



Summary Vision Screening Data: Bosnia and Herzegovina

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1 Glossary of Terms: Vision Screening

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| 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> |



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| 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. |



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| | 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

| | |
|-------------|------------------------------|
| 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 |



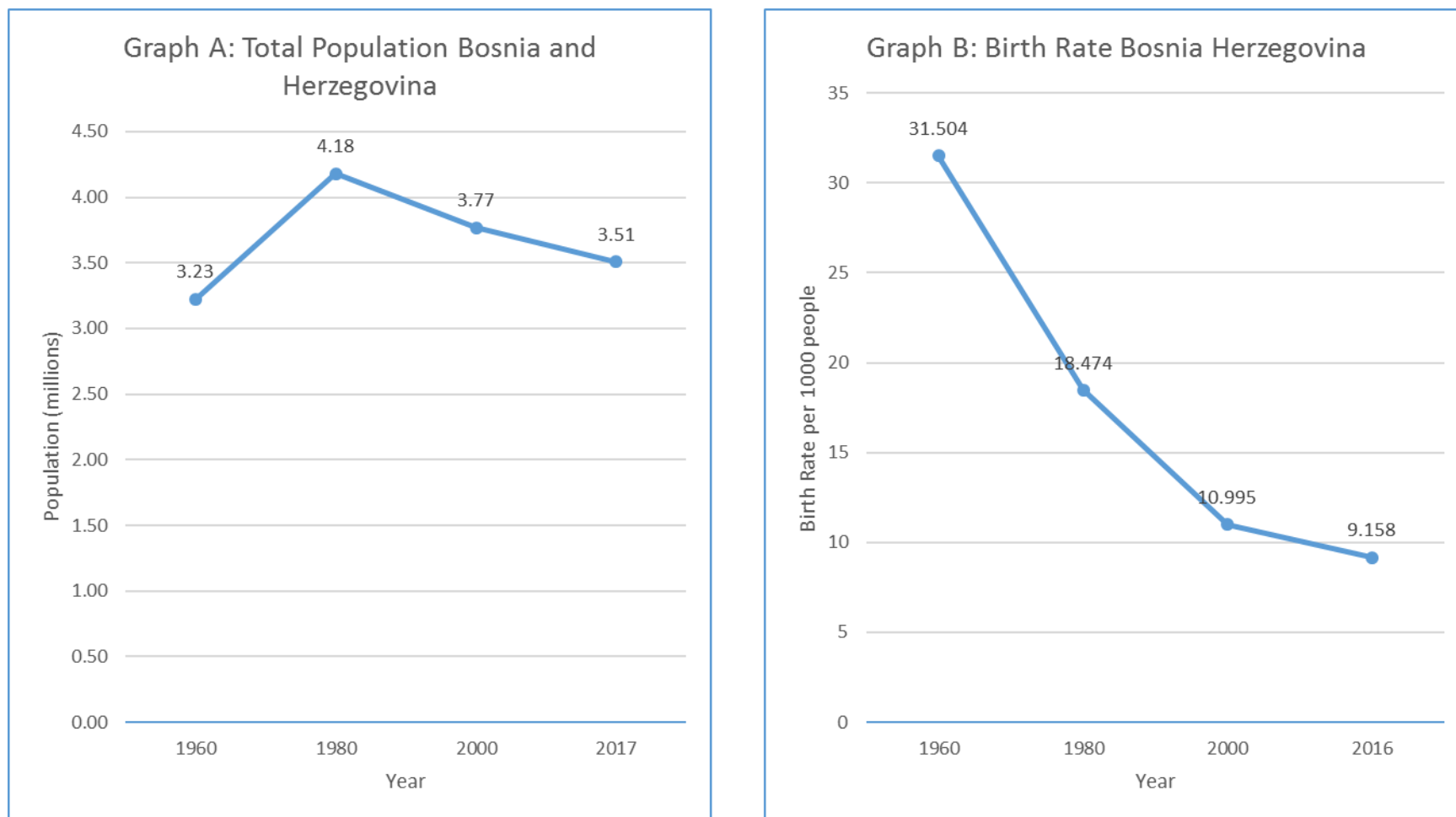
3 Population and Healthcare Overview

The population of Bosnia and Herzegovina is 3,507,017 (World Bank, 2018a) and the birth rate is estimated at 9.2 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.

