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Near vision problems and learning difficulties in school age children

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- ✓ Reading difficulties are commonly associated with disorders of visual function.
- ✓ Early detection and treatment of uncorrected refractive errors, binocular visual anomalies, and amblyopia will reduce the risk of long-term visual problems.
- ✓ The first sign of near vision fatigue is inappropriate work of accommodation and vergence system.
- ✓ Accommodation and vergence problems is hard to detect before age of 7 years.

Birbaum (1984, 1993), Cooper et al. (1987), Bullimore & Gilmartin (1988), (Perreault (1992), Lehmkuhle et al. (1993), Goldstand et al. (2005), Bucci et al. (2008), Dusek et al. (2010), Paloma-Alvarez & Puell (2008, 2010), Quaid & Simpson (2013)

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Aim of the study

To evaluate near vision problems in school age children (7-18 years of age) and their possible relationship with learning problems

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Screening method

Methods

- Visual acuity at distance (3 m)
- Hyperopia test (+1.50D and +2.50D)
- Visual acuity at near (40 cm)
- Accommodation ($\pm 2.00D$)
- Suppression and stereovision (TNO test)
- Dissociated phoria (modified Thoringhton test)
- Near point of convergence (RAF ruler)
- Vergence facility (8 pd base in and 8 pd base out)
- Colour vision

Near visual skills

TAVOH

The development of screening method was supported by University of Latvia and ERAF project Nr. 2011/0004/2DP/2.1.1.1.0/10/APIA/VIAA/027

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Evaluation of screening method

	Latvia	MCT	NYSOA	VERA
Personal	SP	HQSP	HQSP	AS
No of tests	9	~4	~8	~8
Performance	Manual	Manual	Manual	Computerized
Sensitivity	87 %	98 %	72 %	75 % only VA (50 % all tests)
Specificity	77 %	99 %	65 %	93 %
False positive	23 %	1 %	35 %	7 %
False negative	13 %	2 %	28 %	25-50 %

SP – Specialists; HQSP – highly qualified specialists; AS – trained assistant; N – no assitant

MCT - The Modified Clinical Technique
 NYSOA - New York State Optometric Association
 VERA - Visual Efficiency Rating (USA)

Sensitivity (true positive rate) – the proportion of actual positives which are correctly identified as such
 Specificity (true negative rate) – measures the proportion of negatives which are correctly identified as such
 False positive – incorrectly identified; False negative – incorrectly rejected

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Screening at 30 schools → 11 033 school age children

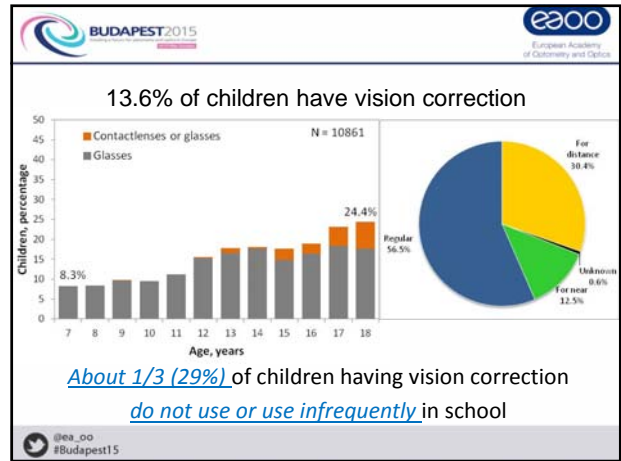
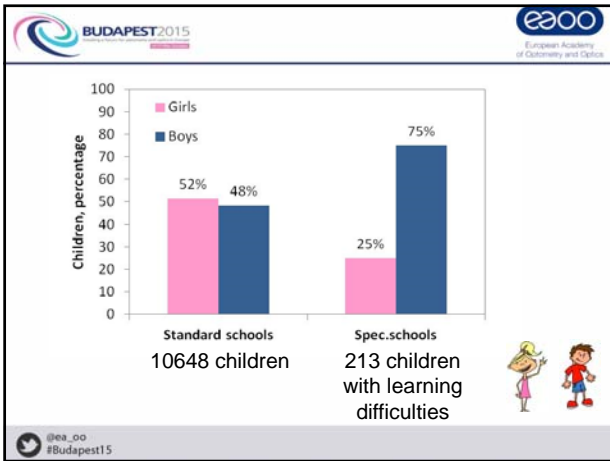
Children, percentage

