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Summary Vision Screening Data: Czech Republic

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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

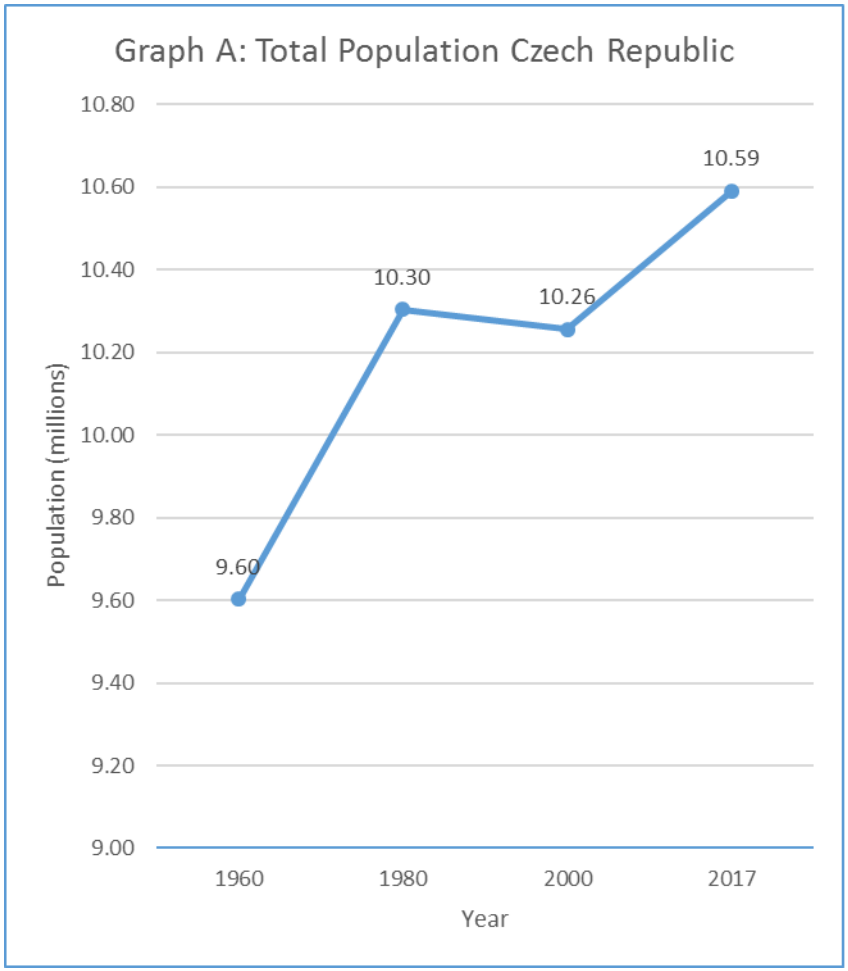
3 Population and Healthcare Overview

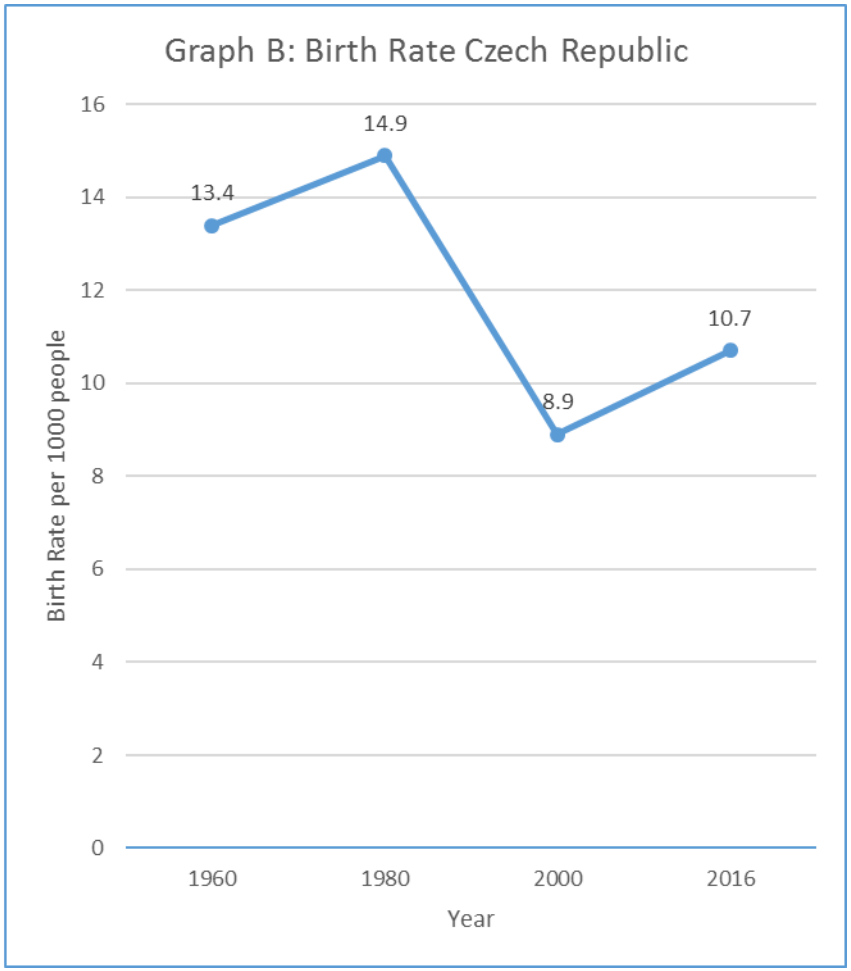
The population of the Czech Republic is 10,591,323 (World Bank, 2018a) and birth rate is estimated at 10.7 births/1,000 population in 2016 (World Bank, 2018b).The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

The Czech Republic has a reported population density of 137 people per square kilometre in 2017 and this has risen from 124 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 1.29 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 2.6 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in the Czech Republic is estimated at 78.3 years (World Bank, 2018e), with a death rate of 10.2 deaths/1,000 population in 2016 (World Bank, 2018f). The Czech Republic has a gross national income per capita (PPP int. $, 2013) of $25,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was $2,146 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 7.4% (WHO, 2016b).

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





Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

In the Czech Republic, vision screening is organised nationally with no differences between regions. Vision screening is funded by compulsory national health insurance which is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by the Ministry of Health and screening vision began several decades ago. In 2005, congenital cataract screening for newborns was introduced. There is no protocol for the timing of review of the programme, however when required, any changes are decided upon by the Ministry of Health and funded by the government.

