

Evidence Statement and Flowchart as guidelines for daily clinical practice in children with handwriting problems.

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Background

Handwriting is a skill which allows children and adults to communicate. Although the use of computers is growing, handwriting is still worldwide an important and the most immediate tool for graphic communication. At school writing supports the learning process in other domains like reading, mathematics and history and the older children are the more they spent their time at school with writing. If children have writing problems, this can affect negatively general school performance and self-perception. In the Netherlands over 30% of children encounter difficulties with learning to write to a greater or lesser extent.

Although learning to write is a cognitive skill, the motor component in the learning process shows a major role. As a result, it has become common in The Netherlands that parents and/or teachers consult a paediatric physio- or occupational therapist in primary care with a request for help.

In 2009, we conducted a digital survey among all members of The Dutch Society for Paediatric Physiotherapists (acronym: NVFK), specialized member of the Royal Dutch Association for Physical Therapy (acronym: KNGF). It appeared that paediatric physiotherapists spent 25-50% of their time in children with handwriting problems. Moreover, it was clear that the variance in diagnostics and intervention methods was large. These findings stressed the clinical relevance to the development of an Evidence Statement. Therefore, the NVFK has assigned the project group 'Children with handwriting problems' to develop an Evidence Statement (ES) for paediatric physiotherapists. The objective of the ES was to achieve uniformity in indication, diagnostics and intervention.

Methods

In an Evidence Statement the existing questions in clinical practice are the starting point. Together with a multidisciplinary focus group, the determinants for handwriting problems were defined and subsequently, the questions to be answered were formulated. The following aspects were determined as relevant for the quality of handwriting:

- the content of the message
- spelling and composition of the text
- legibility of letters, words and sentences
- handwriting movements
- speed and duration.

To come to an adequate indication for physiotherapy, the first set of questions focused on the normal learning process and development of handwriting in children and the specific cognitive and motor components. Subsequently, we searched for differences between good and bad writers, and for the symptoms predicting problems in the learning process. To increase effectiveness of

diagnostics, we focused on feasible, reliable and valid measurement instruments or assessments available in The Netherlands. Finally, we searched for evidence-based intervention strategies.

To answer the questions on etiology, measurement instruments and intervention a broad literature search was done. Based on the formulated questions we searched for relevant Medical Subject Headers (MeSH-terms) and free text to include as many as possible articles. We searched in PubMed, Psychlit, Cochrane and Cinahl. All reference lists were checked for relevant articles. In total, 188 articles are included for the whole ES, in which some articles were used in more than one chapter based on the relevance of the information.

Tabel 1: Limits, MeSH-terms and free text used for the literature search.

limits	<ul style="list-style-type: none"> • children aged 4-12 years 'all child (0-18 years)' • English or Dutch • 1980-2009 (Dutch addition to 01-01-2010) • children with handwriting problems without neurological or musculoskeletal impairments
AND	
MeSH	<p>MeSH – all 'OR '</p> <p>handwriting, motor skill(s), motor skills disorder(s), agraphia, motor performance, psychomotor disorder, handwriting legibility, motor coordination, developmental disabilities, perceptual motor coordination, developmental disabilities, perceptual motor processes, movement disorders, psychometric(s), diagnosis, intervention</p>
AND	
free text	<p>free text- all 'OR'</p> <p>handwriting, poor writers, dysgraphic, dysgraphia, writing skill(s), fine motor (skills), fine motor coordination, handwriting performance, drawing, writing disorder, handwriting difficulties, handwriting dysfunction, visual motor (coordination), visual-motor, visuomotor (control), visuo-motor, psychomotor performance, pain, writers' cramp, motor skill disorder, graphomotor, (developmental) dysgraphia, test(s), assessment, assessment tools, measurements, visual motor test, handwriting test, evaluation tool, evaluation, visual perception or perception test, measurement(s), instrument(s), evaluation, measurement, questionnaire(s), test construction, test validity, rating scales, test reliability, psychometrics, program evaluation, treatment, tools, effectiveness, speed, readiness, KOEK, SOS, VMI, GHB, BHK, intervention studies, therapy, writing program, evidence based practice, training, education</p>

In the next step two project group members scored the quality of the articles:

- For the (randomized) controlled trials or experimental studies the Physiotherapy Evidence Database (PEDro) scoring list was used.
- To evaluate the quality of the measurement instruments, the STARD Checklist (STAndards for Reporting of Diagnostic accuracy, 2003) was used.
- To score the cohort studies, the checklist from the Critical Appraisal Skills Programme (CASP; 2004) was used.

Once the articles were judged on quality and relevance by two members of the project group, for each question separately a summary of the available evidence in the scientific literature was formulated. Based on these summaries, conclusions concerning the level of evidence (A, B, C or D) (CBO, 2007) were formulated and consequently recommendations regarding clinical practice were formulated.

Table 1.2: Level of Evidence for intervention and diagnostic studies (CBO, 2007).

	intervention	diagnostic measurements	negative side effects, etiology, prognosis
A1	systematic review from at least two independent studies at A2-level		
A2	randomised double-blinded clinical trial with high quality and sufficient population and with comparison between groups	comparison to a gold standard with predefined cut-off points and independent judgment from the test results and gold standard, concerning a sufficient number of consecutive patients who all fulfilled both the index- and reference test	prospective cohort study with sufficient number of participants and follow-up with adequate control for 'confounders' and selective follow-up
B	controlled trials with comparison between groups but not randomised (i.e. patient control studies, cohort studies)	research which uses comparison to a reference test, but not fulfilling all aspects as mentioned in A2 studies	prospective cohort study, but not all aspects as mentioned in A2 studies, retrospective cohort studies or patient control studies
C	studies without comparison (i.e. time series or case studies)		
D	expert opinion		