Age, years

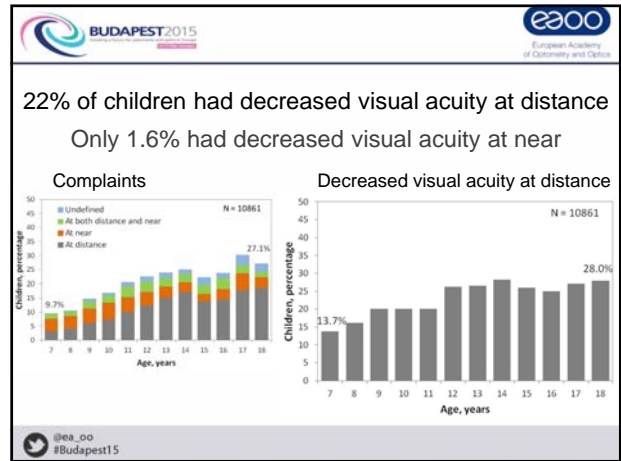
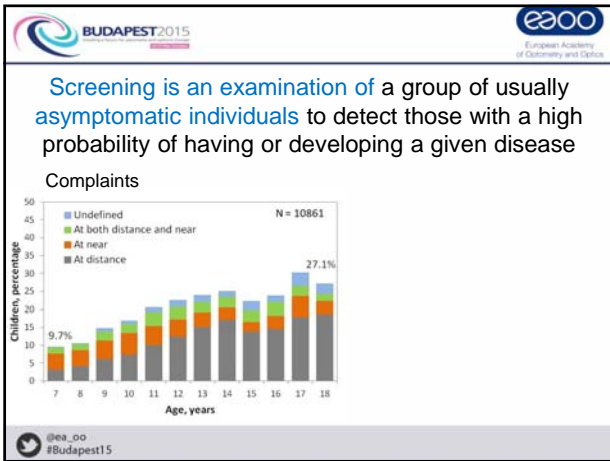
N = 11033

N = 10861

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About 1/3 (29%) of children having vision correction do not use or use infrequently in school



Results of screening in standard schools

Failed the screening:	47.5%
Complain:	18.9%
and no visual problems	5.3%
and decreased visual acuity at distance	4.9%
and accommodation and/or vergence problems	3.4%
and decreased visual acuity at distance, accommodation and/or vergence problems	5.3%
Do not complain:	28.6%
decreased visual acuity at distance	6.4%
accommodation and/or vergence problems	17.0%
decreased visual acuity at distance, accommodation and/or vergence problems	5.2%

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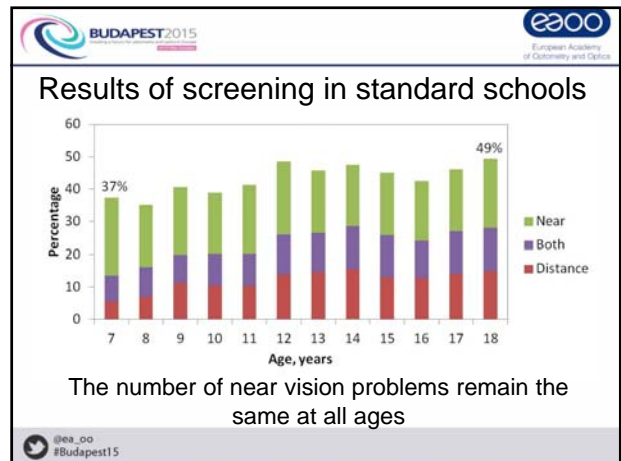
13.7% reasoned

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Results of screening in standard schools

Failed the screening:	47.5%	
Complain:	18.9%	
and no visual problems	5.3%	
and decreased visual acuity at distance	4.9%	
and accommodation and/or vergence problems	3.4%	} 8.8%
and decreased visual acuity at distance, accommodation and/or vergence problems	5.3%	
Do not complain:	28.6%	
decreased visual acuity at distance	6.4%	
accommodation and/or vergence problems	17.0%	} 22.1%
decreased visual acuity at distance, accommodation and/or vergence problems	5.2%	

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Standard vs specialized schools

