

# DETERMINANTS OF CHILDREN'S EXPOSURE TO HOUSEHOLD SECONDHAND SMOKE: PROPOSED FRAMEWORK

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## Abstract:

The purpose of this study is to propose a conceptual framework that depicts the potential factors that influence children's health risks and exposure to their parents' smoking. The proposed framework of this study is established based on the social epidemiology theory, which attributes the surrounding environment to a set of habits that affect health stability. In line with the previous studies that investigated the relationship between parents' smoking practices and children's health risks from exposure to smoking, this study recommended a conceptual framework that constructs five factors: nicotine dependency, knowledge level of parents about smoking risks, parents' perception of smoking, and attitude of parents toward the children's health risks from exposure to smoking, besides the potential moderation effect of socio-demographic factors such as age, gender, ethnicity, income level, educational level, and occupation.

**Keywords:** nicotine dependency, parents' knowledge, parents' perception, parents' attitude, parents' smoking practices, children's health risk

## 1.1 Introduction

Nearly 900,000 nonsmokers are exposed to secondhand smoke every year because of the widespread use of tobacco, which is responsible for more than seven million deaths annually. There is a disparity in the burden of disease in the world, with 40% of children in the United States having been exposed to secondhand smoke; children are the most affected in disability-adjusted life years (WHO, 2021).

Childhood exposure to environmental tobacco smoke is primarily caused by adults who smoke in areas where children live and play, including second and third-hand exposure. Its effects are determined by children's susceptibility to smoke toxicity and include an increased risk of sudden infant death syndrome, middle ear disease, severe asthma, acute respiratory infection, pneumonia, and decreased lung function, as well as school absence and activity restriction (Carreras et al., 2021). Because of this, governments have implemented policies and interventions aimed at reducing exposure at home and eliminating children's exposure in

public places through educational campaigns (Raju, 2021).

Secondhand Smoke (SHS) has been linked to frequent wheezing, respiratory infections, reduced lung function, asthma, and chronic respiratory symptoms in adults. Globally, 600 000 deaths result from SHS exposure, with children accounting for 28% of these deaths (Lim, Teh, Mohamed, et al., 2018). Secondhand tobacco smoke causes significant harm to children and is primarily caused by caregivers smoking in the family home (Ratschen et al., 2018). Increased risks of respiratory tract infections, middle ear infections, sudden unexplained infant deaths, and asthma have been linked to secondhand tobacco smoke (Raju, 2018)(Carreras et al., 2021). This study proposes a framework that illustrates the determinants of children's exposure to household secondhand smoke. For this purpose, the supported theories explain secondhand tobacco smoke among parents, discussed in the first section. While the proposed determinants are discussed separately, and a subsection is specified for each

determinant. The proposed determinants are illustrated in a framework diagram.

## 1.2 Theoretical discussion

Social epidemiology is the branch of epidemiology that studies the social distribution and social determinants of health states (Berkman, Kawachi, & Glymour, 2014). The determinants are a set of personal, social, economic, and environmental factors that determine the health status of individuals or populations (Murakami et al., 2020). These specific characteristics influence health and can be modified. The main concern of social epidemiology is the study of how society and different forms of a social organization influence the health and well-being of individuals and populations, which is why it focuses primarily on the study of social inequalities in health (Raju, 2021).

Authors such as Whitehead and Dahlgren (1991) and Grant, Morgan, Gallagher, and Mannay (2020) describe the relationship between the individual, their environment, and the disease, where the main determinants are seen as layers or strata that influence people's health. The first level (centre or origin) represents the closest level where the main factors or causal factors are found; extreme factors are seen as contextual factors (groups or environments where the phenomena or diseases under study develop). In addition, this scheme represents the hierarchical structure of determinants that affect people's health and the interrelationships between them.

