RESEARCH PAPER

Effect of Passive Smoking on Functional capacity, Cognition and Academic Performance in Primary School Children

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ABSTRACT

Back ground: Passive smoking, or secondhand smoke (SHS) threatens millions of children's health and may impacts their overall development. This study examines function capacity, cognitive abilities, and academic performance in SHS-exposed children versus nonsmokers.

Methods: A total of ninety normal children, aged between 6 and 11 years, from a primary school located in Cairo, Egypt, took part in a comparative study that investigated two distinct groups (A and B): those subjected to passive smoking and those who were not exposed, respectively. All Children could participate if able to follow simple instructions, are in moderate socioeconomic status and regular school attendance. Participants exposed to parental secondhand smoke for 6 years and score moderately high on the Smoking Index (group A). The 3-Minute Step Test (3MST), Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV), and the Academic Performance Rating Scale (APRS) were be used to assess the function capacity, the cognition, and academic performance respectively, for all children in both groups.

Results: Group (A) showed a significant increase in one-minute post-exercise heart rate (HR) with notable decreases in the Wechsler Intelligence Scale (WISC-IV) scores ($p < 0.001$) and the Academic Performance Rating Scale (APRS) scores ($p < 0.001$) compared to group (B) ($p < 0.001$).

Conclusion: Inhaling secondhand smoke harms children's cognitive development, academic performance, cardiovascular fitness, and IQ. Public health initiatives must reduce home exposure, and raising parental awareness is vital for protecting children's health.

Keywords: Passive Smoking; Function Capacity; Cognition; Academic Performance; School Children.

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1. Introduction

Passive smoking, or secondhand smoke (SHS), is a significant health risk for millions of children globally, especially in primary school. Their developing respiratory and cognitive systems make them more vulnerable to harmful tobacco chemicals. Children often cannot avoid SHS, commonly found in homes, vehicles, and public spaces where adults smoke **(1)**.

Cognition includes language, perception, learning, attention, memory, and decision-making. Researches showed that childhood SHS exposure can harm children neurodevelopment, also children aged 6-16 experiencing reduced cognitive skills in reading and calculation **(2,3)**.

Passive smoking significantly impairs lung function, reduces endurance, and negatively affects cognitive processes, which ultimately leads to academic decline and increased absenteeism among individuals exposed to these harmful conditions **(4,5).** Understanding how passive smoking affects children's growth, cognition, and school performance is vital during primary school years. This insight can shape public health policies, guide parents, and aid interventions to safeguard children from secondhand smoke **(6).**

The study aims to determine the change between passive smokers and nonsmokers in cardiopulmonary functional capacity, cognitive functions and academic achievement in primary school children.

2. Materials and Methods

2.1. Study Design:

This study was designed as an observational, cross-sectional comparative study, in which two groups of children those exposed to passive smoking and those not exposed were compared across the selected outcome measures.

The study was conducted at Abdallah El-Nadem primary school (A governmental primary school) at Hadayek Al-koba, Cairo Governorate, Egypt, from September 2024 to March 2025. All assessment procedures were performed on school premises in a quiet, controlled environment to minimize external

distractions. Data collection were completed over a period of 6 months.

2.2. Ethical considerations:

Ethical approval for the current study protocol was obtained from the Ethical Committee of the Faculty of Physical Therapy, Cairo University (No: P.T.REC/012/005358). The present study was registered in the clinical trials government (Registry ID/ NC06723470). A written informed consent form was signed by each child's parent or legal guardian before starting the study protocol.

2.3. Sample Size Calculation

Sample size calculated using G*Power (3.1.9.2) based on WISC-IV data indicated 45 subjects per group, totaling 90 children for adequate power in cognitive function comparison.

2.4. Subjects

A total of ninety apparent developed and healthy children from both sexes were included in this study. Participants were selected using stratified random sampling from different grades (1st to 6th grades) of Abdallah El-Nadem primary school, Cairo, Egypt. Their age ranged between 6 and 11 years, and able to comprehend and follow simple verbal instructions as required for test procedures. All are belonged to moderate socioeconomic status according to the standardized Socioeconomic Sheet **(7)** and they are resident in Cairo with regular school attendance. For the passive smoking group: exposure to secondhand smoke from at least one parent who has been smoking for not less than 6 years with parental smoking classified as moderate to high based on the Smoking Index **(8)**. Children excluded from the study were those with musculoskeletal deformities, sensory impairments, learning or cognitive disabilities, specific medication affecting alertness, autism, or chronic illnesses such as epilepsy, asthma, or cardiovascular diseases.