	Stand.	Spec.	
Failed the screening:	47.5%	51.2%	
Complain:	18.9%	24.9%	<0.05
and no visual problems	5.3%	4.7%	ns
and decreased visual acuity at distance	4.9%	5.6%	ns
and accommodation and/or vergence problems	3.4%	7.5%	<0.05
and decreased visual acuity at distance, accommodation and/or vergence problems	5.3%	7.0%	ns
Do not complain:	28.6%	26.3%	
decreased visual acuity at distance	6.4%	6.6%	ns
accommodation and/or vergence problems	17.0%	11.3%	<0.05
decreased visual acuity at distance, accommodation and/or vergence problems	5.2%	8.5%	ns

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Failed the screening:	47.5%	51.2%	
Complain:	18.9%	24.9%	<0.05
and no visual problems	5.3%	4.7%	ns
and decreased visual acuity at distance	4.9%	5.6%	ns
and accommodation and/or vergence problems	3.4%	7.5%	<0.05
and decreased visual acuity at distance, accommodation and/or vergence problems	5.3%	7.0%	ns
Do not complain:	28.6%	26.3%	
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accommodation and/or vergence problems	17.0%	11.3%	<0.05
decreased visual acuity at distance, accommodation and/or vergence problems	5.2%	8.5%	ns

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Standard vs specialized schools

	Complains only	Vision problems at distance	Vision problems at near	Vision problems at near and distance
Standard schools	5.3%	11.3%	20.4%	10.5%
Specialized schools	4.7%	12.2%	18.8%	15.5%
p	ns	ns	ns	<0.05

Can experience problems with near visual tasks

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Is there any specific visual function difference?

➤ No significant difference in visual acuity.

Dusek and colleagues (2010) demonstrated poorer visual acuity at distance for children with reading difficulties.

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Is there any specific visual function difference?

Children with learning difficulties:

- have more often positive hyperopia test ($p < 0.01$)

Test Result	Standard Schools (%)	Special Schools (%)
Positive	34%	44%
Negative	66%	56%

Children, percentage

Legend: ■ stand.schools, ■ spec.schools

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Is there any specific visual function difference?

Children with learning difficulties:

- have more often positive hyperopia test
- are more esophoric ($p < 0.01$)

Exophoria/Esophoria Type	Standard Schools (%)	Special Schools (%)
< 6 pd exo	8%	9%
6 pd exo ... 2 pd eso	83%	75%
> 2 pd eso	9%	16%

Children, percentage

Legend: ■ stand.schools, ■ spec.schools

~2x

Dusek and colleagues (2010) observed more exophorias at near.

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Is there any specific visual function difference?

Children with learning difficulties:

- have more often positiv
- are more esophoric
- have problems with accommodation (-2.00D, $p < 0.05$) and accommodation response

Accommodation	Standard Schools (s)	Special Schools (s)
Accom +2.00D	~2.3	~3.0
Accom -2.00D	~1.8	~2.7

Accommodation response (s)

Legend: ■ stand.schools, ■ spec.schools

Dusek and colleagues (2010), Paloma-Alvarez and Puell (2008) – accommodation amplitude and binocular accommodative facility is reduced.

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Is there any specific visual function difference?

Children with learning difficulties:

- have more often positive hyperopia test
- are more esophoric
- have problems with accommodation stimulation (-2.00D) and have slower accommodation response
- have slower vergence response ($p < 0.001$)

Dusek and colleagues (2010), Paloma-Alvarez and Puell (2010), Quaid and Sipson (2013) – reduced vergence facility and near point of convergence.

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Is there any specific visual function difference?

Children with learning difficulties:

- have more often positive hyperopia test
- are more esophoric
- have problems with accommodation stimulation (-2.00D) and have slower accommodation response
- have slower vergence response
- have reduced (120 arc sec or worse) or no global stereovision ($p < 0.0001$)

Category	Standard (%)	Specialized (%)
Global Stereovision	17%	42%

Legend: ■ Standard, ■ Specialized

~2.5x

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Is there any specific visual function difference?

Children with learning difficulties:


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- have problems with accommodation stimulation (-2.00D) and have slower accommodation response
- have slower vergence response
- have reduced (120 arc sec or worse) or no global stereovision

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Conclusions

- Our results demonstrate wide range of near vision problems in school aged children. About 1/3 of children fail the screening because of accommodation and/or vergence problems and can experience difficulties with near visual tasks.
- Near visual skills of school age children with learning difficulties are changed more than in children from standard schools. Eye care professionals can help – especially in balancing accommodation and vergence system.

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Thank you for your attention!

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