Children's respiratory systems have a weak immune system. In addition, it must be developed until it reaches its full potential in terms of structure and function (Raju, 2018). The aggression caused by passive inhalation of tobacco smoke can affect the development of this organ and respiratory function, increasing morbidity and mortality. Numerous studies have linked parental smoking and the admission rate for bronchitis and pneumonia in children (Löhler & Wollenberg, 2019). In addition, several published studies such as Myers, Rosen, Zucker, and Shiloh (2020), Felicione et al. (2022), and Falcone et al. (2019) in which large cohorts of asthmatic children were analyzed and observed an increase in the prevalence of asthma in children of smokers and the need for a greater

number of anti-asthmatic drugs to achieve control of this disease (Raju et al., 2021).

## 1.3 Secondhand smoke determinants

Non-smokers inhale undesirable smoke from a smoker's tobacco smoke, known as secondhand smoking. Passive smoking is also known as involuntary or ambient smoking (Abdel-Rahman, 2020). The harmful effects of smoking and the association with respiratory issues, cardiovascular illness, and reproductive disorders is well-documented (Raju et al., 2021). Secondhand smoke has an impact on prenatal development, infant death syndrome, and asthma in children (Papoudi, Jørgensen, Guldborg, & Meadan, 2021). It also causes a variety of malignancies and cerebrovascular diseases (Raju, 2021)(Li et al., 2018). Adults' emotional and physical health is significantly affected by secondhand smoking. According to Myers, Rosen, Zucker, and Shiloh (2020), individuals exposed to secondhand smoke are twice as likely to develop depression as those who are not. Secondhand smoking also increases depressed symptoms and suicidal thoughts in adult women (Gim et al. 2016). Furthermore, another study found that secondhand smoke exposure in the office or at home is a risk factor for elevated stress in both smokers and nonsmokers.

Toxins and enzymes produced by pathogenic bacteria speed up the inflammatory and immune response in the body. Studies by Felicione et al. (2022), Cather, Pachas, Cieslak, and Evins (2017), and Falcone et al. (2019) indicate that the habit of parents smoking practices effected by age, race, or belonging to an ethnic group or socioeconomic class. Some studies suggest that individuals of European origin who are smokers are almost three times more likely to develop nicotine dependency due to the high level of cold weather (Wu et al., 2019). Periodontal tissue and saliva are part of the non-specific defense mechanisms against pathogenic bacteria like nitric oxide, which contributes to the loss of tissues in excessive amounts. This effect would be regulated by the inducible nitric oxide synthase and endothelial nitric oxide synthase enzymes (Papoudi, Jørgensen, Guldborg, & Meadan, 2021).

Various researchers have analyzed the consequences and dose-response effects. In

some previous reviews, such as Ashare et al. (2017), it is concluded that smokeless tobacco is responsible for the evolution of a part of oral leukoplakia in both adolescents and adults. The children health risks from exposure to smoking are associated with parents smoking practices (Myers, Lev, Guttman, Tillinger, & Rosen, 2020), knowledge level (Roberts, Wagler, & Carr, 2017), perceptions (Roberts et al., 2017), attitude (Díez-Izquierdo et al., 2017), and socioeconomic status (Wellman et al., 2018; Taylor et al., 2021).

The inability of parents to protect their children may be linked to risk perception (Papoudi, Jørgensen, Guldborg, & Meadan, 2021). Infants are perhaps the most vulnerable to harm: as secondhand smokers in their own homes, they are at an increased risk of acute respiratory infections, lower respiratory illnesses, sudden infant death syndrome, acute and recurrent otitis media, chronic middle ear effusion, breathlessness, asthma diagnosis, colitis, colic, the onset of wheeze illnesses, cough, and phlegm (Rosen & Kostjukovsky, 2015). Exposure to SHS is especially harmful to children with asthma, as it is linked to poor disease control, deteriorated respiratory function, and increased hospitalization rates (Wu et al., 2019). According to research conducted in Hong Kong, 34% of school-aged children live with a minimum of one parent who smokes. In Taiwan, approximately 45 percent of junior high and 47 percent of senior high school kids are exposed at home to SHS, with about half of them being exposed every day (Chen, Hsiao, Miao, & Chen, 2013).

