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Research Article
Passive Smoking Effect on Cognitive and Motor Development in Preschool Children in Cairo

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Abstract

Background and Objective: About 1% of all deaths worldwide caused by passive smoking in the first study to assess the global impact of second hand smoke, investigators reported that 27.5% of these were children. Worldwide, children are more heavily exposed to second hand smoke than any other age group and they are not able to avoid the main source of exposure mainly their close relatives who smoke at home. The aim of this study was to evaluate the effects of Passive smoking on Cognitive and Motor development in school going children. **Materials and Methods:** A cross sectional study was conducted on 100 healthy volunteers' children of both sexes with age range between 50-70 months enrolled in the current study. Motor development was evaluated by Peabody developmental motor scale 2 and cognitive development was evaluated by Wechsler Preschool and Primary Scale of Intelligence (WPPSI) for both groups of children of smokers` parents and children of non smokers` parents. **Results:** A statistical significant difference of cognitive development with mean value of total I.Q. were 107.4+9.8 for study group (children of smokers` parents) and 112.4+6.5 for control group (children of non smokers` parents) while statistical insignificant difference of motor development was recorded in both groups except locomotion there was statistical significant difference with mean value 170.8±9.2 for study group and 174.6±5.4 for control group. **Conclusion:** Passive smoking has effect on cognitive development and effect on motor development in preschool children.

Key words: Motor development, cognitive development, passive smoking, peabody scale and WPPSI

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Passive smoking means situation where a non-smoker inhales indirectly another person's smoke either by side stream or by mainstream exposure to tobacco smoke and become as smoker while he is smoking free[1]. Children's exposure to environmental tobacco smoke continues to be an area of public health concern. Passive smoking affects child health outcomes and causes many problems and diseases, including respiratory problems and other problems such as otitis media, conductive deafness and change in the head circumference in many children[2]. Children are exposed to tobacco smoke not only in their homes but also in schools, restaurants, child-care settings, cars, buses and other public places. The home is the greatest single source of ETS for children and the major source is parental smoking[3]. Exposure to Environmental Tobacco Smoke (ETS) among children in their homes have been reported to vary from one area to another area such as in Africa was 27.6%, in southeast Asia was 34.3%, in western Pacific was 50.6% and in Europe was the highly range which was 77.8%[4]. Some authors have suggested that people who smoke tend to be more depressed, have a lower level of education and have lower IQ scores than non-smokers[5]. Other mechanisms relating to psychosocial characteristics such as parental education level, intelligence and mental health may also be involved in the inter-relationship between smoking and neuro-development[6]. There is now emerging evidence that exposure to SHS can negatively impact behavior, attention and cognition and motor development. A substantial number of children continue to be at risk as a result of exposure to SHS in homes and vehicles and many public settings that children frequent are still not smokefree[7]. Children whose mothers did not use tobacco but were exposed to SHS during pregnancy, scored lower in cognitive tests than those children whose mothers were not exposed during pregnancy[8]. However, the effects of passive smoking together with motor and cognitive development have not been reported so far. This study was aimed to investigate these effects of passive smoking.

MATERIALS AND METHODS

Study design and participants: The current cross section study was conducted after its approval by the local ethical committee of Faculty of Physical Therapy, Cairo University based on selection of 100 pre-school age children ranging in age from 52-70 months from different nurseries in Cairo (Egypt). Following the official rules and after gaining the agreements of parents and the nurseries managers and explaining the aim and procedures of the study to them it started the first step by recording the age and gender of each child. The children who included in this study classified into two groups (passive smokers and non-smokers), each group include 50 children. Children were selected are normal and healthy children, can follow simple commands. There fathers are smoking and their duration of smoking not least than 6 years. They live in moderate socioeconomic status and their parents have moderate level of education. They live in Cairo and their parents are moderate to high smoking level according to smoking index. If the children have obvious musculoskeletal problems or have visual or auditory defect or have obvious motor development delay or were subjected to any medicine that was affect the arousal and alertness status, they were excluded from the study.