Bosnia and Herzegovina has a reported population density of 69 people per square kilometre in 2017 and this has risen from 65 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 1.02 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 4.9 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Bosnia and Herzegovina is estimated at 77 years (World Bank, 2018e), with a death rate of 11.04 deaths/1,000 population in 2016 (World Bank, 2018f). Bosnia and Herzegovina has a gross national income per capita (PPP int. \$, 2013) of \$9,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was \$957 (Intl \$) and the total expenditure on health in 2014 as percentage of GDP was 9.6% (WHO, 2016b).

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



Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

Vision screening in Bosnia and Herzegovina is organised regionally and is divided into ten regions (cantons). Each region provides vision screening, however, there are differences in which tests are performed in each area. There are no national guidelines on vision screening. Vision screening is funded in the same way in each region. This is done by a combination of parents, charity, health insurance, municipalities, parents' employer, the state and regional funding. Vision screening is embedded into a general preventative child healthcare system, the content of which is determined by ophthalmologists and the local government.

Vision screening in Bosnia and Herzegovina is conducted by ophthalmologists and orthoptists, of which there are estimated to be around 200 professionals in Bosnia and Herzegovina. Screening takes place in hospitals, child healthcare centres, kindergarten and school. There are no other vision screeners in Bosnia and Herzegovina. There have been no general professionals identified that could screen with additional training; this is due to there being no specific training provided for performing vision screening.

The vision screening programme began in 1992 and since then it has continued from the age at which the child enters school (6 years of age). Since its commencement, the vision screening programme has been extended as more tests have been implemented, although it is not known what extra tests have been added to the programme. The vision screening programme is reviewed every 5 years by the government and ophthalmologists, however, it is not known how the revisions to the vision screening programme take place. Quality monitoring is not carried out. There has been no research conducted in Bosnia and Herzegovina regarding the effectiveness or cost-effectiveness of the vision screening programme.

5 Screening programme

In Bosnia and Herzegovina, the target conditions screened for are retinopathy of prematurity (ROP), congenital eye disorders and refractive error. 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 using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination and pupillary reflexes. These tests are conducted by an ophthalmologist in either a hospital or healthcare centre.

5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened using eye inspection and red reflex testing. This is not conducted on all children, it is only if the child is in hospital and the parents are interested or if the paediatrician suspects any abnormality. Red reflex examination to diagnose a white pupil is conducted by an ophthalmologist, as is the eye inspection. There is no sequence to these tests and children are referred for further examination after one abnormal test, and one to two inconclusive tests, the exact number of which is determined by the ophthalmologist.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months of age are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pupillary reflexes, cover test, alternating cover test and autorefractometry. All of which are performed by an ophthalmologist at either a hospital or a healthcare centre. The referral criteria and the sequence of these tests are not known.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months to 7 years of age are screened by an ophthalmologist or an orthoptist using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis, colour vision and autorefractometry (varies between doctors). Visual acuity is measured using the Amsterdam Picture Chart and Numbers (varies between doctors); this is performed for the first time between the aged of 3 and 4 years. If the child fails the first test, the test is repeated again one month later. If the child passes, the test is repeated one year later.

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

| Table 1 | Ophthalmologist | Orthoptist |
|----------------|------------------------|-------------------|
| 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 | Hir | RE | PM | PR | CT | ACT | VA | SV | CV | AR |
|----------------|-----------|------------|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| 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; Hir: Hirschberg test; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity Measurement; SV: Stereopsis; CV: Colour Vision; AR: Autorefraction*

Table 3: Location of vision screening for each age group

| Table 3 | Child Health Care Centre | Hospital |
|----------------|--------------------------|----------|
| 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. Information concerning the exact automated screening conducted in Bosnia and Herzegovina has not been provided, it is known that this differs between doctors.