Nurses have been identified as general professionals that do not currently screen in the Czech Republic but could do so with additional training. There is however currently no specific training to perform vision screening, it relies upon training during general study for paediatric general practitioners (GP).

There are no methods for quality monitoring of vision screening imposed by the government, and there has been only degree level research investigating the vision screening programme. There have been no cost-effectiveness or clinical-effectiveness studies of the vision screening programme.

5 Screening programme

The target conditions screened for by vision screening are congenital cataract and reduced visual acuity. There is no protocol for vision screening available. 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 are screened by either a paediatrician or an ophthalmologist in a hospital. A retinal examination is performed from 31st to 33rd gestational week or 4th-6th postnatal week, whichever term comes earlier. Subsequently, babies are screened at 2-week intervals, if there are signs of retinopathy of prematurity (ROP) the interval is shorter (1 week). If there are no signs of ROP, screening for ROP finishes at the age of 36th gestational week. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility and retinal examination (ophthalmologist only). Referral is necessary if there is evidence of ROP, strabismus, loss of fixation, other congenital ocular abnormality or at the parents' request.

5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened four times by a paediatrician or a nurse in either a hospital or a private clinic. The tests conducted at this age include eye inspection, fixation, red reflex testing and eye motility. Newborns are tested with eye inspection and red reflex at 2 days after release from hospital and with eye inspection, fixation and eye motility at 2 weeks, 6 weeks and 3 months. If a red reflex is not visible, babies are referred to an ophthalmologist.

