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Summary Vision Screening Data: Croatia

Produced as part of Work Package 3

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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 Croatia is estimated at 4,125,700 (World Bank, 2018a) and the birth rate is estimated at 9 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.

Croatia had a reported population density of 73.73 people per square kilometre in 2017 and this has fallen from 74.61 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 1.54 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 3.9 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Croatia is estimated at 78 (World Bank, 2018e), with a death rate 12.3 deaths/1,000 population in 2016 (World Bank, 2018f). Croatia has a gross national income per capita (PPP int. $, 2013) of $20,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was $1,652 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 7.8% (WHO, 2016b).

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

Graph A: Total Population Croatia

4.59
4.43
4.14
4.13

Graph B: Birth Rate Croatia

18.4
14.8
9.8
8.9
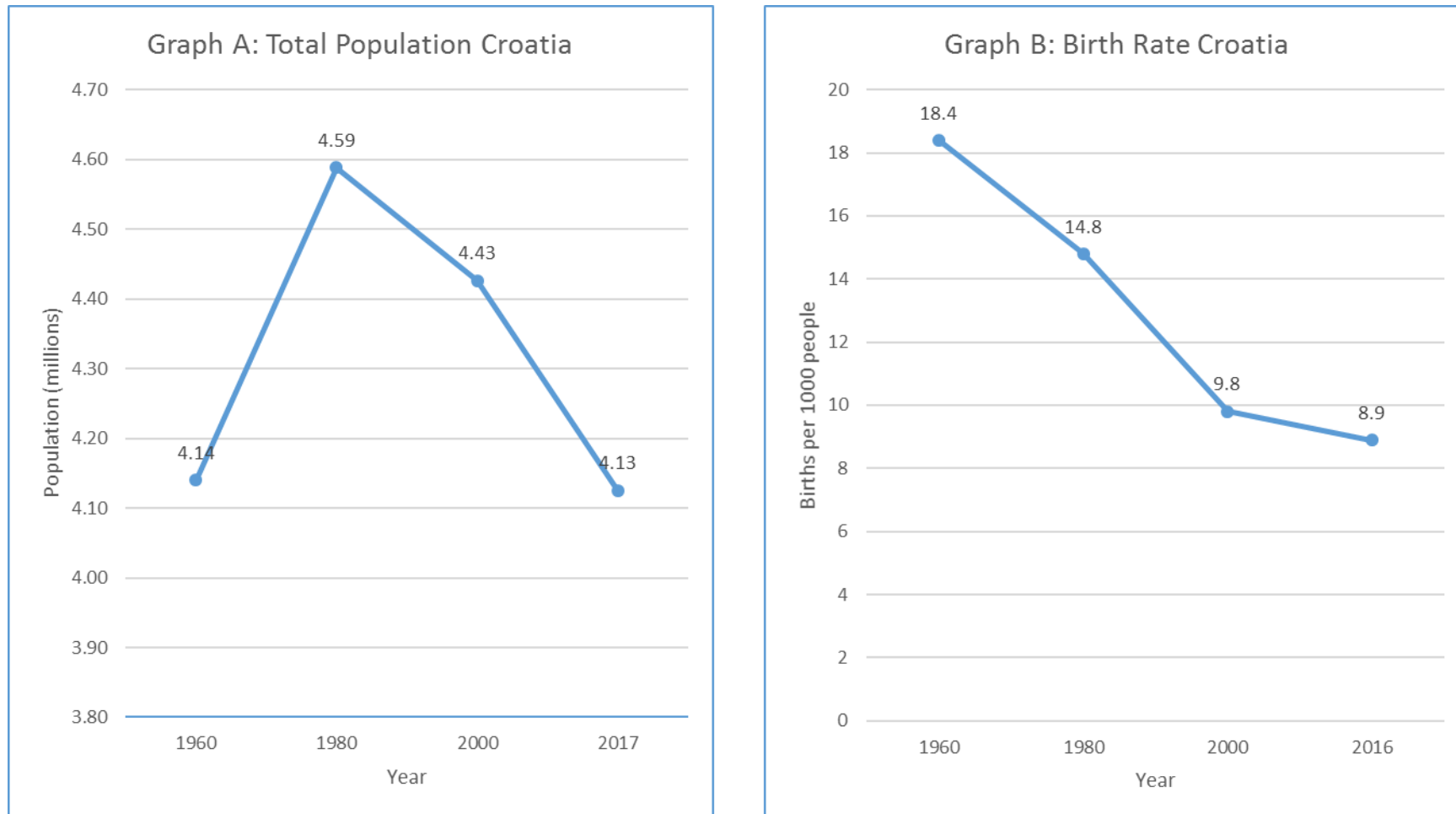
Source: Information sourced from World Bank (2018)

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4   Vision Screening Commissioning and Guidance

Vision screening in Croatia is organised nationally, with no regional variation between protocols. The vision screening programme is funded by health insurance and is embedded into a general preventative child health care screening system. The content of this programme is decided upon by the Ministry of Health and was implemented nationally in July 2015. There have been no changes since its introduction and therefore, no revisions have been made. However, any revisions would be decided upon by the Ministry of Health and funded through national health insurance.

