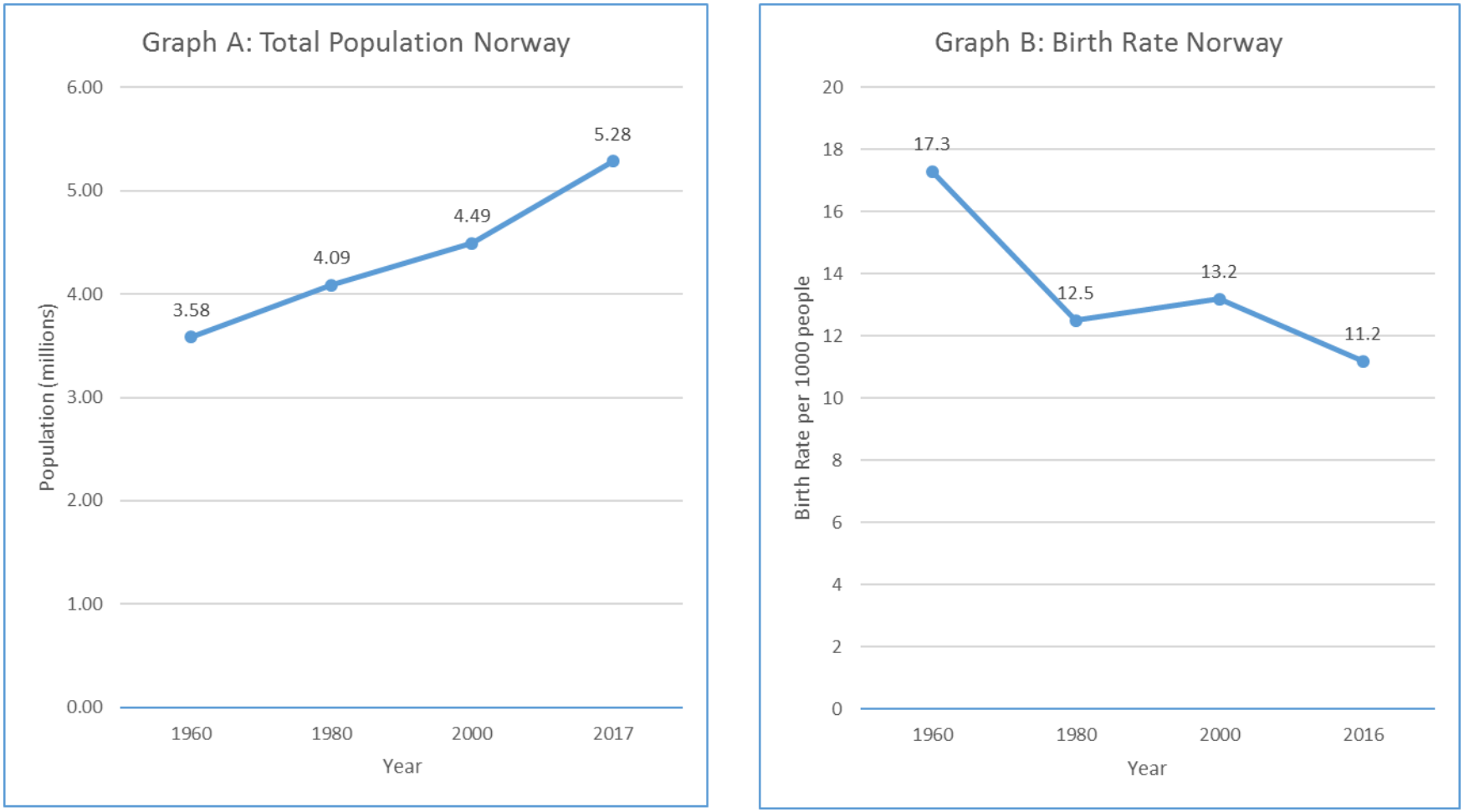
3 Population and Healthcare Overview

The population of Norway is 5,282,223 (World Bank, 2018a) and a birth rate estimated at 11.2 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.

Norway has a reported population density of 14.46 people per square kilometre in 2017 and this has risen from 9.88 people per square kilometre in 1961 (World Bank, 2018c). Infant mortality in 2017 is estimated at 2.1 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Norway is estimated at 82.5 years (World Bank, 2018e), with a death rate of 7.8 deaths/1,000 population in 2016 (World Bank, 2018f). Norway has a gross national income per capita (PPP int. $, 2013) of $66,000 (WHO, 2016). The estimated total expenditure on health per capita in 2014 was $6,347 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 9.7% (WHO, 2016b).

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



Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

In Norway, vision screening is organised regionally by the local municipalities, of which there are 420. The responsibility of primary health care, of which vision screening is included, is the responsibility of the municipalities, with Norway's Ministry of Health playing an indirect role through legislation and funding mechanisms. All municipalities provide and fund vision screening, which is embedded into a general preventative child healthcare screening system. Vision screening has been implemented since the 1970s. However, the first written Norwegian guidelines for vision screening in children are from 1998. The content of the vision screening programme is decided upon by the Norwegian Directorate of Health. In 2006, the guidelines were revised; the revised guidelines maintained the inclusion of visual acuity testing at 4 years of age, but now introduced a recommendation as to which visual acuity test should be performed.

There are national general health screening guidelines for vision screening and the programme is revised every 5 to 10 years. A committee appointed by the National Health Authorities decides upon the revisions. The committee responsible for the last guidelines comprised of:

- ophthalmologists
- 1 orthoptist
- 1 optometrist
- 1 special education person (in visual problems)
- 1 special nurse
- 1 GP
- 1 paediatric neurologist
- 1 senior consultant from the health care ministry

There are no methods for quality monitoring imposed by the government and there has been very little research carried out concerning the vision screening programme in Norway.

