PREVALENCE OF OBESITY AMONG STUDENTS: A SURVEY BASED STUDY IN LUCKNOW, UTTAR PRADESH, INDIA

Arti Yadav¹, Vikas Bharti², Suchit Swaroop³*

Authors Affiliation:

¹Experimental & Public Health Laboratory, Department of Zoology, University of Lucknow, Lucknow-226007, India

²Experimental & Public Health Laboratory, Department of Zoology, University of Lucknow, Lucknow-226007, India

³*Experimental & Public Health Laboratory, Department of Zoology, University of Lucknow, Lucknow-226007, India

Abstract:

Background: Obesity is a major global problem among population. India has paradox of having both under nutrition and obesity as a major problem. This epidemic of obesity is also affecting rural population. It has both short- and long-term adverse health outcomes.

Methods: The present study is a cross-sectional, observational and questionnaire-based study conducted among school and college going students.

Scope of study: On the basis of changes in life style, food habit, sleep pattern and increase the time duration of physical activity, we overcome the obesity and their co-morbidities such as hypertension, type-2 diabetes, Non-alcoholic fatty liver disease (NAFLD), dyslipidaemia, heart disease, thyroid, arthritis.

Conclusion: Obesity and overweight are more prevalent in urban adolescent. There is difference among male and female group. There is tendency of high frequency of obesity and overweight among those students who have higher annual family income, frequency of restaurant and school canteen food and lesser frequency of physical training sessions conducted in school.

Key-words: Obesity, Overweight, Co-morbidities, Adolescent, Physical activity,

INTRODUCTION

Prevalence of obesity has been rising in India as well as in other countries [1]. In a systemic analysis of epidemiological studies from 199 countries, around 1.46 billion people world-wide were estimated to be overweight in 2008, and of these 502 million were obese [4]. Excess body weight is associated with adverse health outcomes on longevity, disability-free life years, quality of life, and productivity [2, 5]. Overweight and obesity has created an additional burden in correlation with several other diseases, worldwide. The burden of obesity includes diabetes, coronary heart disease, stroke, cancer, and osteoarthritis [6]. For a country like India, obesity has not yet become a priority on the policy front. India being the developing nation going through the dual burden of obesity on one side while the high undernourishment on the other [7]. According to the latest round of National family Health survey (NFHS-4, 2015-16), 20.7% percent women and 18.9 percent men in 2005-06 (NFHS-3) (IIPS, 2007, IIPS, 2016) [8]. Obesity and overweight amongst children were considered primarily as disease of developed countries with high per capita income [16]. However, developing countries like India are also joining this pool because of rapid change in food habits and life style.

India has a paradox of being considered a fast weight gaining nation and is also struggling with malnutrition [18]. This could be reflection of the recent emerging socio-economic trends in childhood obesity in India. There are many long-term consequences of childhood obesity as its persistence into adulthood along with its health risks [14]. Obesity is more likely to persist if it starts in adolescence. According to various studies, the current prevalence of childhood overweight in India ranges from 4% to 22%. Various studies point toward possible connections of childhood overweight/obesity with social and psychological characteristics (e.g. anxiety, depression, social withdrawal etc), factors leading to incidence of overweight and obesity among children [8]. Obesity is the accumulation of body fat to that level, which may harm health. A person having more than 20 percent of body weight as fat is suffering from obesity. Body Mass Index (BMI) is a widely used diagnostic tool to measure obesity [22]. According to WHO report BMI should remain at 18.5 to 24.9 kg/m² was a compromise, because in the United States, higher levels of BMI were accepted as normal, with some experts suggesting that there should be an age- related increase in these upper limits. There are age dependent changes in the relationship of BMI to total and that the classic

comorbidities intrinsically linked to an excess BMI e.g., diabetes, hyper-tension, gall stones. Non-smoking individuals are likely to have an optimum population life expectancy and disability- free life if their BMIs remain at -20 kg/m^2 throughout life [25]. An increase in physical inactivity due to increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization [44]. The paradox of malnutrition in India, characterized by the coexistence of undernutrition and obesity, highlights the country's double burden of disease [27]. Historically, obesity was predominantly associated with urban populations; however, recent studies suggest a rising prevalence even among rural communities due to changing lifestyle patterns [28]. This shift is driven by factors such as urbanization, reduced physical activity, and increased consumption of processed and highcalorie foods [32]. Obesity in children and adolescents is of particular concern due to its association with both short- and long-term health consequences. In the short term, excessive weight gain can lead to psychological distress, social stigmatization, and metabolic disturbances [31]. Long-term implications include a heightened risk of non-communicable diseases (NCDs) such as type 2 diabetes, cardiovascular diseases, non-alcoholic fatty liver disease (NAFLD), and certain types of cancers 30]. Early onset of obesity often persists into adulthood, exacerbating the burden on healthcare systems and reducing quality of life [33].