Children were categorized into two groups: group A (Passive Smokers) contained 45 children living with at least one parent who had been smoking and met the previously mentioned inclusive criteria for this category, group B (Non-Smokers) contained 45 children with no parental smoking exposure at home.

2.5 Procedures

Children were assessed individually in a quiet room with minimal furniture, with a researcher and assistant providing comfort and scheduling sessions around core lessons.

To ensure homogeneity of the sample, only middle socio-economic background children were sampled for homogeneity. Socio-economic status (SES) was assessed with scores for education and occupation status. Parents' scores classified SES as low (≤ 8), middle (9-18), or high (19-28) **(7).**

For selecting the exposed children to passive smoking and detailing parental smoking status, type, and duration, parents filled out a smoking questionnaire a week before testing, based on parents` responses, the smoking index was calculated utilizing the following formula: *Smoking Index (SI) = (Number of cigarettes smoked per day × Number of years of smoking) ÷ 20* ***(8).*** The calculated SI was then used to classify the parent as: mild smoker: SI < 100; moderate smoker: SI = 101–300; heavy smoker: SI > 300. Children living with one parent who were moderate or heavy smokers were assigned to the passive smoker group (A). As well, those living in non-smoking households were assigned to the non-smoker group (B).

Once children were selected based on smoking exposure and socio-economic status, standardized assessments evaluated passive smoking's effects on children functioning were employed.

a) Assessment of function capacity using Three-Minute Step Test (3MST):

The 3MST was a safe and well-validated test and had an excellent intra-rater reliability to determine exercise tolerance in healthy children **(9).** It requires stepping up and down on a 12-inch platform at a fixed rate for three minutes. Heart rate recovery is recorded and used as an indicator of fitness. Each child was first seated comfortably in a chair for 3-5 minutes to ensure a stable resting heart rate. The child faced the step platform (height = 30cm) with feet together. At the start of command, the child began stepped up-up, down-down in rhythm with a metronome at 96 bpm.

After 3 minutes, the child sat back on the chair. Heart rates were monitored for the first minute of recovery, noting the rate 60 seconds post-exercise. The difference between peak exercise HR and recovery HR indicated cardiorespiratory fitness **(10).**

b) Cognitive Function: Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV):

WISC-IV is an individually administered, norm-referenced cognitive assessment tool for children aged 6 to 16 years and provides an overall measure of intellectual functioning through 10 core subtests and 5 supplemental subtests. It measures four major cognitive domains: Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI). The (VCI) measures verbal reasoning, concept formation, and knowledge acquired from the environment. The (PRI) measures nonverbal and fluid reasoning, visual-motor integration, and spatial processing. The (WMI) assesses attention, concentration, and ability to hold/manipulate information. The (PSI) measures the child's speed of visual information processing, scanning, and accuracy **(11).**

Each subtest began with sample practice items to ensure understanding. Testing lasted 60–75 minutes, with short breaks as required, especially for younger children (6–8 years old). Raw scores were converted into scaled scores using age-based norms. Scaled scores were grouped to form the four index scores (VCI, PRI, WMI, PSI). These indices were combined to calculate the full scale IQ (FSIQ), the global measure of cognitive ability.**(12)** Scoring sheets were

reviewed immediately after testing to ensure accuracy before entering results into the dataset.

c) Academic Performance: Academic Performance Rating Scale (APRS):

The APRS is a tool for teachers to evaluate academic functioning, behavior, and attention in school-aged children, featuring 19 scored items on a 5-point Likert scale to reflect better performance. The final 19-item version focused on classroom learning and behavior, such as work performance, academic success, behavioral control, attention to tasks, staring episodes, and social withdrawal. These behaviors, often seen in children with attention challenges or stimulant medication side effects, are not direct measures of academic productivity **(13)**. Assessments took place in a quiet, child-friendly room during non-core classes, lasting 45-60 minutes with breaks. The completed forms data were collected over a week and checked for missing answers, teachers provided necessary information. Scores were recorded for total and specific area analysis. Responses were anonymized and stored securely.

