



Assessing Food Environments in Economically Developing Nations: A Comprehensive Study of a Peri-Urban District in Pakistan and Implications for Global Nutrition Initiatives

Saira Ahsan

Government College University Lahore

*Correspondence: sairaahsan47@gmail.com

Citation | Ahsan, S, "Assessing Food Environments in Economically Developing Nations: A Comprehensive Study of a Peri-Urban District in Pakistan and Implications for Global Nutrition Initiatives", IJASD, Vol. 5 Issue. 2 pp 80-89, June 2023

Received | May 20, 2023, **Revised** | May 25, 2023, **Accepted** | June 10, 2023, **Published** | June 19, 2023.

The study addresses the growing significance of food environment research in Economically Developing Nations within the framework of the UN Decade of Action on Nutrition 2016–2025. Policymakers are increasingly focusing on the impact of food environments on diets, nutrition, and health, particularly considering the dual challenge of malnutrition. The concept of food environments encompasses external factors like food availability, pricing, vendor characteristics, and regulations, as well as individual-level factors such as accessibility, affordability, convenience, and desirability. The study explores the nutrition transition, characterized by shifts in diets and nutritional statuses influenced by globalization, urbanization, and economic expansion. The emergence of the "Double Burden of Malnutrition" highlights the challenges posed by increased malnutrition types. In South Asia, including Pakistan, the prevalence of this double burden has risen, further exacerbated by the ongoing COVID-19 pandemic. The study underscores the need to comprehend food environments to address malnutrition effectively. Despite modest progress in achieving Sustainable Development Goal. The study focuses on a peri-urban district in Pakistan, aiming to devise a survey instrument to evaluate the retail food environment comprehensively. It scrutinizes the availability, accessibility, and marketing approaches of food establishments categorized by village size (small, medium, and large) to uncover potential disparities and patterns. The research methodology includes a systematic scoping review and data collection from six electronic databases, covering 115 economically developing nations. