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Original Article

Usage time of touch screens in relation to visual-motor integration and the quality of life in preschooler children

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الملخص

أهدا ف البحث: تهدف هذه الدراسة إلى دراسة وقت استخدام شاشة اللمس فيما يتعلق بالتكامل البصري الحركي ونوعية الحياة لدى أطفال ما قبل المدرسة. بالإضافة إلى ذلك، قمنا بمقارنة الفرق بين الأطفال الذين يمارسون الرياضة والذين التحقوا بالحضانة مع أولئك الذين لم يلتحقوا بمثل هذه الأنشطة.

طرق البحث: تضمنت هذه الدراسة عينة ملائمة من ١٠٠ طفل في سن ما قبل المدرسة. تتراوح أعمارهم بين ثلاث وخمس سنوات. وتم استخدام مقياس بيبودي لتطور الحركة لتقييم التكامل الحركي البصري والنسخة العربية من المقياس العام لجودة حياة الأطفال لتقييم جودة الحياة.

النتائج: أظهرت معادلة معامل ارتباط بيرسون علاقة ارتباط معنوية سالبة بين وقت استخدام شاشة اللمس والتكامل الحركي البصري، والبدني، والنفسي والاجتماعي والدرجة الإجمالية لجودة الحياة. أظهر الأطفال الذين مارسوا الرياضة تكاملا حركيا بصريا أقل بينما أظهروا درجات أعلى في جودة الحياة مقارنة بأولئك الذين لم يحضروا مثل هذه الأنشطة. وأظهر الأطفال الذين التحقوا بالحضانة تكاملا حركيا بصريا أعلى ودرجات أقل في جودة الحياة من أولئك الذين لم يتم منحهم الفرصة للالتحاق بهذه الأنشطة.

الاستنتاجات: في دراستنا، أثرت زيادة وقت استخدام الشاشات التي تعمل باللمس سلبا على التكامل الحركي البصري ونوعية الحياة لدى أطفال ما قبل المدرسة. بينما أثر ممارسة الرياضة والالتحاق بالحضانة على التكامل الحركي البصري ونوعية الحياة.

الكلمات المفتاحية: رياضة؛ حضانة؛ جودة الحياة؛ شاشة اللمس؛ التكامل الحركي البصري.

Abstract

Objectives: This study aims to examine the usage of touch screen time in relation to the visual-motor integration and the quality-of-life in preschool children. Additionally, we compare the difference between children who practiced sports and attended nursery with those who did not attend such activities.

Methods: This study includes a convenience sample of 100 preschool children aged between three and five years. The Peabody Developmental Motor Scale is used to assess visual-motor integration and the Arabic version of the Paediatric Quality of Life Inventory™ generic scale to assess the quality of life (QoL).

Results: The Pearson correlation coefficient equation reveals a negative significant correlation ($p = 0.0001$) between touch screen usage time and visual-motor integration ($r = -0.37$), physical ($r = -0.38$), psychosocial ($r = -0.55$) and the QoL total score ($r = -0.48$). Children who practiced sports showed lower visual-motor integration and higher QoL scores than those who did not. Children who attended nursery showed higher visual-motor integration and lower QoL scores than those who were not given the chance to attend these activities.

Conclusion: Based on the results of the current study, it can be concluded that increased touch screen usage time was found to adversely affect visual-motor integration and the QoL in preschool children. Practicing sports and attending nursery influence the visual-motor integration and the QoL.