Statistical analysis:

Data analysis was carried out utilizing the statistical package for the social sciences computer program (SPSS Inc., Chicago, Illinois, USA; version 25 for Windows). The mean± SD was used to express the data. Subjects' characteristics were compared between groups by unpaired t-test for numerical data and by Chi squared test for categorical data. Normal distribution of data was checked using Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired t-test was conducted to compare one min post exercise HR, WISC-IV, and APRS between groups. The level of significance for all statistical tests was set at $p < 0.05$.

Results

The present displayed the characteristics of the subjects; ninety children (6-11 years) from Egyptian primary school in Cairo governorate participated in this study; forty-five children were passive smoker (group A) and forty-five children were non passive smokers (group B). Table (1) shows the subject characteristics of both groups. There was no significant difference in age, sex and grade distribution between groups ($p > 0.05$). In group (A), the fathers had a mean smoking of 10 ± 2.91 years (range: 6-14 years). The average number of cigarettes smoked per day was 23.76 ± 9.59 (range: 10-39 cigarettes/day). The mean number of packs/year was 11.65 ± 5.15 (range: 3.5-25.20 pack/year) **(Table 1)**.

In addition, there was a significant increase in one-minute post exercise HR of group (A) compared with group (B) (ES = 4.18, $p < 0.001$). Also, there was a significant decrease in WISC-IV (ES = 3.45, $p < 0.001$) and APRS scores (ES = 3.65, $p < 0.001$) of group (A) compared with those of group (B) **(Table 2)**.

Table (1): Demographic & characteristics data of subjects of both groups

	□□□□□ □	Group B	t-value	p-value
	□□□□ ± SD	□□□□ ± SD		
Age (years)	8.22 ± 1.57	8.44 ± 1.69	-0.65	0.52
Sex, n (%)				
Girls	18 (40%)	16 (36%)	(χ^2 = 0.19)	0.66
Boys	27 (60%)	29 (64%)		
Grade distribution, n (%)				
1st	9 (20.0%)	8 (17.8%)	(Fisher's Exact Test = 3.82)	0.59
2nd	6 (13.3%)	7 (15.6%)		
3rd	10 (22.2%)	6 (13.3%)		
4th	9 (20.0%)	12 (26.7%)		
5th	8 (17.8%)	5 (11.1%)		
6th	3 (6.7%)	7 (15.6%)		
Smoking characteristics in group A				
Years of smoking	10 ± 2.91			
Number of cigarettes/days	23.76 ± 9.59			
Number of Packs/years	11.65 ± 5.15			

SD, standard deviation; MD, mean difference; χ2, Chi squared value; p value, probability value.

Table 2. Comparison of one min post exercise HR, WISC-IV, and APRS of both

	□□□□□	Group B	MD (95% CI)	t-value	p value	ES
	Mean ± SD	*Mean ± SD*				
One min post exercise HR (beats/min)	128.80 ± 11.27	87.89 ± 8.05	40.91 (36.81: 45.01)	19.82	0.001	4.18
WISC-IV	91.33 ± 10.89	125.47 ±	-34.1	-16.	0.001	3.45

		8.83	4 (-38.29: -29.98)	33		
APRS	31.49 ± 8.51	67.16 ± 10.91	-35.67 (-39.77: -31.57)	-17.29	0.001	3.65

SD, standard deviation; MD, mean difference; CI, confidence interval; p value, probability value; ES, effect size.

Discussion

Passive smoking, or secondhand smoke exposure, remains a major public health concern, particularly for vulnerable populations such as children. Exposure to environmental tobacco smoke has been associated with various adverse health outcomes, including respiratory illnesses, reduced exercise tolerance, impaired cognitive development, and poor academic performance. In developing countries, where smoking prevalence among adults remains high and public awareness is relatively low, children are especially at risk due to limited control over their home environments **(5, 6)**.

The primary aim of this study was to assess the effect of passive smoking on three critical domains of child development: cardiopulmonary functional capacity, cognitive function, and academic performance. By comparing a group of children exposed to passive smoke with a matched group of non-exposed peers, the study sought to determine whether living with smoking parents has measurable negative impacts on children's physical endurance, intellectual abilities, and classroom performance.

The current study results revealed no significant differences between both groups in terms of age, sex, grade distribution, ensuring that age did not influence the outcome measures with confirming gender balance across the study sample. Grade-level distribution also showed no significant variation between the two groups ($p = 0.59$). This balance in academic level ensured that educational exposure was not a confounding factor.