Obesity is one of the most crucial problems in developing countries. Its risk factors have been studied in India widely using different approaches. Obesity is sedentary life style problem. Some time it may be genetical, xenobiotic etc. Therefore, firstly, it was aimed in the study to figure out the prevalence of obese population in Lucknow district. Secondly, to figure out an association between risk factors of obesity and BMI of the subjects enrolled. Overweight and obesity are prevalent among adults residing in rural areas of Trivandrum. According to WHO BMI guidelines for Asians, the population exhibited a prevalence of 24% for overweight and 40.7% for obesity [6]. Understanding the prevalence of obesity among students is crucial for designing effective interventions that target lifestyle modifications and promote healthier habits.

METHODOLOGY:

It is a cross- sectional, observational and questionnaire- based study conducted in Lucknow city of Uttar Pradesh, India. After taking consent from the subjects, they were asked to fulfil a questionnaire. Questionnaire consists of questions related to demographic, physical and

lifestyle factors. Collected sample size is 109. We categories subjects overweight and obese on the basis of their BMI (overweight 23 to 24.9 and obese 25 to above).

Inclusion Criteria: Subjects between the ages of 18 and 30, encompassing both rural and urban backgrounds, with elevated BMI, are being studied with a focus on various factors such as their sleeping patterns, eating habits, physical activity levels, sleep cycles, screen time exposure, and concerns related to their weight.

Exclusion Criteria: The study excluded pregnant women, individuals aged 30 or above, married individuals, children below 18 years, and those with other medical factors associated with weight gain.

Statistical Analysis: For statistical analysis Mann- Whitney test and chi-square test. Statistical analysis is done by using SPSS software

Results:

BMI-Based Categorization:

The analysis of BMI classification reveals that 60.5% of subjects are categorized as obese while 39.4% are classified as overweight. This indicates a high prevalence of excessive weight within the studied population, highlighting a critical public health concern. Obesity and overweight are major risk factors for several non-communicable diseases, such as cardiovascular disorders, diabetes, and metabolic syndromes.

| Categories based | Subject (N) | Percentage (%) | |
|------------------|-------------|----------------|--|
| on BMI | | | |
| Obesity | 66 | 60.5 | |
| Overweight | 43 | 39.4 | |

Table 1: Distribution of subjects according to the range of BMI.

Residential Area and Family Type:

A majority of the study participants (81.7%) reside in urban areas, whereas only 18.3% (20 individuals) come from rural backgrounds. This suggests that urban lifestyles, often associated with sedentary habits and increased fast-food consumption, might be contributing to higher obesity rates. Additionally, family type plays a role in lifestyle and dietary patterns—59.6% of individuals belong to nuclear families, whereas 40.4% come from joint

families. Nuclear families may exhibit different dietary habits and lifestyle choices, potentially leading to a higher risk of obesity.

Socioeconomic Status and Family History of Obesity:

Socioeconomic status appears to influence obesity prevalence. The majority (80.7%) of the individuals belong to the middle-income group, followed by 10.1% from the upper middle class and 9.2% from the lower middle class. Economic status may impact dietary choices, access to healthy foods, and engagement in physical activities.

Family history also plays a significant role in obesity risk. 35.8% of subjects reported a family history of obesity or overweight, while 64.2% did not have such a history. Genetic predisposition combined with lifestyle habits may contribute to an individual's likelihood of developing obesity.

Exercise Frequency Per Week:

The data suggests a significant lack of physical activity among participants. 34.9% of subjects do not engage in any form of exercise, while 38.5% exercise once or twice per week. Only 26.6% engage in physical activity three or more times a week. This lack of regular exercise could be a contributing factor to the high prevalence of obesity observed in the study population (Graph 1).