A study by Lim, Teh, Nik Mohamed, et al. (2018) on school-going Malaysian adolescents aged 11 to 19 examined their exposure to SHS in the cars of their parents or guardians using a questionnaire that was representative to determine the prevalence rate. The reported prevalence of SHS exposure in parents' cars was 23.3%, and the exposure was higher among Malay compared to the Chinese students 11.9%, and students in rural areas 26.9%.

Several studies have found that smoke-free legislation positively impacts private smoke-free environments (Raju, 2018)(Monson & Arsenault, 2017). Despite this, a considerable percentage of people are still exposed to SHS, particularly at home. In Portugal, for example, 14% of children were exposed to SHS at home

in 2016 (Precioso et al., 2019). As a result, the illness burden associated with SHS exposure remains substantial. SHS exposure resulted in 67,000 fatalities and 1.5 million DALYs in adults in European Union (EU) nations in 2017 (Network, 2018).

Yuan et al. (2019) conducted research to determine the relationship between choroidal thickness and secondhand smoking exposure in children. From January 2016 to July 2017, children aged 6 to 8 were randomly selected from the population-based Hong Kong Children Eye Study at the Chinese University of Hong Kong Eye Centre. All of the subjects were subjected to extensive eye examinations. Swept-source optical coherence tomography was used to quantify choroidal thickness, using built-in software that automatically segmented the choroid layer to examine its terrain imaging. A questionnaire was used to acquire information on secondhand smoking history. When correcting for confounding variables, multiple linear regression models were used to investigate the link between choroidal thickness and secondhand exposure. Among 1400 youngsters, 941 (67.2%) had never been exposed to secondhand smoke, and 459 (32.8%) had been exposed to secondhand smoke. The non-exposure group's mean (SD) age was 7.65 (1.09) years, while the exposure group's mean (SD) age was 7.54 (1.11). After controlling for age, gender, BMI, axial length, and birth weight, secondhand smoking was linked to a thinner choroid by 8.3 meters in the central subfield, 7.2 meters in the inner inferior, 6.4 meters in the outer inferior, 6.4 meters in the inner temporal, and 7.3 meters in the outer temporal. Choroidal thinning has also been linked to an increase in the number of family smokers and the amount of secondhand smoke. Increased choroidal thinning by 7.86 m in the central subfield, 4.51 m in the outer superior, 6.23 m in the inner inferior, 5.59 m in the outer inferior, 6.06 m in the inner nasal, and 6.55 m in the outer nasal was related with an increase of 1 family smoker. An increase in choroidal thinning by 0.54 m in the central subfield, 0.42 m in the inner temporal, and 0.47 m in the outer temporal was related to increased exposure to 1 secondhand cigarette smoke per day.