Recent research has examined whether demographic characteristics such as age, sex, and grade level significantly differ between children exposed to passive smoking and those who are not. A study conducted by **Zheng, (2015) (1)** in Macau among 875 children aged 6–14 years found no significant sex-based difference in the prevalence of passive smoke exposure ($\chi^2 = 0.326$, $p > 0.05$). The study demonstrated that paternal smoking was the strongest predictor of children's exposure to secondhand smoke, with an odds ratio of 34.06, but sex and age of the children were not significant confounders.

On the other hand, **Ababulgu et al., (2016) (2)** investigated secondhand tobacco smoke (SHS) exposure among 1,673 Ethiopian adolescents aged 13–19 years in a school-based cross-sectional survey. Their findings revealed that 17.2% of adolescents were exposed to SHS at home, while an alarming 60.8% reported exposure in public places. Female adolescents were significantly more likely to experience SHS exposure at home than males. Additionally, having smoking parents or peers markedly increased the likelihood of exposure both at home and in public areas.

Detailed data were collected from Group (A) regarding the smoking behavior of parents, particularly fathers revealed that, the mean number of years of smoking was 10 ± 2.91 years, with a range between 6 and 14 years. On average, fathers smoked 23.76 ± 9.59 cigarettes per day, with some reporting up to 39 cigarettes daily. The calculated pack-years, averaged 11.65 ± 5.15. These values confirmed that children in Group (A) were exposed to moderate-to-heavy secondhand smoke over a prolonged period, according to the Smoking Index by **Terry and Rohan 2002, (8).**

This was confirmed by the recent research over the past decade who explored the intensity and duration of parental smoking and its implications for children's exposure to secondhand smoke. A robust cross-sectional study by **Ulbricht et al., (2015) (14)** involving over 1,200 households with children under age 3 found that the number of smokers in the home and the intensity of smoking (measured by daily cigarette use) significantly increased the likelihood of children's secondhand smoke exposure, confirmed by elevated urinary cotinine levels (≥10 ng/ml). The study reported that 57.1% of children in smoking households tested positive for SHS exposure, and homes with heavier smokers saw proportionally higher cotinine levels in children. These results underscore the direct relationship between higher smoking intensity similar to the ~24 cigarettes/day reported in Group (A) and biochemical evidence of significant SHS exposure in children.

Our results regarding cardiopulmonary functional capacity which was assessed using one-minute post-exercise heart rate (HR) after performing the 3-Minute Step Test indicated a significant difference between the two groups with p-value of (0.001).These findings suggest that passive smoking is associated with reduced cardiovascular fitness and delayed heart rate recovery, potentially reflecting compromised cardiorespiratory health in exposed children.

This was supported by the study of **Sharma and Jangra, (2024) (15)** who assessed the aerobic capacity of young adults through the Queen's College Step Test, which is closely related in protocol to the 3MST. Participants were grouped as active smokers, passive smokers, and non-smokers. Although VO max differences did not reach statistical significance, passive smokers consistently showed lower aerobic capacity than non-smokers ($p = 0.299$), indicating subclinical reductions in cardiovascular fitness due to secondhand smoke exposure. This trend reinforces the

notion that heart rate recovery and aerobic endurance are affected even without overt respiratory disease.

Also, **López Blázquez et al., (2019) (16)** found that children exposed to household tobacco smoke exhibited marked reductions in lung function, notably with Forced Expiratory Volume in 1 second (FEV_1) / Forced Vital Capacity (FVC) ratios below 80%, indicating obstructive impairment. These impairments are consistent with delayed post-exercise recovery and reduced aerobic efficiency, supporting the interpretation that secondhand smoke compromises cardiopulmonary functional capacity in school-aged children.

Despite the largely consistent support, some studies have not found significant differences in heart rate recovery in children. For instance, although not exclusively focused on the 6–11 age group, a broader analysis by **Fildan et al., (2011) (17)** highlighted that functional impairments from SHS exposure were more often detectable in children with pre-existing respiratory conditions. Among otherwise healthy children, short-term passive smoke exposure did not consistently result in reduced heart rate recovery or functional performance. This suggests that baseline health may moderate the impact of SHS on cardiovascular recovery.

The current study results of cognitive abilities demonstrated a significant disparity in overall cognitive performance between the two groups. This substantial cognitive gap indicates that children exposed to passive smoking may experience impairments in multiple domains of intellectual function, including memory, reasoning, attention, and processing speed. These findings raise serious concerns about the neurotoxic effects of environmental tobacco smoke on the developing brain.