Ophthalmologists perform vision screening in hospitals and child healthcare centres. There are approximately 400 vision screening professionals per million population. Paediatricians, GPs and nurses have been identified as general health professionals who do not currently screen, but could do so with additional training. There is no specific training available currently.

From June 2015, vision screening of all 4-year-old children performed in ophthalmologists' practices was introduced as a national health policy. Since January 2016, founded on the Bušić, Bjeloš & Kuzmanović Elabjer (2016) ZAPS (Zagreb Amblyopia Preschool Screening Study) study results, vision screening of all 4-year-old children performed in ophthalmologists' practices has become the National Preventive Program of Early Amblyopia Detection. Two-hundred and fifty thousand brochures about amblyopia and preventive program of early amblyopia detection per year are printed and delivered to primary care paediatricians in order to be distributed to the parents of 3-year-old children.

There are methods imposed for quality monitoring of vision screening imposed by the government and this is conducted through the national registry of amblyopia. There has been research concerning the vision screening programme (Bušić, Bjeloš & Kuzmanović Elabjer, 2016), however, there has been no cost-effective analysis conducted.

5   Screening programme

The target condition screened for in Croatia are retinopathy of prematurity, congenital eye defects and amblyopia. 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 with an eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. A paediatrician will conduct screening at ages 1, 2 and 3 months, at child healthcare centres. Alternatively, this may be conducted at a hospital by an ophthalmologist depending on the delivery status. For instance, all preterm babies with the delivery status with birth weight range from 1500 to 2000 g and/or gestational age ≤ 35 weeks who received oxygen therapy ≥ 4 hours and all preterm babies with the delivery status ≤ 1500 g and/or gestational age ≤ 32 weeks should be screened by an ophthalmologist, in neonatal units: posterior eye segment examination is performed at the age of 4 to 6 weeks, or 31 to 34 weeks gestational age. The ophthalmologist examines the vascularisation zone of the retina and depending on the results of the examination, follow up examinations are scheduled every week, every 1 to 2 weeks or every 2 to 3 weeks. The ophthalmologist should also examines for any other eye abnormalities.

5.2   Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened using an eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. It is unknown at what specific ages these tests are carried out, but all are carried out before 3 months of age. Vision screening takes place at child healthcare centres and is conducted by either a paediatrician or a GP. Red reflex testing is also conducted at child healthcare centres and the examination is completed at the discretion of the paediatrician. Babies are referred to an ophthalmologist for further examination after either two abnormal or inconclusive test results. A normal result is indicated by a red reflex from both eyes with symmetric responses. No reflex, dark spots in the red reflex, a markedly diminished reflex, the presence of a white reflex, or asymmetry of the reflexes are all indications for referral to an ophthalmologist. The exception to this rule is a transient opacity from mucus in the tear film that is mobile and completely disappears with blinking.

5.3   Vision screening - 3 months to 36 months

Babies aged between 3 and 36 months of age are screened at age 12, 24 and 36 months by a paediatrician at child health care centres. Tests utilised include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover

test and alternating cover test. Children with a positive family history of visual impairments or who present pathological findings are referred to an ophthalmologist.

5.4 Vision screening - 36 months to 7 years

Between the ages of 36 months and 7 years, children undergo two visual acuity measurements. These tests are completed at a child health care centre at age 4 years by an ophthalmologist (crowded Lea symbols), and 7 years by a school medicine specialist (different tests, Lea symbols, Snellen, Tumbling E, Landolt C). The linear Lea Symbols test is recommended by the National Preventive Program of Early Amblyopia Detection in Croatia. However, the country representative states that the screening techniques used by health professionals are not standardised in terms of vision test used, approach to the technique of testing, testing distance, pass criterion for the line, pass cut-off criteria for referral to complete ophthalmological examination, or providers' attentiveness, experience and training.

An abnormal test result is defined as a visual acuity of equal to or worse than 0.1 logMAR for Lea symbols (≥ 0.8 decimal, 6/7.5 Snellen) at 4 years of age. Children are referred for further diagnostic examination after either one abnormal or one inconclusive test result. Children are referred for further examination after one abnormal or inconclusive test result.