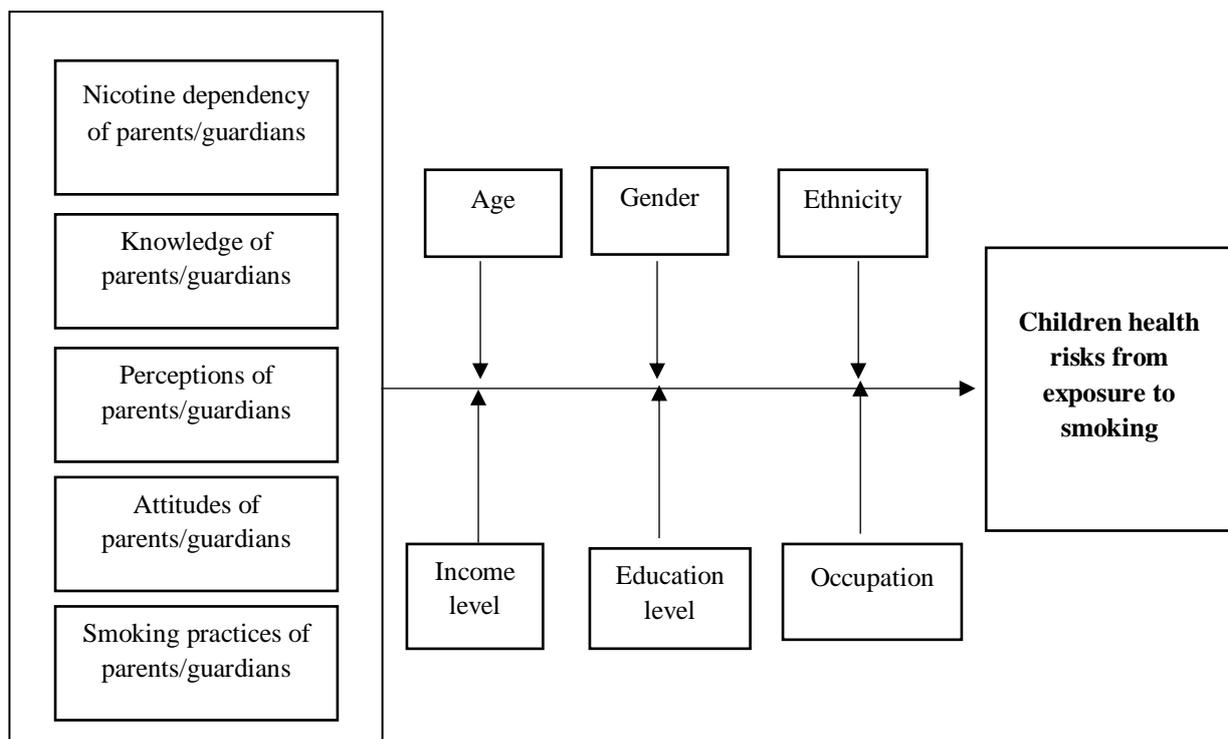
Ling et al. (2020)SHS examined among school-going adolescents in Malaysia aged 11–19 years using a cross-sectional study design and multi-

stage sampling method. A pre-validated standard questionnaire was used for data collection. Descriptive and multivariate analyses were used to analyze the data, and the results are presented as an adjusted odds ratio with a 95% confidence interval (95%) (Raju, 2021). From the study, exposure to secondhand smoking was higher outside the home in the past seven days, 51.2% compared to at home 37.8%, and the likelihood of exposure to SHS was higher for school-goers from rural areas.

#### 1.4 Proposed framework

Based on the discussion above, children are more vulnerable to health risks than adults because they have a smaller body surface area and a lower weight. In addition, those who live with smokers, either because their parents or

caregivers smoke, have a higher risk of suffering from upper and lower respiratory infections and of requiring medical consultations or hospital admissions than those who live in a home with no smokers. In this regard, several factors are related to the parents' or guardians' smoking habits. Among these factors are nicotine dependency, knowledge level of parents about smoking risks, parents' perception of smoking, the attitude of parents, and the parents' smoking practices. These factors received less attention in the literature review. This study constructed a proposed framework that illustrates the potential direct effect of these factors on the children's health risks from exposure to smoking, as shown in Figure 1. Also, the proposed framework comprises six socio-demographic factors: age, gender, ethnicity, income level, education level, and occupation.



**Figure 1: Proposed conceptual framework**

#### 1.5 Conclusion

The houses in which at least one of their inhabitant's smokes constitute a dangerous environment for children since it is where they spend their time. Previous studies have also estimated that children who live in environments where they are exposed to receiving a dose of nicotine equivalent to smoking cause an

increased risk of acute respiratory and ENT infections and asthma problems. Based on the previous studies that investigated the relationship between parents' smoking practices and children's health risks from exposure to smoking, this study proposed a conceptual framework that constructs five factors: nicotine dependency, knowledge level of parents about smoking risks, parents' perception of smoking,

and attitude of parents toward the children's health risks from exposure to smoking, besides the potential moderation effect of socio-demographic factors such as age, gender, ethnicity, income level, education level, and occupation.