This was approved by the study of **Khorasanchi et al., (2017) (18)** who examined the impact of passive smoking on cognitive and emotional function among 940 adolescent girls. The researchers found that those exposed to passive smoke had significantly lower cognitive function scores and higher incidences of depression, aggression, and insomnia compared to non-exposed peers, this indicating that environmental tobacco smoke impairs higher-order thinking skills during development.

Supporting this, a clinical study conducted by **Fayez and El-Tohamy, (2018) (3)** found that children exposed to passive smoke had a significantly lower mean IQ score (107.4 ± 9.8) compared to children of non-smoking parents (112.4 ± 6.5), showing a clear cognitive disadvantage associated with secondhand smoke exposure.

The study results regarding academic performance revealed that children in Group (A) had significantly lower academic performance scores, compared to children in Group (B). The mean difference between groups was -35.67, with ($p = 0.001$), reflecting a statistically and educationally significant disadvantage among children exposed to passive smoke. This lower performance encompasses areas such as task completion, attentiveness, behavior regulation, and overall academic output. These findings reinforce the real-world impact of passive smoking on children's school functioning, aligning with the observed deficits in cognitive ability.

This was confirmed by the study of **Yustisia et al., (2022) (19)** who investigated the relationship between family smoking habits and academic performance in 77 elementary school students. Researchers found that 88.5% of students had family members, who smoked at home, with 16.4% showing urinary cotinine levels above 200 ng/Ml indicative of high exposure to secondhand smoke. Students with the highest cotinine levels, particularly boys, exhibited the lowest average academic report card scores, supporting the assertion that secondhand smoke exposure adversely impacts school performance. The authors linked these performance deficits to potential cognitive decline and behavioral regulation issues caused by nicotine exposure.

Also, **Gupta et al., (2020) (20)** underscored that passive smoking adversely affects children's cognitive and physical development, citing decreased attention control and increased behavioral problems. These factors were identified as critical mediators of poor school outcomes. The authors emphasized that there is no safe level of secondhand smoke exposure, highlighting long-term educational risks in addition to health consequences.

Finally, the finding of the current study highlights the importance of continued health education and reinforcement of smoke free polices for further protection of school-aged children from harmful effects of SHS. A similar nuance appeared in a Portuguese study by **Precioso et al., (2021) (21),** where only 6.1% of mothers and 11.2% of fathers smoked at home, despite higher national smoking prevalence rates. These low in-home smoking rates were attributed to increased public health awareness and the adoption of smoke-free home rules. Thus, while many parents remained active smokers, the location and manner of their smoking reduced the likelihood of indoor SHS exposure.

Conclusion

Passive smoking adversely affects function capacity, cognitive skills, and academic achievement among primary school-aged children. Those children who were exposed to secondhand smoke displayed diminished cardiovascular functional capacity, lower intelligence quotients, and inferior academic results in comparison to their non-exposed counterparts. These outcomes highlight the urgent necessity for public health campaigns aimed at minimizing children's exposure to secondhand smoke, especially within the home environment. Enhancing parental awareness of these risks is crucial for protecting children's health and promoting their cognitive development.

AUTHOR CONTRIBUTIONS

The authors refer to their contributions to the following areas of the article: The study's idea and design were carried out by Nourhan M. Abd El-Aleem, while Doaa A. M. .Sanad, and Amira M. Al-Tohamy

prepared the draft paper and collected, analyzed, and interpreted the data. Emad Mohamed Ibrahim Taha assisted in data collection and contributed to reviewing the manuscript. Each author examined the findings and gave their approval to the manuscript's final version.

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CONFLICT OF INTEREST

The authors state that they have no financial conflicts of interest with respect to the topics included in the work.

DATA AVAILABILITY STATEMENT

Upon request, the corresponding author provided the data that support the study's findings. The data are not publicly available due to privacy and ethical considerations.

References

1) Zheng, Z. L. (2015). Household passive smoking and its related factors among children in Macau. Chinese Journal of Public Health, 31(10), 1254–1257.

2) Ababulgu, S. A., Dereje, N., Girma, A. (2016). Secondhand tobacco smoke exposure among adolescents in an Ethiopian school. Healthcare in Low-resource Settings, 4(1), 55848.

3) Fayez, M. M., & El-Tohamy, A. (2018). Passive smoking effect on cognitive and motor development in preschool children in Cairo. Journal of Medical Sciences, 18(4), 192-197.