5 Screening programme

The target conditions screened for by 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. 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 neonatal intensive care unit of a hospital. The tests conducted in preterm babies less than 32 weeks gestational age (GA) include ROP screening until full normal vascularisation of the retina. Preterm babies aged above 32 gestational weeks are screened in the same manner as full term babies as described in section 5.2.

5.2 Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by a paediatrician, GP, or a specialist nurse in a child healthcare centre. The tests conducted at this aged include eye inspection, fixation and red reflex testing (paediatrician). Red reflex and a general eye exam is tested at birth and 6 weeks of age. Babies are referred as soon as there are signs of abnormality. There is no defined policy for referral or observation when tests are inconclusive, this is at the discretion of the clinician. The red reflex examination is conducted at discharge and is performed by a paediatrician (or paediatrician-in-training). The further screening at the child healthcare centre is usually not performed by a paediatrician, but by GPs (the "general eye examination"). The "general eye examination" from birth to 3 months is defined in the national guidelines, and should include:

- family history of any eye problems
- problems concerning pregnancy or delivery
- examination of red reflex
- examination for any congenital anomaly
- examination for abnormal eye movements
- examination of visual behaviour/fixation pattern and following
- ask for any worry or concern from the parents

5.3 Vision screening - 3 months to 36 months

Infants aged 3 to 36 months are screened by a specialist nurse or a GP at a mother and child healthcare centre. Testing is conducted four times during this period: at 3 months, 6 months, 1 year and 2 years of age. The tests conducted include eye inspection, fixation, red reflex testing, Hirschberg test and pupillary reflexes. There is no defined policy for referral or

observation when tests are inconclusive; this is left to the discretion of the clinician. Due to low sensitivity and specificity, corneal light reflex and cover test has been omitted as a screening examination in the guidelines from 2006. Referral to an ophthalmologist in the period 3-36 months is based on a total judgement of both findings and worry from the parents and/or the specialist nurse. Manifest strabismus is also a reason for referral.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years of age are screened once, between 4 and 5 years of age, by a specialist nurse at a mother and child healthcare centre. The tests conducted at this age include eye inspection, red reflex testing and a visual acuity measurement. Visual acuity is measured for the first time at 4-5 years of age, however, there are no recommendations as to which chart to use. In Norway, the Østerberg's chart has been the most commonly used test since the 1970s. To pass the visual acuity test, the child needed to see at least 3 objects on line 4/6 (or 0.67 decimal, 0.2 logMAR) in each eye. If the child failed, he/she were required to repeat the screening test after 1-2 months. If they failed again, he/she would be referred to an ophthalmologist. The LH chart (logMAR principle, uncrowded) is now the recommended chart. The indication for referral is now a visual acuity of less than 3 correct symbols (out of 5) on line 3/4.8 (0.63) in one or both eyes and is not repeated at any other age. Referral is determined by less than 3 correct answers out of 5 symbols on the line 3/4.8 (Snellen 6/9.5 or 0.225 logMAR) on charts measured to be used at 3 metres. A new investigation is conducted within 1-2 months if the child failed; otherwise, referral is necessary through indications based on general exam and medical history.

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

Table 1	**Paediatrician**	**Ophthalmologist**	**GP**	**Specialist nurse**
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	Red reflex testing	Eye inspection	Retinal examination	Fixation	Hirschberg	Pupillary reflexes	Visual acuity measurement	General eye exam
Preterm babies	✓ *>32 weeks GA*	✓ *>32 weeks GA*	✓ *<32 weeks GA*	✓ *>32 weeks GA*	×	×	×	✓ *>32 weeks GA*
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**	**Child healthcare centre**
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 Norway.

7 Provision for Visually Impaired

The Norwegian school system is based on full integration and therefore there are no schools for blind or severely visually impaired children. Special education professionals monitor visually impaired children attending regular primary school. This is done through two special educational centres ("resource centres") that the municipal special educational teachers may refer children to or get special support from in difficult cases. The support and devices are financed by the government and include data equipment, low vision devices (e.g. cameras) and mobility training.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

No data available.

8.2 Coverage

All children are invited for vision screening as part of general screening in children. Invitations are sent out by letter as part of the official health system and all children are covered. Attendance is estimated at 97-98%.

8.3 Screening evaluation

The sensitivity of vision screening is estimated at 95%. The specificity of vision screening is estimated at 95%. These are rough estimates; unfortunately there is no research data available.

8.4 Treatment success

It is estimated that there are 1,500 operations per year for strabismus and approximately 2 to 5% of preschool children are treated. This is based on national data in 2003, which showed that there were 1200 operations that year. No further data available. Ophthalmologists are professionals that prescribe glasses for children under the age of 7 years. Optometrists (since 2000) are also allowed to prescribe glasses for children under 7 years of age, however, they are not permitted to use diagnostic eye drops on children under 5 years of age. Other treatment options include patching, atropine and cataract surgery where appropriate. All eligible children are offered treatment.

9 Costs of vision screening in children

9.1 Cost of vision screening

The salary costs per year for specialist nurses in mother and child healthcare centres (about 600 centres across Norway) is 450,000 NOK (approximately 47,000 Euros, November 2018). A normal work shift is detailed as 7.5 hours per day. Vision screening is the main focus in this examination, but other factors are investigated, such as an evaluation of language, motor function, and physical activity. The 4 year old vision screening is stated as taking approximately 1 hour to complete.

9.2 Cost of treatment for amblyopia

No data available.

9.3 Cost of Treatment for strabismus

No data available.

9.4 Cost of treatment for cataract

No data available.

10 References

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