## References

- [1] Abdel-Rahman, O. (2020). Incidence and Mortality of Lung Cancer Among Never Smokers in Relationship to Secondhand Smoking: Findings From the PLCO Trial. *Clinical Lung Cancer*, 21(5), 415-420.e412. doi:<https://doi.org/10.1016/j.clcc.2020.04.009>
- [2] Ashare, R. L., Lerman, C., Tyndale, R. F., Hawk, L. W., George, T. P., Cinciripini, P., & Schnoll, R. A. (2017). Sleep Disturbance During Smoking Cessation: Withdrawal or Side Effect of Treatment? *Journal of Smoking Cessation*, 12(2), 63-70. doi:10.1017/jsc.2016.11
- [3] Berkman, L. F., Kawachi, I., & Glymour, M. M. (2014). *Social epidemiology*: Oxford University Press.
- [4] Carreras, G., Lachi, A., Cortini, B., Gallus, S., López, M. J., López-Nicolás, Á., . . . Tack, S. H. S. P. I. (2021). Burden of disease from exposure to secondhand smoke in children in Europe. *Pediatric Research*, 90(1), 216-222. doi:10.1038/s41390-020-01223-6
- [5] Cather, C., Pachas, G. N., Cieslak, K. M., & Evins, A. E. (2017). Achieving Smoking Cessation in Individuals with Schizophrenia: Special Considerations. *CNS Drugs*, 31(6), 471-481. doi:10.1007/s40263-017-0438-8
- [6] Chen, Y.-T., Hsiao, F.-H., Miao, N.-F., & Chen, P.-L. (2013). Factors Associated with Parents' Perceptions of Parental Smoking in the Presence of Children and Its Consequences on Children. *International Journal of Environmental Research and Public Health*, 10(1). doi:10.3390/ijerph10010192
- [7] Díez-Izquierdo, A., Lidón-Moyano, C., Martín-Sánchez, J. C., Matilla-Santander, N., Cassanello-Peñarroya, P., Balaguer, A., & Martínez-Sánchez, J. M. (2017). Smoke-free homes and attitudes towards banning smoking in vehicles carrying children in Spain (2016). *Environmental Research*, 158, 590-597. doi:<https://doi.org/10.1016/j.envres.2017.07.012>
- [8] Falcone, M., Bernardo, L., Wileyto, E. P., Allenby, C., Burke, A. M., Hamilton, R., . . . Lerman, C. (2019). Lack of effect of transcranial direct current stimulation (tDCS) on short-term smoking cessation: Results of a randomized, sham-controlled clinical trial. *Drug and Alcohol Dependence*, 194, 244-251. doi:<https://doi.org/10.1016/j.drugalcdep.2018.10.016>
- [9] Felicione, N. J., Ozga, J. E., Dino, G., Berry, J. H., Sullivan, C. R., & Blank, M. D. (2022). Timing of smoking cessation treatment integrated into outpatient treatment with medications for opioid use disorder: Feasibility trial. *Journal of Substance Abuse Treatment*, 132, 108579. doi:<https://doi.org/10.1016/j.jsat.2021.108579>
- [10] Gim, W., Yoo, J.-H., Shin, J.-Y., & Goo, A.-J. (2016). Relationship between Secondhand Smoking with Depressive Symptom and Suicidal Ideation in Korean Non-Smoker Adults: The Korean National Health and Nutrition Examination Survey 2010-2012. *Korean Journal of family medicine*, 37(2), 97-104. doi:10.4082/kjfm.2016.37.2.97
- [11] Grant, A., Morgan, M., Gallagher, D., & Mannay, D. (2020). Smoking during pregnancy, stigma and secrets: Visual methods exploration in the UK. *Women and Birth*, 33(1), 70-76. doi:<https://doi.org/10.1016/j.wombi.2018.11.012>
- [12] Li, L., Guo, L., Chen, X., Xiang, M., Yang, F., Ren, J.-c., & Zhang, G.-h. (2018). Secondhand smoke is associated with heavy metal concentrations in children. *European Journal of Pediatrics*, 177(2), 257-264. doi:10.1007/s00431-017-3053-2
- [13] Lim, K. H., Teh, C. H., Mohamed, M. H. N., Pan, S., Ling, M. Y., Yusoff, M. F. M., . . . Ismail, N. (2018). Exposure to tobacco secondhand smoke and its associated factors among non-smoking adults in smoking-restricted and non-restricted areas: findings from a nationwide study in Malaysia. *BMJ Open*, 8(1), e017203.
- [14] Lim, K. H., Teh, C. H., Nik Mohamed, M. H., Pan, S., Ling, M. Y., Mohd Yusoff, M.