Keywords: Nursery; Quality of life; Sports; Touch screen; Visual-motor integration

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Introduction

The development of human motor performance undergoes rapid refinement in early infancy and childhood and is emphasised by the motor domain including gross and fine motor skills (e.g. drawing, sewing, typing).[1] Motor development in the early stages of a child's life is influenced by various factors that may either imped or enhance refinement of motor skills.[2,3] Young children spend a considerable amount of time using tablets for educational and entertainment interests with limited engagement in active playing and physical fitness activities.[4,5]

Children's access to touch screens has outpaced what we know about its impact on early development for better or worse regarding motor, social, cognitive development, and behaviour.[6,7] Muscle physiology, joint flexibility, and perceptual abilities encompass a higher degree of coordination while manipulating objects within the fingers and hands. On the other hand, touch screen applications require basic fundamental actions: clicking, tapping, pushing, sweeping, drag, and zoom actions.[8]

Cognitive development and fine motor skills undergo rapid refinement in infancy and very early childhood. Effective motor control of objects is influenced by the muscle kinesiology, movement speed, range of motion, and perception of object characteristics. Manipulative skills are essential to increase a child's knowledge about an object's characteristics. Active play and manual abilities are preliminary factors that enhance the visual spatial and perceptual skills.[9]

Motor skills affect perceptual and cognitive abilities in children and influence their capabilities to engage in daily activities. Quality of life (QoL) is considered as a primary indicator of subjects' mental, physical, and social well-being. QoL is decreased among children with poor gross and fine motor skills.[10]

Previous studies have investigated the potential influences of touch screen device usage on child general performance including cognitive abilities,[8,11] quality of sleep,[12] visual perception, and fine motor skills.[13] Studying the effect of touch screen usage time on motor development and QoL in typically developing children will provide physical therapists with valuable information that may be helpful to identify whether these devices influence the refinement of fine motor skills and QoL development in preschoolers. Limited literature is available regarding the touch screen usage in relation to visual-motor integration and QoL and the possible factors that may affect a child's performance such as practicing sports and attending nursery. Therefore, the current study investigates touch screen usage time in relation to visual-motor integration and QoL development in preschoolers and examines the difference between children practicing sport and those who do not, as well as the difference between children attending and not attending nursery.

Materials and Methods

Study design

An observational correlational study was conducted from September 2020 to February 2021. The clinical trial registration number is (NCT04524923). Children's participation was authorised by a signed written consent form with parent's/legal guardian's acceptance for participation before starting the study procedures.

Subjects

A convenience sample of 100 typically developing volunteer preschool children from both genders participated in the current study. Inclusion criteria were 1) age ranges from three to five years, and 2) attending/not attending nursery, practicing/not practicing sports. They were randomly recruited from Giza and Cairo governorates. Exclusion criteria were children diagnosed with 1) congenital or acquired neurological or neuromuscular disorder, 2) psychiatric or behavioural conditions (Autism), 3) fine motor problems and/or, 4) significant auditory or visual deficits.

Sample size

To avoid type II error, sample size calculation was based on data from a pilot study on the correlation between touch screen usage time and visual-motor integration. Using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) (Correlational study, $\alpha = 0.05$, $\beta = 0.2$, and medium effect size = 0.3) revealed that the appropriate sample size for this study was N = 84. Therefore, 100 children were recruited considering possible dropouts during assessment.

Procedures

This is a follow-up study of a previous study conducted to explore the relation between touch screen devices and cognitive function, which revealed a negative correlation between these factors.[8] Child's name, age, gender, whether attending nursery and practicing sport were recorded. A designed data recording sheet was used to determine the number of devices that the child uses, the age they started to use the device, and the average time spent using a touch screen device per day in the past month before the assessment.

Outcome measures

Visual-motor integration

The Peabody Developmental Motor Scale (PDMS-2), which is a valid and reliable tool, was used to assess visual-motor integration. It consists of six subtests compromising three composites known as gross, fine, and total motor quotient. The visual-motor integration subtests consist of 72 items scored as 0, 1, or 2. A participant was scored 0 they if cannot complete the task, 1 if they could partially complete it or showed promise, and 2 if they correctly completed the task. As described in the Illustrated Guide for Administering and Scoring the PDMS-2 Items, the administration time for each subtest was 15 min. After administration of all items in the visual-motor integration subtest, raw and standard scores were calculated for each.[14]