Weight Gain After COVID-19:

Since the COVID-19 pandemic, 15.6% of participants reported experiencing weight gain, while the majority (84.4%) did not report significant weight changes. This suggests that while the pandemic influenced weight gain in some individuals—possibly due to lockdown restrictions, stress-related eating, and reduced physical activity—the impact was not uniform across the population.

Sleep Patterns:

A significant proportion of individuals (62.4%) sleep between 5 to 7 hours per night, while 11% sleep less than 5 hours. Sleep deprivation is known to contribute to weight gain and metabolic disorders. On the other hand, 24.8% sleep 8 hours or more, which is considered ideal for maintaining a healthy metabolism.

Extreme Appetite Duration:

A majority (60.6%) reported experiencing hunger every 5 to 6 hours, while 14.7% experience extreme appetite every 6 to 7 hours. 16.5% feel extremely hungry every 7 to 8 hours, and only 4.6% report feeling extreme hunger between 8 to 10 hours. Frequent hunger pangs could be associated with high-calorie intake and poor dietary habits, further contributing to obesity.

Age, Weight, Height, and BMI Distribution:

Average age of included subjects were 22.11 years. The mean weight was 65.97 kg, while the mean height was 158.75 cm, leading to an average BMI of 26.19, which falls in the overweight category. The minimum BMI recorded was 17.3 (underweight), while the maximum BMI reached 41 (severe obesity). A standard deviation of 4.22 indicates moderate variability in BMI within the population (Table 2).



Graph 1: Represents exercise pattern in each week of the subjects.



Graph 2: Distribution of the subjects based on their specify causes associated to obesity/overweight. This graphical presentation shows subjects response on their specific disease which is responsible for their obesity. Some subjects are showing many causes that are interlinked with obesity like Depression and trouble sleeping.

| | Age | Weight (kg) | Height (cm) | BMI |
|---------------|-------|-------------|-------------|-------|
| Number of | 109 | 109 | 109 | 109 |
| Subjects | | | | |
| Mean | 22.11 | 65.97 | 158.75 | 26.19 |
| Median | 22 | 65 | 158.4 | 25.6 |
| Standard | 3.295 | 10.86 | 11.06 | 4.22 |
| Deviation | | | | |
| Minimum | 5 | 26 | 121 | 17.3 |
| Maximum | 32 | 97 | 182.8 | 41 |
| Interquartile | 3 | 14 | 14 | 5.3 |
| range | | | | |

| Table 2: | Distribution | of Age, | Weight, | Height | and BMI |
|----------|--------------|---------|---------|--------|---------|
| | | | | | |

DISCUSSION:

The current study shows the prevalence of overweight and obese adolescents. It includes higher number obese followed by overweight. Variation in social and economic characteristics was obtained by studying the association between BMI and social, economic, and residential area. A strong insignificant association was obtained which states that BMI of individual is associated to their social, economic, and residential area. A previously studied study shows strong association with differences in social, economic, and residential area of individuals [5]. Obesity also has multiple impacting factors such as fast food/alcohol intake, using electronic gadgets while eating, lifestyle(active/sedentary), biological rhythm, economic-status and physical activities. Liking for fast food, operating gadgets (TV watching/ using mobiles/ reading) during meals have not been found significantly associated with obesity or overweight, i.e., strong association between the mentioned variables with obesity or overweight population. In one of the previous studies a strong association was reported [25]. Sleep pattern generally affects the lifestyle and so increases obesity. In the current study a strong insignificant association was obtained for sleep pattern, sleep duration and screen exposure with BMI in the studied population.

The findings of this study highlight a concerning prevalence of obesity and overweight among the study population, with 60.5% categorized as obese and 39.4% as overweight. These results align with previous studies indicating a global increase in obesity rates due to lifestyle changes, dietary habits, and socioeconomic factors [42, 39]. The high prevalence of obesity in this study population underscores the need for targeted public health interventions to address lifestyle modifications and dietary awareness.

Influence of Urbanization and Family Type:

The dominance of urban residency (81.7%) among the study participants suggests that urban lifestyles contribute significantly to obesity risk. Urban environments are often associated with sedentary behaviors, increased availability of high-calorie foods, and reduced physical activity, as documented in prior research [45,41]. Additionally, the study found that a higher percentage of participants belonged to nuclear families (59.6%), which may influence dietary choices and physical activity patterns. Nuclear families often lack traditional meal patterns seen in joint families, leading to higher consumption of processed foods and reduced home-cooked meals.

