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# Correlation between Hand Tripod Pinch Grip and Handwriting Quality impact on Academic Performance- A Narrative Review

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***Abstract***

***Background:*** *Hand is an important structure used for reaching, holding object predominantly for that grasp and grip strength particularly tripod pinch grip strength is very essential and handwriting is one of the skilled fine motor movements in that deft handwriting which include particular speed with legible writing product is needed for students especially for their higher grades to achieve their best academic performance.* ***Objective:*** *Deft Handwriting is an essential functional skill that impacts on Academic performance and progress from primary school level to higher grades, mostly assumed that grasp and tripod pinch grip affects legibility, speed, yet research studies examining this relationship as correlation are limited.* ***Method:*** *We used Narrative review methodology to map existing research on tripod pinch grip and handwriting quality from the school-age children to higher grades and to identify gaps in the literature.* ***Results:*** *Ten articles met search criteria and were categorized by grasp patterns which mainly include tripod –dynamic tripod grip strength and handwriting performance in speed and readability and grasp kinetics and handwriting performance. Findings suggest an inefficient grasp can lead to decreased handwriting quality i.e legibility and speed. The current literature is inconclusive and several gaps were identified.* ***Conclusion:*** *Tripod pinch grip strength consider as an important since the thump ,index and middle finger its fine motor action , pressure and force exerted on the pencil since static and dynamic tripod pinch commonly used with students if the student lack of this factor finally end in the low academic performance which affect their higher grades, hence Early Analysis at the primary level and early intervention with maintain the higher grades consider as an essential factor reveals from the article.*

**Keywords:** *Tripod pinch grip strength, Handwriting quality*

## 1. Introduction

Hand grip is essential function of human hand which includes various skill which need for human daily activity for various purpose in the society in which Handwriting is an important skill among the school life of children. Handwriting has been described as a "complex perceptual-motor skill non encompassing a blend of visual-motor coordination abilities, motor planning, cognitive, and perceptual skills, as well as tactile and kinaesthetic sensitivities" (Feder & Majnemer., 2007). Writing is a

demanding process that start as early stage of 2 in first graphic movement are produced and in the late adolescence. General developmental brain changes in middle childhood, and their possible relationships with handwriting acquisition. It is also relevant to highlight the similarity between the trajectory followed by children to become expert writers and data from the field of motor learning. The neural changes that have been described in relation to motor learning and the acquisition of a motor expertise can inform us on how the brain correlates of handwriting evolve in children.

In handwriting, motor programs are codes that specify the number of basic motor units (strokes, see below for an operational definition of a stroke) and their spatiotemporal relations in an abstract, effectors-independent way. Neuropsychological models developed a similar notion of "graphic motor pattern" or "motor engram". Handwriting production is usually characterized through the handwriting product, i.e., the spatial accuracy of the written trace (shaping, size, legibility etc.) and through the handwriting process, i.e., the movement that generates this trace (Rosenblum, Weiss, & Parush, 2003; Tucha, & Lange, 2008). Such coupled analysis of handwriting product and process is possible when writing is recorded on graphic tablets from which several kinematic variables can be computed, such as the mean velocity, the number of lifts and stops (Paz-Villagrán, Danna, & Velay, 2014), or the movement fluency (e.g., Danna, Paz-Villagrán, & Velay, 2013).

Handwriting quality constitute both speed and legible Handwriting is a psychomotor ability defined by two outcomes: speed and legibility, also referred as handwriting quality (Graham et al., 2006). This is essential for their higher academic performance and functional hand writing involved skilled fine motor coordination, grip power, motor control, and grip force applied by individual thumb and finger to the barrel of writing instruments. Handwriting speed seems to affect not only the amount of text produced, but also its quality (Connelly et al., 2005; Connelly, Dockrell, Walter, & Critten, 2012; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Limpo, Alves, & Connelly, 2017; Puranik & Al Otaiba, 2012). This is thought to be especially true in the case of young children who have not yet automatized handwriting. For these children, the motors aspects of handwriting still exert considerable demands on working memory, leaving limited resources available to be devoted to higher-order levels of processing (Cameron, Cottone, Murrah, & Grissmer, 2016), such as planning or idea generation (Berninger & Amtmann, 2003). Handwriting speed is number of writing product per minute. (Jones and Christensen,1999; Pontart et al., 2013; Alamargot and Morin, 2015). The full hand grip and pinch are the main functions of the hand. The grip function of the hand is of great importancein professional and daily life activities (Duruöz MT 2019). According toAmerican Society of Hand Therapists (ASHT) hand strength is one of the components measured during the evaluation of hand function that reflect the overall strength of the upper limb. Hand strength can be obtained by measuring grip and pinch strength; there are three different types of pinch strength such as tip, key, and tripod pinch strength (Martins JC 2015; Shetty M 2019)