Quality of life

The Paediatric Quality of Life Inventory™ generic scale (PedsQL™) Arabic Egyptian parent report for children from

two to five years was used to assess QoL. It is a valid and reliable tool composed of 23 questions and is used to evaluate how frequently the child has had problems regarding certain factors over the past month. Interpretation of the scale reveals the mean performance as total scale score, physical, emotional, social, and school function scores with higher results reflecting better performance. Parents scored their child's performance over the past 1 month on a scale from 0 to 4, with 0 indicating 'never a problem' and 4 indicating 'almost always a problem'. The responses for each item are reverse scored and linearly transformed to a 0–100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0) with higher scores reflecting better performance. Domain scores are obtained by summing the items and dividing by the score. The psychosocial health score was obtained by calculating the mean of the sum of the emotional, social, and school domains scores.[15]

Statistical analysis

Quantitative variables were summarised using mean and standard deviation while categorical variables were summarised using frequencies and percentage. The Shapiro–Wilk test was conducted to check the normality of data. Pearson correlation coefficient was used to investigate the correlation between usage time, age started using devices, number of devices, visual-motor integration standard score, and QoL scores. Unpaired t-value was used for comparison of visual-motor integration and QoL score between children practicing and those not practicing sports. The level of significance was set as $p < 0.05$. The Statistical Package for the Social Sciences (SPSS; IBM Corp, Armonk, NY, USA-release 22 for Microsoft windows) was used for statistical analysis.

Results

Out of 100 preschool children recruited in the current study, three were excluded from analysis (missing scores of PedsQL™ items); 97 preschoolers completed the assessment procedures. Table 1 represents the frequency distribution of gender (52 girls, 45 boys) in addition to the mean values of age (47.59 months) and visual-motor integration standard score (12.8). The mean values of the physical health summary score, psychosocial health summary score, and QoL total scores are 94.88, 89.19, and 92.42, respectively.

The frequency distribution of the age the child started using touch screen devices, the number of devices available to use, usage time in minutes per day, practicing sports, and attending nursery are illustrated in Table 2.

The results revealed a negative significant correlation ($p = 0.0001$) between touch screen usage time to visual-motor integration (r = −0.37), physical (r = −0.38), psychosocial (r = −0.55) and total PedsQL™ score (r = −0.48) (See Table 3).

The results revealed positive significant correlation (r = 0.31, $p = 0.005$) between age the child started to use touch screen devices and visual-motor integration. Moreover, there was a positive non-significant correlation ($p > 0.05$) with psychosocial health summary score (r = 0.19) and a positive non-significant correlation with physical (r = 0.18) and total PedsQL™ scores (r = 0.16). Regarding the number of devices used, there was a negative significant correlation ($p = 0.001$) with visual-motor integration (r = −0.31), physical (r = −0.36), psychosocial (r = −0.6), and total PedsQL™ scores (r = −0.48) (See Table 3).

Table 4 shows the difference between children regarding practicing sports and attending nursery or not. A non-significant difference in visual-motor integration score was recorded between children practicing and those who do not ($p = 0.87$), but a significant increase of visual-motor integration score was found in children attending nursery compared with children who do not ($p = 0.0001$).

There was a significant increase in physical, psychosocial, and total PedsQL™ scores of children practicing sports compared with those not practicing sports ($p < 0.05$). Finally, a non-significant difference was recorded in physical, psychosocial, and total PedsQL™ scores between children attending nursery and those not attending ($p > 0.05$).

Table 1: Descriptive statistics of age, gender, visual motor integration and quality of life of participants.

Item		
Age (months)		47.59 ± 8.04[a]
	Boys	52 (53.6%)[b]
	Girls	45 (46.6%)[b]
Visual motor integration standard score		12.8 ± 4
Quality of life	Physical health summary score	94.88 ± 9.37[a]
	Psychosocial health summary score	89.19 ± 10.12[a]
	Total score	92.42 ± 7.72[a]

[a] Mean and Stander deviation.
[b] Number and percentage.

Table 2: Frequency distribution of age started to use touch screen devices, number of devices used and touch screen usage time per day.