7 Provision for Visually Impaired

In Tuzla, the third largest city in the centre of the country, there is one school for blind or severely visually impaired children and most other cities have at least one centre for visually impaired children. The costs per child for these schools are not known and there is no data regarding this. It is not known what support visually impaired children who attend regular mainstream school receive, but it is apparent that they do receive some support through donations.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of amblyopia in Bosnia and Herzegovina is unknown. It is estimated that, before the age of 7 years 50% of cases with amblyopia are treated, the rest are untreated (Vodencarevic et al., 2017). The screening, although implemented in 1992 under Yugoslavian rule, has only been obligatory in all schools for the last 2 years (since 2016); but it is not possible to impose attendance to the appointment. Persistent amblyopia has a prevalence of around 10% of cases, before the age of 7 years (Vodencarevic et al., 2017). There is no available data regarding the prevalence of strabismus. The number of amblyopic children with each of the four types of amblyopia are estimated at 50.8% for refractive amblyopia, 28.8% for anisometropic amblyopia and 20.3% for strabismic amblyopia (Vodencarevic et al., 2017). There is no data available for deprivation amblyopia.

A study of childhood cataract included 58 children (34 (58.6%) males and 24 (41.4%) females) with an average age at presentation of 11.12 years (SD \pm 9.03 years). Twenty-nine (50%) patients were unilateral cataracts. Thirty-seven (63.8%) patients had isolated cataracts and 24 (29.3%) patients had other ocular anomalies associated with paediatric cataract. High refractive anomalies, nystagmus and microphthalmia were most commonly associated ocular findings. Strabismus was present in 14 (24.1%) cases. Posterior cortical cataract was present in 29 (32.6%) and nuclear cataract in 28 (31.5%) cases. Estimated incidence of congenital cataract was 2.62 per 10,000 births and incidence of paediatric cataract was 8.6 per 10,000 births (Halilbašić et al., 2014).

8.2 Coverage

All children are invited for vision screening; this is done when the child enters elementary school at 6 years of age, by the government and hospitals. The coverage and attendance for vision screening before the age of 7 years, including visual acuity measurement, is unknown. However, a study carried out in the region of Tuzla, recruited 7415 children (aged 4-15 years) from 24 schools and 8 preschools, whereby children were screened by medical students. The medical students had received training in a one-day workshop, detailing how to grade the child's eyesight, for each eye separately, based on whether or not the child could see at least 3 out of 5 optotypes of the 6/12 line of Snellen E chart, at 6 metres. Each child who failed was referred to an ophthalmologist for further diagnostic examination (n=409, 5.5%), of this cohort, 237 (55%) of children went to their appointment (Vodencarevic et al., 2017).

8.3 Screening evaluation

There is no available data about the percentage of false negative or false positive results after vision screening. The positive predictive value, sensitivity and specificity of vision screening in Bosnia and Herzegovina is also unknown.

8.4 Treatment success

The percentage of infants treated for congenital eye disorders is not known, there is no data on this. There is also no data regarding the percentage of children treated for strabismus after being screened before the age of 7 years. There is no exact data regarding the number of children that have amblyopia, and therefore, it is not possible to determine the percentage of children treated for this. There is no data available pertaining to the percentage of compliance with referral after an abnormal screening test results and there is no registration or documentation of noncompliance with referral after an abnormal screening test result. There is no data available concerning the number of patients treated for congenital cataract, amblyopia and strabismus per year by orthoptists and/or ophthalmologists. Only ophthalmologists prescribe glasses for children under the age of 7 years, other treatments include patching, penalisation with glasses and cataract surgery. However, not all children are treated and this is due to payment problems, such as if the child needs glasses and the parents cannot afford to pay for them.

9 Costs of vision screening in children

Vision screening is free of charge for parents and there is no financial reward for parents when children do attend their vision screening appointment. There is, however, a penalty for those who do not attend; the child cannot enter school.

9.1 Cost of vision screening

Vision screening costs an estimated 50 Euros per child, with medical specialists earning approximately 650 Euros per month. It is not clear what the total screening costs are, per year, for vision screening. The cost of medical tuition is between 200-1400 Euros per year. This is dependent upon whether or not the government pays for a student, or if the student is self-funded. This price only accounts for tuition, the student then has to buy all of the necessary course materials, including books. It takes approximately 6 years of medical studies (4000-12000 Euros) and a further 5000 Euros for ophthalmology residency to complete the training.

9.2 Cost of treatment for amblyopia

There is no data and there have been no studies into the estimated costs of treatment for amblyopia for typical patients with refractive and strabismic amblyopia, including follow-up.

9.3 Cost of Treatment for strabismus

Strabismus surgery, including follow-up is estimated at 300 Euros for the surgery and 300 Euros for the follow-up.

9.4 Cost of treatment for cataract

Congenital cataract surgery is estimated at 1000 Euros per child.

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