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Is there a deficit in the product and process of handwriting in children with attention-deficit hyperactivity disorder? A systematic review and recommendations for future research

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 01 December 2023 and was last updated on 01 December 2023.

INTRODUCTION

Review question / Objective The aim of this systematic review was to identify studies investigating the product and/or process of handwriting in children with ADHD compared with typically developing individuals.

Rationale Handwriting abnormalities in children with attention deficit hyperactivity disorder (ADHD) have sometimes been reported both (i) at product level (i.e., quality/legibility of the written trace and speed of writing) and (ii) at process level (i.e., dynamic and kinematic features such as on-paper and in-air durations, pen pressure and velocity peaks, etc.). Conversely, other works have failed to reveal any differences between ADHD and typically developing children. The question of the presence and nature of handwriting disorders in ADHD remains open and merits an in-depth examination.

Condition being studied ADHD, and typically-developing children (up to 18 years-old).

METHODS

Search strategy To include all relevant articles in this systematic review, a search was carried out using the PubMed, Web of Science and CENTRAL electronic databases with no restrictions on the year of publication and only limited to English language articles. We selected these databases for their broad spectrum of disciplines which regularly publish research pertinent to the topic of this review in ADHD. Manual searches were also conducted to find further references of appropriate articles. The final search included publications dating to September 2023. The following keywords were inputted: “("handwriting" OR "dysgraphia" OR "written production" OR "fine motor abilities" OR "fine motor skills") AND ("attention deficit hyperactivity disorder" OR "ADHD") AND ("children" NOT "adults").

Participant or population ADHD, and typically-developing children.

Intervention NA.

Comparator NA.

Study designs to be included Comparative studies.

Eligibility criteria 1) report data linked to handwriting characteristics in children with ADHD regarding product and/or process (e.g., legibility, spatial components, correction errors, letters size, speed of handwriting, amplitude of movement, in-air time and other kinematic features, pen pressure, etc.); (2) contain data on handwriting characteristics whether or not the children had taken methylphenidate and regardless of the presentation of ADHD (e.g., inattentive or hyperactive-impulsive presentation) and; (3) provide a comparison between children with formal diagnosis of ADHD according to international criteria (e.g., based on DSM-5, APA, 2013) and a typically developing control group.

Information sources Electronic databases and bibliographic survey.

Main outcome(s) The main targeted outcomes were : (i) handwriting skills: product (i.e., trace characteristics, speed of production) and process of handwriting: dynamic and kinematic, finger and arm movements, pen grip and finger pressure on the pen, in-air and on-paper durations, pen velocity, pen pressure, etc.

Additional outcome(s) Proportion of ADHD children facing product and/or process of handwriting abnormalities.

Data management An evaluation of titles and abstracts was conducted to decide whether or not the articles were eligible for the review. The inclusion criteria were that publications had to: (1) report data linked to handwriting characteristics in children with ADHD regarding product and/or process (e.g., legibility, spatial components, correction errors, letters size, speed of handwriting, amplitude of movement, in-air time and other kinematic features, pen pressure, etc.); (2) contain data on handwriting characteristics whether or not the children had taken methylphenidate and regardless of the presentation of ADHD (e.g., inattentive or hyperactive-impulsive presentation) and; (3) provide a comparison between children with formal diagnosis of ADHD according to international criteria (e.g., based on DSM-5, APA, 2013) and a typically developing control group. Exclusion criteria were: (1) qualitative and case studies; (2) no handwriting measures; (3) absence of typically developing control group; (4) absence of formal diagnosis of ADHD and; (5) subjects older than 18 years of age.

Quality assessment / Risk of bias analysis All included publications were evaluated using the Critical Appraisal Skills Pro-gram (CASP) dedicated to experimental studies (CASP, 2010). The CASP questionnaire enables assessment of study validity via three main sections asking the following questions: 1) Are the results of the study valid? (Section A); 2) What are the results (Section B); 3) Would the results help locally? (Section C). In this way, methodological quality, presentation of results and external validity are systematically examined in order to check whether comparisons may reasonably be made from one study to another if necessary.

Strategy of data synthesis First author, year of publication, sample size, mean age, gender, inclusion and exclusion criteria, ADHD presentation, medication state, and handwriting measures were identified. Statistically significant main results were considered as main results for each study. For each domain (product and process of writing), the study characteristics, methodological quality and results will be discussed.

Subgroup analysis NA.

Sensitivity analysis NA.

Language restriction Limited to English language articles.

Country(ies) involved France.

Keywords ADHD; Handwriting; Dysgraphia; Product of handwriting; Process of handwriting.

Contributions of each author

Author 1 - Frédéric Puyjarinet - First principal Investigator of the review. Carried out the methodology and wrote the methodology section of the manuscript.
Email: f.puyjarinet@hotmail.fr
Author 2 - Yves Chaix - Reviewed the final manuscript and proposed some improvements.
Author 3 - Maelle Biotteau - Second principal Investigator of the review. Carried out the methodology and wrote the methodology section of the manuscript.