For other tests, no guidelines are available with regards to referral criteria, therefore, it is at the discretion of the examiner. There are no guidelines concerning the number of inconclusive tests that necessitate referral for further diagnostic examination, this also is at the discretion of the examiner.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by a paediatrician or nurse at the paediatrician's office. The tests conducted in this age group include eye inspection, fixation and eye motility. Automated screening with PlusOptix is sometimes available, but not obligatory. Eye inspection and motility are checked at the age of 4-5 months, 6 months, 8 months, 10-11 months, 12 months, and 18 months. Fixation is checked at the age of 4-5 months, 8 months, 12 months, and 18 months. There are no guidelines on how many abnormal or inconclusive screening results necessitate referral for further diagnostic examination, this is at the examiner's discretion.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by a paediatrician or a nurse at the office of the paediatrician. The tests conducted at this age include eye inspection, eye motility, visual acuity (VA) measurement, colour vision (Broschmann Dieter, Kuchenbecker Jörn) and automated screening (PlusOptix). Eye inspection, eye motility and VA are tested at the age of 5 and 7 years, knowledge of colours is tested at the age of 5 years, colour vision is tested at the age of 7 years. VA is measured for the first time at 3 years of age. It is measured a second time at 5 years of age and then again at the ages of 7, 11, 13, 15, 17 and 19 years. The optotype charts used include Lea Symbols, HOTV and Tumbling E (Pflüger). There is no standardisation concerning whether these charts are logMAR, linear crowded tests or uncrowded. However, typically a linear crowded, with a testing range from 0.1 – 1.0 (decimal) is used. The examiner decides which test to use and therefore there is no categorical difference between which chart is used at which age. There are no specific guidelines concerning the referral criteria, however in general:

- Worse than 0.5 decimal (0.3 logMAR, 6/12 Snellen) at 3 years
- Worse than 0.63 decimal) (0.2 logMAR, 6/9.5 Snellen) at 5 years
- Worse than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) at 7 years and older (
- Difference between eyes or signs of strabismus at any age

There are no guidelines on how many abnormal or inconclusive screening results necessitate referral for further diagnostic examination, this is at the examiner's discretion.

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

Table 1	Paediatrician	Ophthalmologist	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	Eye inspection	Red reflex testing	Fixation	Eye motility	Retinal examination	Visual acuity	Colour Vision	Automated screening
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	Paediatrician office	Private Clinic
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.

In the Czech Republic, PlusOptix is used. Paediatricians and ophthalmologists can hire the machines for approximately 3300 Czech Crowns (128.14 Euros*) per year. The paediatrician or ophthalmologist can buy the device for 8,400 Czech Crowns (326.21 Euros*). There are about 130 PlusOptix devices provided in the Czech Republic. The exact number of children screened using this device is not known, but it is estimated at 26,000 children per year. Paediatricians usually perform this in children at 6 months, 1.5 years and 3 years of age' however, there are also private screening programmes in kindergartens, where the age of tested children is between 5-6 years. It is stand-alone test, however depending on the location of screening, it can be conducted in collaboration with other tests; for example, paediatricians also perform VA tests, ophthalmologists can measure refraction with objective methods. It is usually offered to all children.

Referral criteria are as follows:

Age (months)	Anisometropia (Dioptres)	Astigmatism (Dioptres)	Myopia (Dioptres)	Hyperopia (Dioptres)	Anisocoria (mm)
6-12	2.00	2.50	2.00	4.00	1.50
12-36	1.50	1.50	2.00	3.00	1.50
36-72	1.50	1.00	1.00	2.50	1.50
72-240	1.00	1.00	1.00	2.00	1.50

Referral in children who pass the VA test but fail on PlusOptix is at the discretion of the examiner. If a paediatrician conducts the testing, children are usually referred to ophthalmologist if they fail the PlusOptix and pass the VA test. There is no comparative data between regions who do use and do not use PlusOptix, or on the outcomes of screening by visual acuity/PlusOptix because there are no areas of the Czech Republic that do not use PlusOptix.