- F., . . . Lim, H. L. (2018). Exposure to tobacco secondhand smoke and its associated factors among non-smoking adults in smoking-restricted and non-restricted areas: findings from a nationwide study in Malaysia. *BMJ Open*, *8*(1), e017203. doi:10.1136/bmjopen-2017-017203
- [15] Ling, M. Y. J., Lim, K. H., Hasani, W. S. R., Rifin, H. M., Majid, N. L. A., Lourdes, T. G. R., . . . Yusoff, M. F. M. (2020). Exposure to secondhand smoke among school-going adolescents in Malaysia: Findings from the tobacco and e-cigarettes survey among Malaysian adolescents (TECMA). *Tobacco induced diseases*, *18*, 96-96. doi:10.18332/tid/128622
- [16] Löhler, J., & Wollenberg, B. (2019). Are electronic cigarettes a healthier alternative to conventional tobacco smoking? *European Archives of Oto-Rhino-Laryngology*, *276*(1), 17-25. doi:10.1007/s00405-018-5185-z
- [17] Monson, E., & Arsenault, N. (2017). Effects of Enactment of Legislative (Public) Smoking Bans on Voluntary Home Smoking Restrictions: A Review. *Nicotine & Tobacco Research*, *19*(2), 141-148. doi:10.1093/ntr/ntw171
- [18] Murakami, K., Obara, T., Ishikuro, M., Ueno, F., Noda, A., & Kuriyama, S. (2020). Associations of Education and Income With Secondhand Smoke Exposure Among Non-Smoking Pregnant Women in Japan: The Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study. doi:<https://doi.org/10.21203/rs.3.rs-64032/v1>
- [19] Myers, V., Lev, E., Guttman, N., Tillinger, E., & Rosen, L. (2020). “I can’t stand it...but I do it sometimes” parental smoking around children: practices, beliefs, and conflicts – a qualitative study. *BMC Public Health*, *20*(1), 693. doi:10.1186/s12889-020-08863-7
- [20] Myers, V., Rosen, L. J., Zucker, D. M., & Shiloh, S. (2020). Parental Perceptions of Children’s Exposure to Tobacco Smoke and Parental Smoking Behaviour. *International Journal of Environmental Research and Public Health*, *17*(10). doi:10.3390/ijerph17103397
- [21] Network, G. B. o. D. C. (2018). Global burden of disease study 2017 (GBD 2017) results. *Seattle, United States: Institute for Health Metrics Evaluation*.
- [22] Papoudi, D., Jørgensen, C. R., Guldborg, K., & Meadan, H. (2021). Perceptions, Experiences, and Needs of Parents of Culturally and Linguistically Diverse Children with Autism: a Scoping Review. *Review Journal of Autism and Developmental Disorders*, *8*(2), 195-212. doi:10.1007/s40489-020-00210-1
- [23] Precioso, J., Rocha, V., Sousa, I., Araújo, A. C., Machado, J. C., & Antunes, H. (2019). Prevalence of Portuguese Children Exposed to Secondhand Smoke at Home and in the Car. *Acta Médica Portuguesa; Vol 32, No 7-8 (2019): July-August*. doi:10.20344/amp.11655
- [24] Ratschen, E., Thorley, R., Jones, L., Opazo Breton, M., Cook, J., McNeill, A., . . . Lewis, S. (2018). A randomized controlled trial of a complex intervention to reduce children’s exposure to secondhand smoke in the home. *Tobacco Control*, *27*(2), 155. doi:10.1136/tobaccocontrol-2016-053279
- [25] Raju, V. (2018). Theory of Lim law: Leadership style. *Eurasian Journal of Analytical Chemistry*, *13*(6), 125–136. <http://www.eurasianjournals.com/Theory-of-Lim-Law-Leadership-Style,104466,0,2.html>
- [26] Raju, V. (2021). Implementing Flexible Systems in Doctoral Viva Defense Through Virtual Mechanism. *Global Journal of Flexible Systems Management*, *22*(2), 127–139. <https://doi.org/10.1007/s40171-021-00264-y>
- [27] Raju, V., Juan, W., Shrestha, S., Kalathinathan, A., & Ramachandran, K. (2021). *Role of Big Data Analytics in Belt and Road Initiative (BRI): Multivariate Analysis with Gaussian Distribution of Data*. 169–177. <https://doi.org/10.3233/FAIA210245>
- [28] Roberts, C., Wagler, G., & Carr, M. M. (2017). Environmental Tobacco Smoke: Public Perception of Risks of Exposing Children to Second- and Third-Hand Tobacco Smoke. *Journal of Pediatric Health Care*, *31*(1), e7-e13. doi:<https://doi.org/10.1016/j.pedhc.2016.08.008>
- [29] Rosen, L., & Kostjukovsky, I. (2015). Parental risk perceptions of child exposure