The pinch grip on a tripod is the thumb pad rubs against the pads of the index and middle fingers. A three fingered or tripod grasp is when the thumb, index finger and middle finger work together to pick up small objects (NHS foundation trust), It is one the development of pincer grasp which is developed neatly from the age of 9 -10 months (Rachal Nall 2018) A child will develop a whole hand grasp known as a palmar supinate grasp around 1-1.5 years of age. By the age of 2-3 a child will develop a digital pronate grasp where the writing utensil is held in the hand with the tip of the crayon being help on the thumb side of the hand. This then transitions to a four-finger grasp between 3.5-4 years and a static tripod grasp between the ages of 3.5 and 4 years where the child holds the writing utensil with the thumb and index finger and rests the writing utensil on the middle finger. A dynamic tripod grasp typically develops between 4-7 years of age where the pencil movement will occur through manipulation of the fingers and hand. One of the most important developmental stages that impacts tripod grasps is the crawling stage. When a kiddo crawls, they begin to dissociate their hand into two sides: the skills side and the stabilization side. The skills side includes the thumb, index finger and the middle finger. While the stabilization side is the ring finger and the pinky finger. (Kelly deyoung) The dynamic tripod grip has been the most recommended pencil-grip pattern because it allowed for efficient distal movements of the pencil and purportedly minimized muscle tension that could have resulted in fatigue. (Elliott JM 1984, Bergmann KP1990) This grips pattern involved the thumb, index, and middle finger functioning together as a tripod (Jones D 1999). Previous studies reported, it occurred between the ages of 4 and6 years and continues to be refined up to age 14. As per the previous research, the information obtained from the hand tripod grip strength is very useful in the educational industry especially in schooling life among children which is majorly contributed for handwriting skills and determining its quality by speed and legibility which is need proper kinetic and kinematic forces of muscle exerted on pen or pencil Tripod grasps are needed for the development of fine motor skills. For children's daily activities, fine motor skills play a very essential role in increasing finger dexterity and in-hand manipulation skills,

Dynamic tripod grasp is where the child uses their finger muscles to control the pencil, rather than their forearm and upper arm. Proper grasping can increase the possibilities of generating good quality content with legible writing (Sarah Shakibaie., 2023), the purpose of this study reviews analysis for tripod grip strength in various parameter with association with, quality of hand writing.

## 2. Materials And Methods

**Design:** Narrative review Article

**Data source and study selection process**

The database search was performed primarily English language articles, and used were Google Scholar, pub Med (NLM), The key words used were Pinch grip, grip, tripod grip, handwriting, speed, legibility, children. The literature related to tripod grip strength and handwriting published from the 2000 to 2023 was searched. Analysis of the reference lists of all the retrieved articles was done. Through online database search 49 articles were reviewed, 10 articles were included in this study based on the inclusion criteria of correlation study.

**Inclusion criteria:** Correlation study, correlation with Tripod pinch grip strength and handwriting quality, speed and legibility, the studies from 2000 to 2023

**Exclusion criteria:** Regression Analysis and Intervention study, other Variables relation.

## 3. Results and Discussion

Based on the previous original research 49 studies were identified of these studies 10 were retrieved as per inclusion criteria and other studies were most often excluded on the basis of methodology (Figure 1) Ten correlation studies provide the evidence in this review, the tripod pinch grip strength is related to handwriting quality (i.e speed and legibility) of school children. An approach to handwriting quality mostly article support both speed and legible or readable handwriting. Moderate speed is needed in handwriting of school children and show their ability to adequately express their ideas, knowledge and creativity in a timely and effective manner. Competent handwriting is essential for school-aged children's participation and achievement at school (Parush, Lifshitz, Yochman & Weintraub, 2010) Adequate handwriting speed allows students to keep pace with increasing school work demands (Li-Tsang et al., 2011); is essential under examination conditions (Summers & Catarro, 2003); and is a requirement for many professional and vocational settings (Barnett, Henderson, Scheib & Schulz, 2009). Slow handwriting lengthens the time necessary to accomplish projects, but it also alters the character of writing itself. Students never learn to flow through thoughts and words when the velocity of writing is reduced significantly or when the writing is continually stopped by a manual chore. (Nilukshika KVK,2012, Konur O.2006) In an examination setting, handwriting speed is critical. Because there is a fundamental trade-off connection between handwriting speed and readability, having to write fast adds the extra dimension of creating readable text. (Weintraub N1998 Franzsen D 2014) Very limited reviews which is related since the tripod pinch grip strength moderately correlated with handwriting speed and varies age, gender (mellissa M.prunty, Annapratt 2020, Khushbakhat Butt , Sania Maqbool., 2022). Hand writing legibility means written product that is overall able to be read and understood by the writer as well as others. (Colleen Beck., 2000) Legibility is defined by the ease of grasping the message the writing conveys, processing fluency (Szymczak., 2016, for "clear display", see, Kahneman., 2011). Reviews support tripod pinch grip strength is essential for holding object like pen or pencil and there is a significant relation between the handwriting legibility and tripod pinch Grip (vaibhav kadaskar 2020), also relates fine motor precision, force on pen or pencil in positive (Asmaa Ahmed Abd El-samad, 2021), (juile dennis, yyonneswinth., 2001) in that Dynamic tripod is mostly used in handwriting Donica, Denise K; Massengill, Meghan; Gooden, Mary Jessup., 2018).

## 4. Conclusion

Most of the reviewed article explains the relation between the grasp and tripod pinch grip strength and handwriting quality (speed & legibility) is moderately correlate with each other. Deft Handwriting Include legible writing product in a particular speed which is very essential skill for students during their learning period because which is needed for their higher grades for doing their best performance in Academic level and also to achieve in competitive exams , Those skill should identify children from primary schooling level hence research need further , and their hand and finger grip strength tack part an important factor which hold pencil or pen in a particular position like tripod grasp and dynamic tripod grip is used for manipulate the pencil or pen with help of particular muscle force and grip strength is needed, reviewed article relate the tripod pinch grasp especially dynamic tripod mostly used and has significant positive relation with speed and legibility with vary from age ,gender and hand dominance. Tripod pinch strength analysis at the early at the primary level is an important since now days post

covid period most of the normal children are used up with more electronic gadgets and less usage of writing habit used with pen and pencil for that tripod pinch grip strength consider as an important since the thump, index and middle finger its fine motor action , pressure and force exerted on the pencil since static and dynamic tripod pinch commonly used with students if the student lack of this factor finally end in the low academic performance which affect their higher grades, hence Early Analysis at the primary level and early intervention with maintain the higher grades consider as an essential factor reveals from the article.

**Conflict of Interest:** Nil.

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