Socioeconomic Status and Genetic Factors:

The study identified that the majority of individuals (80.7%) belonged to the middle-income group, with a smaller percentage from upper middle (10.1%) and lower middle classes

(9.2%). Economic status plays a significant role in obesity risk, influencing dietary choices and accessibility to healthier food options [37]. Additionally, a notable proportion (35.8%) reported a family history of obesity, indicating the interplay between genetic predisposition and lifestyle factors [40]. Studies suggest that individuals with obese family members are at a higher risk of developing obesity due to shared dietary and activity behaviors in addition to genetic susceptibility [38].

Physical Activity and Exercise Habits:

Physical inactivity is a critical contributor to obesity, and the study results reinforce this concern. A substantial proportion (34.9%) of subjects did not engage in any exercise, while only 26.6% exercised three or more times per week. These findings are in line with global research that identifies physical inactivity as a major determinant of obesity and metabolic disorders [35]. Encouraging regular physical activity through public health campaigns and structured programs may help mitigate obesity risk.

Weight Gain Post-COVID-19:

The COVID-19 pandemic had a measurable impact on weight gain, with 15.6% of participants reporting increased weight. Lockdown restrictions, decreased physical activity, and stress-induced overeating may have contributed to this trend [34]. However, the majority (84.4%) did not report significant weight changes, suggesting that lifestyle variations among individuals influenced the outcomes.

Sleep Patterns and Appetite Regulation:

A large proportion of participants (62.4%) reported sleeping between 5 to 7 hours per night, while 11% slept less than 5 hours. Insufficient sleep is well-documented as a risk factor for obesity due to its impact on metabolic regulation and appetite hormones [43]. The study also identified patterns of extreme hunger, with 60.6% experiencing hunger every 5 to 6 hours, potentially leading to increased calorie intake. Poor dietary habits combined with inadequate sleep may exacerbate weight gain trends [36].

BMI, Age, and Variability:

The study population had an average BMI of 26.19, indicating a general trend toward overweight status. The standard deviation (4.22) suggests moderate variability, with BMI

values ranging from underweight (17.3) to severe obesity (41). These findings emphasize the importance of targeted obesity prevention strategies tailored to young adults, who constituted the majority of this study sample (mean age: 22.11 years).

Conclusion and Public Health Implications:

The study highlights the multifactorial nature of obesity, influenced by urbanization, socioeconomic status, physical inactivity, sleep patterns, and dietary habits. Public health initiatives should focus on promoting active lifestyles, healthier food choices, and awareness regarding the impact of sleep and stress on obesity. Interventions tailored to urban populations, particularly among young adults, may be necessary to curb the rising trend of obesity. This study provides a good knowledge about the obese population in Lucknow district especially among college students. It also enlightens about risk factors associated with obesity. The limitation of this study is that it did not include nutritional assessment of the life style of population studied.

References:

- 1. Balarajan, Y., & Villamor, E. (2009). Nationally representative surveys show recent increases in the prevalence of overweight and obesity among women of reproductive age in Bangladesh, Nepal, and India. The journal of nutrition, 139(11), 2139-2144.
- Wang, Y. C., McPherson, K., Marsh, T., Gortmaker, S. L., & Brown, M. (2011). Health and economic burden of the projected obesity trends in the USA and the UK. The Lancet, 378(9793), 815-825.
- 3. Muralidharan, E., & Pathak, S. (2018). Sustainability, transformational leadership, and social entrepreneurship. Sustainability, 10(2), 567.
- Gortmaker, S. L., Swinburn, B. A., Levy, D., Carter, R., Mabry, P. L., Finegood, D. T., ... & Moodie, M. L. (2011). Changing the future of obesity: science, policy, and action. The Lancet, 378(9793), 838-847.
- Safei, M., Khan, S., & Gupta, R. (2021). Global burden of obesity: An epidemiological perspective. International Journal of Obesity Research, 45(2), 125– 137.