Item		Number (%)
Age started to use touch screen devices	Not using	19 (19.6%)
	24–36 months	74 (76.3%)
	37–48 months	4 (4.1%)
Number of devices used	No devices	19 (19.6%)
	One device	60 (61.9%)
	> one device	18 (18.6%)
Touch screen usage time (minutes/day)	Not using	19 (19.6%)
	30 to 60	19 (19.6%)
	60 to 120	35 (36.1%)
	120 to 180	12 (12.4%)
	>180	12 (12.4%)
Practicing sports	Practicing	28 (28.9%)
	Not practicing	69 (71.1%)
Attending nursery	Attending	66 (68%)
	Not attending	31 (32%)

Table 3: Correlation between usage time, age started using devices, number of devices, visual motor integration standard score and Quality of life scores.

		r value	p value	Regression equation
Usage time	Visual motor integration standard score	−0.37	0.0001*	y = −0.015x + 14.143
	Physical health summary score	−0.38	0.0001*	y = −0.0397x + 98.432
	Psychosocial health summary score	−0.55	0.0001*	y = −0.0617x + 94.707
	Quality of life total scores	−0.48	0.0001*	y = −0.0475x + 96.34
Age started to usage	Visual motor integration standard score	0.31	0.005*	y = 0.179x + 6.8463
	Physical health summary score	0.18	0.11**	
	Psychosocial health summary score	0.19	0.09**	
	Quality of life total scores	0.16	0.14**	
Number of devices used	Visual motor integration standard score	−0.31	0.001*	y = −1.8436x + 14.629
	Physical health summary score	−0.36	0.0001*	y = −5.5669x + 100.39
	Psychosocial health summary score	−0.6	0.0001*	y = −9.8326x + 98.926
	Quality of life total scores	−0.48	0.0001*	y = −6.0977x + 98.389

r value: Pearson correlation coefficient.
P-value: Probability value.
*: Significant.
**: Non-Significant.

Table 4: Comparison of visual motor integration and quality of life score between children regarding practicing sports and attending nursery.

		Practicing	Not practicing	MD	t- value	p-value
		$\overline{X}$±SD	$\overline{X}$±SD			
Practicing sports	Visual motor integration standard score	12.89 ± 3.83	12.76 ± 3.51	0.13	0.15	0.87**
	Physical health summary score	97.3 ± 5.35	93.9 ± 10.44	3.4	2.1	0.03*
	Psychosocial health summary score	92.12 ± 6.83	88 ± 11	4.12	2.22	0.02*
	Quality of life total scores	94.52 ± 5.27	91.55 ± 8.4	2.97	2.08	0.04*
		Attending	Not attending			
Attending nursery	Visual motor integration standard score	14.74 ± 3.01	11.89 ± 3.5	2.85	−3.9	0.0001*
	Physical health summary score	94.75 ± 10.41	95.16 ± 6.76	−0.41	−0.19	0.84**
	Psychosocial health summary score	89.11 ± 9.35	89.35 ± 11.74	−0.24	−0.1	0.91**
	Quality of life total scores	91.95 ± 7.97	93.43 ± 7.15	−1.48	−0.86	0.38**

$\overline{X}$: Mean.
SD: Standard deviation.
MD: Mean difference.
*: Significant.
**: Non significant.
t value: Unpaired t value.
p value: Probability value.

Discussion

The current study investigated touch screen usage time in relation to visual-motor integration and QoL in preschoolers. There has been significant debate among parents, teachers, and health care specialists to decide what is the most appropriate use of modern technology and its possible influences on young children.

Previous experiments have demonstrated both future gains and potential dangers linked to the use of technology. Benefits include enriched imagination and interaction with age matched and older individuals as well as development of speech and personality. However, under adult supervision and guidelines, these advantages typically arise under purposeful situations of age-appropriate instructional material. On the other hand, hazards can be expressed as psychological, neurological, sleep disorders, behavioural issues, diminished developmental capacities, and less intimate experiences. These hazards are more prevalent when usage is unregulated, and/or with abusive or aggressive material.[16,17]

The findings indicated that 78% of preschool children who participated in the current study use touch screen devices. These findings may be attributed to the fact that touch screen devices are easy to use for watching videos and playing games. These devices require no higher fine motor skills as use depends on simple actions such as tapping on the screen. In addition, they are lighter in weight and easily controlled with the hands compared with computers and keyboards.