7 Provision for Visually Impaired

In the Czech Republic, there are 9 state schools (650 children attend) and 7 grammar schools (400 children attend) for blind or severely visually impaired children. However, many children are integrated into regular mainstream schools with the help of personal assistants. The costs per child for these schools is not known. There is special support for visually impaired children who attend regular primary school; the ophthalmologist can prescribe special tools, including:

- Magnifying newspapers, books and websites on computers
- Technology that magnifies documents using phone and tablet software (Enlarge on the Go)
- Technology that reads documents and books for the individual
- Braille
- Methods of simplifying computer work
- Talking phones

*Currency conversion as of 28/12/2018

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of treated or untreated amblyopia at the age of 7 years is estimated at 2.5%, and the prevalence of persistent amblyopia at the age of 7 years is estimated at 2% (Varadyová, 2007), but there is no accurate statistical data available for these measures. In 2015, the prevalence of strabismus was detailed by the Institute of Health Information and Statistic of the Czech Republic as 770/100,000 people ("Oftalmologie | ÚZIS ČR", 2018) i.e. 0.77%. However, the classification of type of strabismus is not available and the reporting physicians only report the presence of diagnosis of strabismus, there is no information provided about age. There is no further data available.

8.2 Coverage

It is estimated that 100% of children are invited for vision screening, this is conducted by the general practitioner (GP) through different sources including letters. The coverage and attendance of all vision screening, including visual acuity measurements is estimated at almost 100%.

8.3 Screening evaluation

The percentage of false negative and false positive results is not available. The positive predictive value, sensitivity and specificity of vision screening are also not available.

8.4 Treatment success

Following screening referral before the age of 7 years, the percentage of children treated for strabismus is not known. There is no further data available. The percentage of compliance with referral, after an abnormal screening test result is estimated at 90%. However, these is no registration or documentation of noncompliance with referral after an abnormal screening test result. It is not known how many patients are treated for congenital cataract, amblyopia and strabismus each year.

Ophthalmologists are the only professionals that prescribe glasses for children under the age of 7 years. Other treatment options include patching, cataract surgery, strabismus surgery, ptosis surgery, glaucoma surgery and retinoblastoma treatment. All eligible children are offered treatment.

9 Costs of vision screening in children

9.1 Cost of vision screening

The salary costs (range) per year for vision screening professional is not available. The salary costs (range) per hour for vision screening professionals is estimated at 10-20 Euros. It is estimated that it costs approximately 20,000 Euros to train vision screening professionals between leaving secondary education and qualification. The total screening costs per year for vision screening is not available. Screening of visual functions is part of general follow-ups.

9.2 Cost of treatment for amblyopia

The estimated costs for treatment of typical patients with refractive and strabismic amblyopia, including follow-up are:

- Visit to ophthalmologist: 20 Euros
- Visit to orthoptist: long visit 13 Euro, short visit 6 Euros
- 1 session of active stimulation (consists of CAM vision stimulation, troposcope and stereoscope training, cheiroscope training and specialised computer programme for details recognition): 10 Euros
- Patches: 15 Euros/3 months
- Glasses: 40 Euros - amount that can be claimed for from insurance.
- Extra money possible only for glasses and patches.
- Number of visits depends on age and disease type, usually per year = ophthalmologist twice, long orthoptic visit twice, 20 sessions of stimulation, glasses = 306 Euros per year.

9.3 Cost of Treatment for strabismus

The estimated costs for strabismus surgery including follow up are:

- Surgery: 100 Euros
- Visit to orthoptist: long visit 13 Euros, short visit 6 Euros (once or twice a year)
- Visit to ophthalmologist: 20 Euros (at the beginning usually in 1 week, 3 months, 6 months)
- 1 session of active stimulation: 10 Euros (max 20 lectures a year)
- Patches: 15 Euros/3 months
- Glasses: 40 Euros

9.4 Cost of treatment for cataract

The estimated costs for congenital cataract surgery including follow up of deprivation amblyopia are:

- Surgery: 550 Euros

- Check-up under general anaesthetic (at the beginning every 3 months, then every 6 months until 3-4 years): 100 Euros
- Visit to orthoptist: long visit 13 Euros, short visit 6 Euros (once or twice a year)
- Visit to ophthalmologist: 20 Euros (at the beginning every 2-3 weeks, then every 2-3 months, then every 6 months and once a year in preschool age)
- 1 session of active stimulation: 10 Euros (max 20 lectures a year)
- Patches: 15 Euros/3 months
- Glasses: 40 Euros

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