Procedures

Questionnaire: Using to collect data for each child and determine who's excluded and duration of parents smoking and no. of cigarettes; 1: Age, 2: Heigh, 3: Weight, 4: Sex, 5: Educational level of parents and parental occupation (done through socioeconomic sheet), 7: Are any of parents smoker? (Mother-father-both) (Cigarette or other type), 8: How many years of smoking? 9: How many numbers of cigarettes per day?

For evaluation of motor development: Using Peabody developmental motor scale 2: Assist (a) Gross movement according to selected age which includes: Stationary performances, Locomotion and Object manipulation and (b) The Fine movement which include: Visual-motor integration.

For evaluation of cognition

Wechsler Preschool and Primary Scale of Intelligence (WPPSI): Assist the following cognitive tests: Verbal, performance and full scale I.Q. according the following subtests: Block design-information-matrix, Reasoning-Bug Search-Picture, Memory-Similarities-Picture, Concepts-Cancellation-Zoo, Locations-Object, Assembly-Vocabulary-Animal Coding-Comprehension-Receptive, Vocabulary-Picture and Naming.

Data analysis: Data were analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 21 (SPSS Inc., Chicago, IL). Numerical data were described as

mean and standard deviation or median and range. Categorical data were described as numbers and percentages. Data were explored for normality using Kolmogorov-Smirnov test and Shapiro-Wilk test. Comparisons between two groups for normally distributed numeric variables were done using the independent Student's t-test while. Comparisons between genders were performed using the chi square test. A p-value less than or equal to 0.05 were considered statistically significant. All tests were two tailed.

RESULTS

In Table 1, there was a significant difference for age. The mean value for study group (62.7±5.4) was significantly higher than control group (60.1±5.1).

In Table 2, the Mean±Standard Deviation (SD) of score of (WPPSI Scale) verbal I.Q. There was statistically significant in the study group than control group. While Performance I.Q. showed no significant difference in the study group than control group. Total I.Q. were showed significant difference in the study group than control.

Mean values of score of Peabody scale are illustrated in Table 3. The Mean±Standard Deviation (SD) of score of visual motor subtest for the control and study groups were showed no significant difference in the score of Visual motor in the study group than control group. The Mean±Standard Deviation (SD) of score of object manipulation, locomotion and score stationary subtest for the control and study groups showed no significant difference in the score of object manipulation locomotion and score stationary in the study group than control group.

Percentile rank of Peabody scale as shown in Table 4. The statistical analysis of the percentile rank of the standard scores indicated that there was a significant difference for visual motor and locomotion.

Standard scores: Standard scores provide clearest indication of a child's subtest performance. It allows examiner to make comparisons across subtests. Subtest standard scores are converted from raw scores based on the distribution with a mean of 10 and a standard deviation of 3.

In Table 5, the statistical analysis of the standard scores indicated that there was a significant difference for visual motor and locomotion.

This is split analysis was done by gender and the results repeated to accesses affect different gender on study variables.

Table 1: Baseline characteristics of the participants (age and gender)

	Study group		Control group		
	No.	Percentage	No.	Percentage	p-value
Age (months)					
Mean±SD	62.7±5.4		60.1±5.1		0.016
Range	55-70		52-68		
Gender					
Boys	32	64.0	20	40.0	0.016
Girls	18	36.0	30	60.0	

p≤0.05 is considered statistically significant

Table 2: Effect of passive smoking on Wechsler Preschool and Primary Scale of Intelligence (WPPSI)

	Study group		Control group		
WPPSI	Mean	SD	Mean	SD	p-value
V.I.Q	108.3	10.5	113.7	7.9	0.005
P.I.Q.	99.3	12.7	101.1	11.7	0.457
Total I.Q.	107.4	9.8	112.4	6.5	0.003

p≤0.05 is considered statistically significant, V.I.Q.: Verbal I.Q., P.I.Q.: Performance I.Q.