Clinical reasoning

Subsequently, the evidence-based conclusions were converted into recommendations for clinical reasoning. The framework of the Hypothesis-Oriented Algorithm for Clinicians (HOACII) in neurological patients (Schenkman et al., 2006) was used for the development of a Flowchart in which all steps in clinical decision making were explained with the evidence and recommendations as basis

for all steps. We distinguished five profiles of children with handwriting problems. In the Flowchart, the hypotheses for the child with handwriting problems are practically elaborated in the various stages of clinical reasoning. This Flowchart starts with the request for help and the circle continues until treatment and evaluation. The evidence-based recommendations are incorporated in every step of the clinical reasoning process. Using the method and measurement procedure recommended in the Flowchart, the clinical reasoning process will lead to a diagnosis in one of the five profiles. For each of these profiles recommendations for a task-oriented treatment are formulated.

Besides the development of the ES and the Flowchart, this project has already resulted in a number of case reports published in the Dutch Journal of Paediatric Physiotherapy, in which the clinical reasoning model has been worked out. The next step is to ensure implementation of the ES and the Flowchart in collaboration with the NVFK and KNGF. Internationally, there is a lot of interest in the Flowchart and international publications are currently underway.

Conclusions

This ES contributes to the understanding of underlying perceptual motor processes and co-occurring problems of children with handwriting problems. It will guide decision-making in clinical practice and improves the transparency to other people involved in helping these children (primarily teachers and parents). Physiotherapists and occupational therapists can use these recommendations to facilitate their specific role in managing children with handwriting difficulties. Moreover, the literature review pointed out that there is a lack of high quality comparative intervention studies.

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References

The complete list of references can be found in the Dutch version of this Evidence statement at www.kngfrichtlijnen.nl

List with abbreviations:

PPT = Pediatric Physiotherapist

OT= Occupational Therapist

Ned Tijdschr Kinderfysiother = Dutch Journal of Paediatric Physiotherapy

Short list measurement instruments

<i>How I think I'm getting on</i>	Dutch questionnaire on motor competence experience in children (De Kloet et al., 2007)
<i>CBSK-M</i>	Dutch questionnaire on self-perception of motor competence in children (Rossum et al., 2000), a Dutch translation of Harter's Self-Perception Profile for Children (Harter S. Manual for the Self-Perception Profile for Children. Denver: University of Denver Department of Developmental Psychology; 1985).
<i>SQT</i>	School Questionnaire for Teachers (Engelsman, 1995). A Dutch questionnaire, especially developed for teachers to detect handwriting problems. Scoring of the 10 questions is on a 5-point scale.
<i>BHK</i>	Concise Evaluation Scale for Children's Handwriting (Hamstra-Bletz et al., 1987). The BHK is a method to determine the level of handwriting quality and speed and to detect a deviation in handwriting development in 7 to 12-year-old children.
<i>SOS</i>	Systematic Detection of Motor Handwriting Problems in Children (Smits-Engelsman, 1999; Van Waelvelde, 2008). The SOS contains the 6 most sensitive items of the BHK; the scoring system is comparable to the BHK.
<i>VAS</i>	Visual Analogue Scale (VAS): a psychometric response scale which can be used in questionnaires focusing on fatigue or pain. The child scores the subjective experience by indicating a position along a continuous line between two end-points.
<i>NRS</i>	Numeric Rating Scale: a psychometric response scale which can be used in questionnaires focusing on fatigue or pain. The child scores the subjective experience by numerical rating in a scale from 1-10.
<i>CVO</i>	This is the Dutch version of the Developmental Coordination Disorder Questionnaire (Wilson et al., 2007; Schoemaker et al., 2007). The Developmental Coordination Disorder Questionnaire (the DCDQ) is a brief parent questionnaire designed to screen for coordination disorders in children, aged 5 to 15 years.
<i>M ABC</i>	Movement Assessment Battery for Children-1; Henderson & Sugden, 1992; Dutch version: Smits-Engelsman, 1998. The second version M ABC-2 appeared in 2007: Henderson, Sugden & Barnett, 2007, and the Dutch translation and standardization by Smits-Engelsman in 2010.
<i>GMO</i>	Motor Observation Questionnaire for Teachers (Van Dellen & Kalverboer, 1990; Schoemaker et al., 2008). This questionnaire aims to screen children aged 5-12 years on Developmental Coordination Disorders by teachers using a 4-point Likert-scale.

<i>KOEK</i>	Dutch observation assessment: Screening Prewriting skills Occupational Therapy (SPOT) (Van Hartingsveldt et al., 2006), an observational assessment instrument of 5 and 6- year- old children.
<i>Beery VMI</i>	Developmental Test of Visual-motor Integration (5 th edition); Beery & Beery, 2004). The Beery VMI helps assessing the extent to which individuals can integrate their visual and motor abilities. The Short Format and Full Format tests present drawings of geometric forms arranged in order of increasing difficulty that the individual is asked to copy. The Short Format is often used in children ages 2–8 years. The Beery VMI series also provides supplemental Visual Perception and Motor Coordination tests, in which the same stimulus forms are used as in the Short and Full Format tests. These supplemental tests are provided as a means for assessing visual and motor contributions to VMI performance.
<i>CHaP</i>	Children's Questionnaire for Handwriting Proficiency; Rosenblum, 2008: this handwriting questionnaire has to be filled out by the child him or herself. The CHaP is a modified version of the Handwriting Proficiency Screening Questionnaire (HPSQ), a teacher questionnaire on handwriting.

Remarks

In this statement we choose to present the findings based on years at school. For instance school year 3 means the third year the child visits school. This was done because the length and content of the educational trajectory in handwriting have more impact on the results than age. In the Netherlands children start school at the age of 4.