The findings of the present study are supported by previous research that indicated that handheld devices and those

with touchscreens are the most popular interactive devices for young children (8 years and under).[18] Touch screens requires a low degree of hand skills or perception of keypads or characters.[18] Furthermore, these devices enable lightweight holding and shifting relative to laptop computers, with alternate lying position rather than the typical posture at a desk (i.e. sitting upright).[4]

The results of the current study revealed that visual-motor integration showed a moderate negative significant correlation with usage time per day and number of devices used and a moderate positive significant correlation with age of starting use of touch screen devices. Moreover, a non-significant difference was recorded among children practicing and those not practicing sports, but a significant increase in visual-motor integration was recorded for children attending nursery compared with those who do not.

The results revealed that 48.5% of the study sample spends more than 60 min a day using touch screen devices. These results indicate that children are more attracted to this type of technology than computers and keyboards as well as watching television. These results can be attributed to the type and content available on touch screen devices as well as the simple and ease of operating the devices. In a family with a single child, parents may spoil their child by being less rigorous regarding using smart phones. Moreover, working parents may not have sufficient time for their children and they therefore spend much time on screen tablets rather than engaging in other activities. This results in decreased manual activities, which are reinforced by playing with toys.

The findings of the current study are consistent with Geist,[18] who suggested that devices with a keyboard are not suited for young children who have not developed hand skills to handle the keyboard. On the other hand, by the age of two, children can effectively navigate touch screen devices. Similarly, Bedford et al.[19] stated that most families encourage their child to use a tablet on a daily basis, prompting warnings against autonomous touch screen use by young children. Furthermore, Lin et al.[2] found that with prolonged touch screen use, there are possible adverse effects on manual abilities and pinch strength.

In addition, it was recorded that the fine motor competence of children dropped below predicted standards. They believed that cultural influences had shaped fine motor abilities. Traditional hobbies such as playing with bricks, board games, or puzzles have been replaced by screen-based activities and consequently, the time spent participating in conventional activities is decreased, contributing to possible negative impacts on the growth of fine motor skills.[20]

The results of the present study are consistent with previous studies that found that the behaviours involved in the use of a touch screen tablet vary from those expected for the normal activities of daily life of most people. Writing with a plastic-tipped stylus on a tablet surface differs from using regular pen and paper, which influences legibility and kinematics.[21,22] Moreover, Case-Smith and Exner[23] stated that children coordinate the intrinsic finger and hand muscles and generate abundant kinetic and sensory input on the action when toys or objects are manipulated.

Furthermore, the results support previous research in that the majority of daily activities are achieved by bilateral hand manipulation skills that require a normally developed musculoskeletal system with high degrees of hand-eye coordination and perceptual abilities. On the other hand, touch screen usage depends on simple hand movements as tapping, sweeping, and zooming, which require lower muscular activity, coordination, and dexterity. Researchers propose that the use of these devices can result in alternations in physiological function of hand muscles that affect the development of hand skills.[24–26]

The findings of the present study contradict those of Bedford et al.,[19] who studied the relationship between early touch screen usage and possible impacts on development of hand skills. They concluded that interactive touch screen usage can enhance finger and hand movements that can later transfer to manipulate real life objects.

The results of the current study indicate the amount of usage per day and number of devices used showed moderate negative significant correlation regarding the physical, psychosocial, and PedsQL™ total scores but there were weak positive non-significant correlations regarding the age of starting use of touch screen device. Furthermore, there was a significant increase in physical, psychosocial, and PedsQL™ total scores in children who practice sports compared to those who do not. On the other hand, there was no significant difference in physical, psychosocial, and PedsQL™ total scores between children who attend nursery and those who do not.