Table 3: Effect of passive smoking on Peabody Scale (Raw score)

	Study group		Control group		
Peabody scale	Mean	SD	Mean	SD	p-value
Visual motor	140.5	4.0	141.4	2.9	0.164
Object manipulation	44.8	3.4	44.3	1.6	0.349
Locomotion	170.8	9.2	174.6	5.4	0.013
Stationary	56.8	3.0	56.1	2.6	0.230

p≤0.05 is considered statistically significant

According to Table 6, there was statistically significant difference in girls between control and study group in verbal I.Q, Performance I.Q. and total I.Q.

According to Table 7, there was not statistically significant difference in girls between control and study group in Peabody scale.

According Table 8, there was statistically significant difference in boys between control and study group in verbal I.Q. in WPPSI scale.

In Table 9, there was statistically significant difference in boys between control and study group in visual motor and locomotion in Peabody scale.

DISCUSSION

In this cross-sectional study examining the effect of passive smoking on cognitive and motor development in preschool children, this study found exposure to passive smoking was significantly associated with poor cognition especially verbal IQ and total IQ (WPPSI).

Prolonged exposure to SHS associated with a range of health-related problems similar to those found in smokers

Table 4: Effect of passive smoking on Peabody scale (percentile rank)

	Study group (n = 50)		Control group (n = 50)				
Percentile rank	Mean	SD	Mean	SD	Mean difference	Test value	p-value
Visual motor	77.24	23.36	85.12	13.7	-7.88	-2.057	0.043
Object manipulation	57.22	23.03	53.72	14.09	3.50	0.916	0.362
Locomotion	61.52	29.92	72.98	19.9	-11.46	-2.255	0.027
Stationary	56.58	17.58	56.32	15.55	0.26	0.078	0.938

SD: Standard deviation, $p \leq 0.05$ is considered statistically significant

Table 5: Effect of passive smoking on Peabody scale (standard score)

	Study group (n = 50)		Control group (n = 50)				
Standard score	Mean	SD	Mean	SD	Mean Difference	Test value	p-value
Visual motor	13.02	2.65	13.86	2.14	-0.84	-1.746	0.084
Object manipulation	10.66	2.01	10.3	1.11	0.36	1.11	0.27
Locomotion	11.12	2.8	12.22	1.98	-1.10	-2.265	0.026
Stationary	10.56	1.46	10.54	1.3	0.02	0.072	0.942

Table 6: Split analysis for girls show effect of passive smoking on Wechsler Preschool and Primary Scale of Intelligence (WPPSI)

	Female				
	Study group		Control group		
WPPSI	Mean	SD	Mean	SD	p-value
V.I.Q	104.1	6.5	111.9	6.9	<0.001
P.I.Q.	92.7	10.7	103.2	10.1	0.001
Total I.Q.	104.7	8.2	112.9	6.6	<0.001

V.I.Q.: Verbal I.Q., P.I.Q.: Performance I.Q.

Table 7: Split analysis for girls show effect of passive smoking on Peabody scale

	Female				
	Study group		Control group		
Peabody scale	Mean	SD	Mean	SD	p-value
Visual motor	139.5	4.4	140.7	3.5	0.289
Object manipulation	44.8	2.3	43.9	1.5	0.119
Locomotion	171.7	8	173.6	6.5	0.366
Stationary	55.7	3.4	55.3	2.7	0.664

Table 8: Split analysis for boys show effect of passive smoking on Wechsler Preschool and Primary Scale of Intelligence (WPPSI)

	Male				
	Study group		Control group		
WPPSI	Mean	SD	Mean	SD	p-value
V.I.Q	110.7	11.5	116.4	8.7	0.063
P.I.Q.	103	12.3	98	13.4	0.172
Total I.Q.	108.9	10.3	111.7	6.3	0.291

V.I.Q.: Verbal I.Q., P.I.Q.: Performance I.Q.