- 6. Unnikrishnan, R., Anjana, R. M., & Mohan, V. (2012). Obesity in India: The weight of the nation. Journal of the Association of Physicians of India, 60, 60–64.
- Chaurasiya, D., Singh, N., & Mishra, V. (2019). The epidemiology of childhood obesity in India: A review. Indian Journal of Community Health, 31(4), 431–438.
- Gupta, N., Shah, P., Nayyar, S., & Misra, A. (2013). Childhood obesity and the metabolic syndrome in developping countries. The Indian Journal of Pediatrics, 80, 28-37.
- P. W., Rudolf, M. C., Anhalt, H., Camacho-Hubner, C., Chiarelli, F., Eliakim, A., ... & Hochberg, Z. (2005). Childhood obesity. The journal of clinical endocrinology & metabolism, 90(3), 1871-1887.
- King, L. K., March, L., & Anandacoomarasamy, A. (2013). Obesity & osteoarthritis. In Indian J Med Res (Vol. 138).
- 11. Ofei, F. (2005). Number 3 GHANA MEDICAL JOURNAL (Vol. 39).
- Powell-Wiley, T. M., Poirier, P., Burke, L. E., Després, J. P., Gordon-Larsen, P., Lavie, C. J., Lear, S. A., Ndumele, C. E., Neeland, I. J., Sanders, P., & St-Onge, M. P. (2021). Obesity and Cardiovascular Disease A Scientific Statement From the American Heart Association. In Circulation (Vol. 143, Issue 21, pp. E984–E1010). Lippincott Williams and Wilkins. https://doi.org/10.1161/CIR.000000000000973.
- Ranjani, H., Mehreen, T. S., Pradeepa, R., Anjana, R. M., Garg, R., Anand, K., & Mohan, V. (2016). Epidemiology of childhood overweight & obesity in India: A systematic review. In Indian Journal of Medical Research (Vol. 143, Issue FEBRUARY, pp. 160–174). Indian Council of Medical Research. https://doi.org/10.4103/0971-5916.180203.
- 14. Safaei, M., Sundararajan, E. A., Driss, M., Boulila, W., & Shapi'i, A. (2021a). A systematic literature review on obesity: Understanding the causes & consequences of obesity and reviewing various machine learning approaches used to predict obesity. In Computers in Biology and Medicine (Vol. 136). Elsevier Ltd. https://doi.org/10.1016/j.compbiomed.2021.104754.
- 15. Saha, J., Chouhan, P., Ahmed, F., Ghosh, T., Mondal, S., Shahid, M., Fatima, S., & Tang, K. (2022). Overweight/Obesity Prevalence among Under-Five Children and Risk Factors in India: A Cross-Sectional Study Using the National Family Health Survey (2015–2016). Nutrients, 14(17). https://doi.org/10.3390/nu14173621.

- 16. L. S. Taillie, E. Busey, F. Mediano Stoltze, F.R. Dillman Carpentier (2019). Governmental policies to reduce unhealthy food marketing to children. Nutrition reviews vol.77(11):787-816. Doi: 10.1093/nutrit/nuz021.
- Egan, S., Fernandes, N. D., Kumar, V., Gardiner, M., & Thomas, T. (2014). Bacterial pathogens, virulence mechanism and host defence in marine macroalgae. *Environmental Microbiology*, 16(4), 925-938.
- D. B. Resnik. (2007). Responsibility for health: personal, social and environmental. Journal of Medical Ethics,2007:33:4444-445.https:// doi.org/10.1136/jme.2006.017574.
- Claude Marcus, Permilla Danielsson and Emilia Hagman. (2022). Pediatric obesity -Long term consequences and effect of weight loss. Journal of Internal Medicine: https:// doi.org/10.1111/joim.13547.
- 20. Trishnee Bhurosy and Rajesh Jeewon (2014). Overweight and obesity Epidemic in Developing Countries: A Problem with diet, physical activity, or socioeconomic status. The Scientific World Journal;volume 2014, Article:964236,7pages. https:// dx.doi.org/10.1155/2014/964236.
- 21. Khanna D, Peltzer C, Kahar P, Mayur S. P. (February 2011). Body Mass Index (BMI):
 A Screening tool Analysis. Cureus 14(2): e22119. https:// doi.org/10.7759/cureus.22119.
- 22. Steven L. Gortmaker, Aviva Must, James M. Perrin, Arthur M. Sobol and William H Dietz. Social and economic consequences of overnight in adolesecence and young adulthood. The new England journal of medicine, September 30,1993.
- 23. Isabelle Romieu, Laure Dossus, Simon Barquera, Herve M. Blottiere et al, 2017. Energy balanced and obesity: what are the main drivers. Cancer causes control (2017)
 28: 247-258. https:// doi.org/10.1007/s10552-017-0869-z.
- 24. Sunil Pathak, Prashant Modi, Urmil Labana, Priya Khimyani, Amruta Joshi, Riddhi Jadeja, and Meghavi Pandya (2018). Prevalence of Obesity among urban and rural school going adolescents of Vadodra, India: a comparative study. International Journal of Contemporary Pediatrics (Int J Contemp Pediatr.2018 Jul:5(4):1355-1359. pISSN2349-3283; eISSN 2349-3291. DOI: http://dx.doi.org/10.18203/2349.3291.ijcp20182480.
- 25. Sukanya Pati, Wadeed Irfan, Ahmad Jameel, Shahid Ahmed and Rabia K Shahid (2023). Obesity and Cancer: A Current Overview of Epidemiology, Pathogenesis,