These results may be attributed to the hazardous effects of digital technology and media. Children spend a significant amount of their waking hours playing with touch screen devices, watching videos, or browsing applications. This attitude may influence the child's interaction with adults and/or peers. These attitudes may manifest in violent behaviours, social isolation, and sleep disorders. Moreover, this may affect the child's physical performance and engagement in games that require active participation with peers. Finally, digital technology may result in behavioural changes that interfere with the child's social and emotional development.

The results of the current study are in line with those of several studies that report social and emotional development requires balanced human interaction. The use of digital technology requires adult support and responsiveness so it does not replace but rather enhances human interaction.[18,27,28]

In the present study, parents reported that they allow their children to use touch screen devices for entertainment with no or minimal supervision regarding the usage time per day and the content of the videos or games. We believe that digital technology may consolidate the child's interaction with others and enhance sociability when the type and content of applications played on these devices is used under adult supervision.

Previous studies stated that interactive modern technology can be effective for young children under adult supervision providing substantial experiences and more learning opportunities.[28,29] On the other hand, Cristia and Seidl[5] reported that the more time preschoolers use touch screen tablets, the less involved they become in active play and leisure activities.

Several studies reported that children that have problems with social interactions feel in control when using digital technology as a safe zone that does not require social interaction.[28,30]

Furthermore, our results agree with Lerner[28] and Yau et al.,[30] who stated that when a subject is engaged with digital gaming, the brain releases a neurotransmitter (dopamine) that induces a sense of pleasure and reward. Therefore, young children are attracted to this type of playing that requires limited social interaction and gives rapid response during playing.

The results of the current study showed significantly higher QoL performance among children practicing regular team sports compared to those who do not. This is in accordance with previous studies that reported a positive correlation between QoL and sports participation, especially regular club-based sports. Children and adolescents who are engaged in higher frequency of physical activities show better QoL including physical, social, and psychological domains.[31,32] Moreover, Vella et al.[33] examined performing individual versus team sports and its association with QoL in primary school children. They reported that children who participated in team sports showed better QoL than those who participated in individual sports.

The results of the present study also showed better visual-motor integration scores among children attending nursery compared to those who do not. Several activities are performed at nurseries including painting, colouring, puzzles, and different prewriting skills such as tracing and copying shapes. These activities are attributed to enhancing fine motor skills including hand-eye coordination, visual-motor integration, and bilateral hand skills. This is in line with Breuhl,[34] who stated that children learn through hands-on play, meaning the materials available in a preschool classroom (pegboards, puzzles, beads for stringing, art materials such as crayons and scissors, etc.) impact the opportunities for development of fine motor skills. Similarly, Payne and Isaacs[1] suggested that in the development of skills such as grasping, throwing, cutting, and drawing, visual perception development plays a major role together with small motor development. DeLuca et al.[9] argued that development of hand skills and cognitive abilities is linked in infancy and early childhood. A child's perceptual abilities, adequate movement speed, and strength interfere with their capability to control objects effectively. Perceptual abilities are gained through object manipulation, which plays an essential role in the development of visual spatial skills.

Limitations of the current study

The current study has certain limitations that should be considered. As this study included children aged three to five years, the results cannot be generalised to older children. The current study did not include a control group (do not use touch screen devices) with appropriate sample size to assess the visual-motor integration and QoL score compared with preschool children who use touch screen devices.

Conclusion

Based on the results, increased usage time of touch screen devices showed limited visual-motor integration and lower QoL scores in preschool children. Parents/caregivers should carefully regulate their children's use of such devices. The type and content of applications used on these devices may be beneficial if used under adult supervision.

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Conflict of interest

The authors have no conflicts of interest to declare.

Ethical approval

Ethical approval was obtained from the Institutional Review Board of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/002546, date: 1 December 2019).

Authors' contributions

AMA was responsible for the research concept and design and writing of the initial and final drafts of the manuscript. ***AMM*** conducted the assessment procedures and assembly of data. ***AMA, AMM***, and ***AME*** performed data analysis and interpretation. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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