Table 9: Split analysis for boys show effect of passive smoking on Peabody scale

	Male				
	Study group		Control group		
Peabody scale	Mean	SD	Mean	SD	p-value
Visual motor	141	3.7	142.5	1.2	0.085
object manipulation	44.8	3.9	44.9	1.7	0.925
Locomotion	170.3	9.9	176.1	2.6	0.013
Stationary	57.4	2.6	57.3	2.1	0.878

but is also linked to detrimental effects upon cognitive performance in children, adolescents and adults. Children exposed to SHS show reduced many cognitive abilities such as vocabulary and reasoning skills when compared with non-exposed child[9] as well as more general cognitive and intellectual deficits[10].

Possible reasons for the observed exposure levels in children that live in homes where adults use tobacco outside. Their findings indicated there are some sources of SHS that parents cannot easily control through indoor smoking bans. In fact, SHS can remain in the home even if smoking took place days, weeks and months earlier through contaminated dust and surfaces, a smoker's finger and smoker`s clothes[11].

Cognitive and behavioral outcomes are affected by postnatal exposure by parents to passive smoke. Postnatal exposure to household smoke was reported to be associated with reduced IQ scores and cognitive abilities in 3 year-olds[12].

This study is agreed with Polanska *et al.*[13] their preliminary data on REPRO PL cohort performed on smaller sample size (63 children) indicated a statistically significant association between exposure to ETS and cognitive child development ($\beta = -4.0$; $p = 0.04$) and no statistically significant association with motor and language abilities.

In this study there was difference between study and control group in motor development which was measured by Peabody scale especially visual motor and locomotion there was significant difference.

The process of motor development as a continuous process that change in motor behavior throughout the life

cycle and brought about by interaction among the requirements of the movement task, the biology of the person and the conditions of the environment[14].

Children of smokers had an increased risk of getting problems with balance that their scores below the median value of the population. They found small but significant differences on areas of balance and fine motor coordination[15].

The SHS exposure was determined if a household member smoked at least 1 cigarette per day or the child had a serum cotinine of at least 0.05 ng mL^{-1}. The authors found that children with SHS exposure had diminished visual motor coordination and less well developed fine motor integration skills, balance and strength which were agreed with this study[16].

In this study it was recorded the effect of gender on both WPPSI and Peabody scales.

According to girls, there is significant difference in the verbal, performance and total I.Q. between the two groups that the mean of study group less than the mean of control group. In Peabody scale there is no significant difference between them.

According to boys, there is significant difference in verbal IQ only but performance IQ and total IQ there is no significant difference. In Peabody there is significant difference in visual motor and locomotion and no significant difference in object manipulation and stationary.

In the preschool aging girls were advanced in cognitive development while boys were more advanced in motor development but passive smoking effects this area and change it. Girls were more affected in cognitive development and boys more affected in motor development.

Girls are exposed to higher rates of secondhand smoke than boys but boys have greater problems with hyperactivity, aggression, depression and other behavioral problems which agreed with current results that the motor development in boys was more affected than girls while the cognitive development in girls was more affected[16].

Jacobsen *et al.*[17] suggested stronger associations between ETS exposure and cognitive outcomes in males.

CONCLUSION

Passive smoking has effect on cognitive development at age 4-5 years old and effect on motor development in preschool children especially visual motor and locomotion. Passive smoking has negative effect on cognitive and motor development.

Results from present study reinforce the importance of continued interventions to reduce childhood exposure to passive smoking.

SIGNIFICANCE STATEMENT

This study discovered the effective of passive smoking on motor and cognitive development in any age especially in preschool age and effect on girls and boys also that can be beneficial for in assessment of development of children also in planning of treatment and for educated parents to stop smoking in homes or near to their children and minimize its influence on child development and health that passive smoking effects on normal development and its sequence and delayed them. This study will help the researcher to uncover the critical areas of effective of passive smoking on both genders and its effect on what distinguishes this age from stages and normal sequences of development that many researchers were not able to explore. Thus a new theory on effective of passive smoking on girls (cognition) and boys (motor development) may be arrived at.

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