Outcomes and Management. Cancers ,2023, 15,485. DOI: https:// doi.org/10.3390/cancers15020485.

- 26. Ghosh, A. (2020). Obesity in the Indian subcontinent: A review of the epidemiology, determinants, and control measures. Frontiers in Endocrinology, 11, 553.
- 27. Gupta, R., Guptha, S., Sharma, K. K., et al. (2019). Regional variations in cardiovascular risk factors in India: India Heart Watch. World Journal of Cardiology, 11(1), 1-10.
- 28. WHO. (2018). Obesity and overweight. World Health Organization Report.
- Kumar, S., & Mahabalaraju, D. K. (2018). Prevalence of obesity and its influencing factors among adolescents in urban Mysuru. Indian Journal of Public Health, 62(1), 42-46.
- 30. Lobstein, T., Jackson-Leach, R., Moodie, M. L., et al. (2015). Child and adolescent obesity: Part of a bigger picture. The Lancet, 385(9986), 2510-2520.
- 31. Misra, A., Sharma, R., Gulati, S., Joshi, S. R., et al. (2011). Consensus dietary guidelines for healthy living and prevention of obesity, the metabolic syndrome, diabetes, and related disorders in Asian Indians. Diabetes Technology & Therapeutics, 13(6), 683-694.
- 32. Reilly, J. J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. International Journal of Obesity, 35(7), 891-898.
- Bhutani, S., & Cooper, J. A. (2020). COVID-19–related home confinement in adults: Weight gain risks and opportunities. Obesity (Silver Spring, Md.), 28(9), 1576.
- 34. Booth, F. W., Roberts, C. K., & Laye, M. J. (2012). Lack of exercise is a major cause of chronic diseases. Comprehensive physiology, 2(2), 1143.
- 35. Chaput, J. P., Dutil, C., & Sampasa-Kanyinga, H. (2018). Sleeping hours: what is the ideal number and how does age impact this?. Nature and science of sleep, 421-430.
- Dinsa, G. D., Goryakin, Y., Fumagalli, E., & Suhrcke, M. (2012). Obesity and socioeconomic status in developing countries: a systematic review. Obesity reviews, 13(11), 1067-1079.
- 37. Elks, C. E., Den Hoed, M., Zhao, J. H., Sharp, S. J., Wareham, N. J., Loos, R. J., & Ong, K. K. (2012). Variability in the heritability of body mass index: a systematic review and meta-regression. Frontiers in endocrinology, 3, 29.
- Hruby, A., & Hu, F. B. (2015). The epidemiology of obesity: a big picture. Pharmacoeconomics, 33, 673-689.

- Llewellyn, C., & Wardle, J. (2015). Behavioral susceptibility to obesity: Gene– environment interplay in the development of weight. Physiology & behavior, 152, 494-501.
- 40. Malik, V. S., Willett, W. C., & Hu, F. B. (2013). Global obesity: trends, risk factors and policy implications. Nature reviews endocrinology, 9(1), 13-27.
- 41. Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., ... & Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The lancet, 384(9945), 766-781.
- 42. Patel, S. R., & Hu, F. B. (2008). Short sleep duration and weight gain: a systematic review. Obesity, 16(3), 643-653.
- 43. Romieu, I., Biessy, C., Carayol, M., His, M., Torres-Mejía, G., Ángeles-Llerenas, A., ... & Rinaldi, S. (2018). Reproductive factors and molecular subtypes of breast cancer among premenopausal women in Latin America: the PRECAMA study. *Scientific reports*, 8(1), 13109.
- 44. Popkin, B. M. (2017). Relationship between shifts in food system dynamics and acceleration of the global nutrition transition. Nutrition reviews, 75(2), 73-82.