- to tobacco smoke. *BMC Public Health*, 15(1), 90. doi:10.1186/s12889-015-1434-x
- [30] Taylor, G. M. J., Baker, A. L., Fox, N., Kessler, D. S., Aveyard, P., & Munafò, M. R. (2021). Addressing concerns about smoking cessation and mental health: theoretical review and practical guide for healthcare professionals. *BJPsych Advances*, 27(2), 85-95. doi:10.1192/bja.2020.52
- [31] Wellman, R. J., Sylvestre, M.-P., O'Loughlin, E. K., Dutezak, H., Montreuil, A., Datta, G. D., & O'Loughlin, J. (2018). Socioeconomic status is associated with the prevalence and co-occurrence of risk factors for cigarette smoking initiation during adolescence. *International Journal of Public Health*, 63(1), 125-136. doi:10.1007/s00038-017-1051-9
- [32] Whitehead, M., & Dahlgren, G. (1991). What can be done about inequalities in health? *Lancet*, 338(8774), 1059-1063.
- [33] WHO. (2021). Descriptive note on Tobacco Retrieved from <https://www.who.int/mediacentre/>
- [34] Wu, T. D., Eakin, M. N., Rand, C. S., Brigham, E. P., Diette, G. B., Hansel, N. N., & McCormack, M. C. (2019). In-Home Secondhand Smoke Exposure Among Urban Children With Asthma: Contrasting Households With and Without Residential Smokers. *Journal of public health management and practice: JPHMP*, 25(2), E7-E16. doi:10.1097/PHH.0000000000000790
- [35] Yuan, N., Li, J., Tang, S., Li, F. F., Lee, C. O., Ng, M. P. H., . . . Yam, J. C. (2019). Association of Secondhand Smoking Exposure With Choroidal Thinning in Children Aged 6 to 8 Years: The Hong Kong Children Eye Study. *JAMA Ophthalmology*, 137(12), 1406-1414. doi:10.1001/jamaophthalmol.2019.4178