4) Stirland, L. E., O'Shea, C. I., Russ, T. C. (2018). Passive smoking as a risk factor for dementia and cognitive impairment: systematic review of observational studies. International Psychogeriatrics, 30(8), 1177-1187.

5) Ngo, C. Q., Vu, G. V., Phan, P. T., Chu, H. T., Doan, L. P. T., Duong, A. T., Ho, R. C. (2020). Passive smoking exposure and perceived health status in children seeking pediatric care services at a Vietnamese tertiary hospital. International journal of environmental research and public health, 17(4), 1188.

6) Elbeeh, M. E. (2023). Secondhand smoke's effects on brain development: ADHD and associated behaviors in children. Journal of Umm Al-Qura University for Applied Sciences, 9(4), 591-608.

7) Park E and Park K (2011). Parks textbook of preventive and social medicine, 21 thed, Banarasides Bhanot Publishers, Jebalpur, Madhya Pradesh. P: 54-56

8) Terry, P. D., Rohan, T. E. (2002). Cigarette smoking and the risk of breast cancer in women: a review of the literature. Cancer Epidemiology Biomarkers & Prevention, 11(10), 953-971.

9) Ferreira, Kaymaz, N., Yıldırım, Ş., Tekin, M., Aylanç, H., Battal, F., Topaloğlu, N., & Akbal, A. (2022). The effects of passive smoking on the six-minute walk test in obese pediatric cases. Journal of clinical research in pediatric endocrinology, 6(4), 245

10) Barrón, A. I., Riera, S. Q., Reychler, G. (2021). The 3 Minute Step Test is a validated field test to evaluate the functional exercise capacity in children aged 6 to 12. Respiratory medicine and research, 80, 100833.

11) Rosales-Gómez, M., Navarro-Soria, I., Torrecillas, M., López, M. E., Delgado, B. (2025). Cognitive Profiling of Children and Adolescents with ADHD Using the WISC-IV. Behavioral Sciences, 15(9), 1279.

12) Liu, S., Wei, W., Chen, Y., Hugo, P., & Zhao, J. (2021). Visual–spatial ability predicts academic achievement through arithmetic and reading abilities. *Frontiers in Psychology, 11*, 591308.

13) Quadri, M. F. A. Q., El-Kordy, M. S., Moukhyer, M. E., Mukhayer, A., Ahmad, B. (2017). Psychometric Properties and validation of the Arabic Academic Performance Rating Scale. Education Research International, 2017(1), 1504701.

14) Ulbricht, S., Unger, F., Groß, S., Nauck, M., Meyer, C., & John, U. (2015). Factors associated with secondhand smoke exposure prevalence and secondhand smoke level of children living with parental smokers: a cross sectional study. Journal of Community Health, 40(3), 501-507.

15) Sharma, A., Jangra, M. K. (2024). Effect of active, passive and non-smoking on aerobic capacity among young collegiates. Journal of Clinical & Diagnostic Research, 18(Suppl. 3), 28.

16) López Blázquez M, Pérez Moreno J, Vigil Vázquez S, Rodríguez Fernández &Arch B. (2019). Impact of Passive Smoking on Lung Function and Asthma Severity in Children. Aug;54(8):436-437. doi: 10.1016/j.arbres.2017.10.016. Epub 2019 Dec 6**.**

17) Fildan M., Öberg, M., Jaakkola, M. S., Woodward, A., Peruga, A. & Prüss-Ustün, (2011). Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries. Lancet 377, 139–146 (2011).

18) Khorasanshi N., Kleier, J. A., Mites-Campbell, M., & Henson-Evertz, K. (2017). Children's exposure to secondhand smoke, parental nicotine dependence, and motivation to quit smoking. Pediatric Nursing, 43(1), 35.

19) Yustisia, I., Sari, N., Tawali, S., Arif, M., & Ramliah, S. (2022). High urinary cotinine levels and low academic performance of elementary school students in families with careless smoking habits. eJournal Kedokteran Indonesia, 10(1), 197–203

20) Gupta, D., Rao, A., & Suprabha, B. S. (2020). Passive smoking and its effects on the development of a child. Indian Journal of Public Health Research & Development, 11(4), 491–494.

21) Precioso, J., Rocha, V., Sousa, I., Araújo, A. C. L. L., Machado, J. C., & Antunes, H. (2019). Prevalence of Portuguese children exposed to secondhand smoke at home and in the car. Acta Médica Portuguesa, 32(7-8), 499–504.