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

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

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

Table 2	EI	Fix	RR	EM	Hirsch test	RE	PM	PR	CT	ACT	VA
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
0 to 3 months	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
3 to 36 months	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✗
3 to 7 years	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓

Key:

EI: Eye inspection; **Fix**: Fixation; **RR**: Red reflex testing; EM**:** Eye motility; **Hirsch**: Hirschberg test; **RE**: Retinal examination; **PM**: Pursuit movements; **PR**: Pupillary reflexes; **CT**: Cover test; **ACT**: Alternating cover test; **VA**: Visual Acuity

Table 3: Location of vision screening for each age group

Table 3	Child Healthcare Centre	Hospital	Private clinic	Public place	Other
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 vision screening takes place in Croatia.

7   Provision for Visually Impaired

There are two specialist schools in Croatia, for blind or severely visually impaired children. There were 969 visually impaired children in Croatia in 2016, according to the Croatian Institute for Public Health (2018). The costs per child for these schools is unknown. Teaching assistants are provided as special support for visually impaired children who attend regular primary school.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of treated or untreated amblyopia in Croatia is estimated at 8.08% at the age of 48-54 months, based on the assessment of 15,648 children (Bušić, Bjeloš & Kuzmanović Elabjer, 2016). However, it is unknown what the prevalence of persistent amblyopia, which is amblyopia missed by screening or failed treatment. The prevalence of strabismus in Croatia is unknown, as is the incidence and distribution of the four types of amblyopia (refractive, strabismic, combined-mechanism and deprivation).

8.2 Coverage

All children are invited by the Ministry of Health for vision screening during the regular examination by a paediatrician in primary healthcare centres. When the child is aged three years, parents receive an invitation for vision screening at the age of four years. This invitation for vision screening at the age of 4 years is 100%and it is thought that 100% of children attend their vision screening appointment. Furthermore, 100% of eligible children, under the age of 7 years, are invited for screening using a visual acuity measurement, with an approximated 90-100% attendance rate. It is unknown how many children attend a referral appointment after an abnormal screening test result.

8.3 Screening evaluation

The percentage of false negative vision screening results is estimated at 0%, with an estimate of 3% false positive referrals from vision screening (Bušić, Bjeloš & Kuzmanović Elabjer, 2016). The positive predictive value of a refer result is 72.7% and the negative predictive value of a refer result is 100% (Bušić, Bjeloš & Kuzmanović Elabjer, 2016). The sensitivity of vision screening in Croatia is stated as being 100%, with a specificity of 97% (Bušić, Bjeloš & Kuzmanović Elabjer, 2016).

8.4 Treatment success

The percentage of children treated for amblyopia before age 7 years is 8.08%. The percentage of infants treated for congenital eye disorders and strabismus before the age of 7 years is unknown. All patients with congenital cataract, amblyopia and strabismus are treated by ophthalmologists. Ophthalmologists are the only professions who prescribe glasses for children aged less than 7 years, with additional treatment options including patching and glasses for refractive error. All eligible referred children are offered treatment for vision disorders.

9 Costs of vision screening in children

The Reference Centre of the Ministry of Health of the Republic of Croatia for Paediatric Ophthalmology and Strabismus, in a collaboration with the Croatian Institute for Public Health, has all the data reported about the national vision screening program of 4-year-old children. However, there are no costs-analysis studies on vision screening. The costs related to screening are as follows:

- Screening test 95 Croatian Kuna (KN) or 13 Euros*
- Comprehensive eye examination if the child is screened positive 285 KN or 38 Euros*
- Follow up examination 164 KN or 22 Euros*
- Cataract surgery with implantation of intraocular lens 3515 KN or 469 Euros*
- Cataract surgery without implantation of intraocular lens 3115 KN or 415 Euros*

There is no further information available regarding the costs involved with vision screening in Croatia. Vision screening is obligatory but not enforced in terms of penalty for non-compliance.

9.1 Cost of vision screening

The salary costs per year and per hour for vision screening professionals is not known. It is unknown how much it costs to train a general preventative child health care screening professional between leaving secondary education to qualification. The total screening costs per year for vision screening in Croatia is unknown.

9.2 Cost of treatment for amblyopia

The costs for treatment of typical patients with refractive amblyopia and strabismic amblyopia is unknown.

9.3 Cost of Treatment for strabismus

The costs for strabismus surgery is unknown.

9.4 Cost of treatment for cataract

The costs for congenital cataract surgery is unknown.

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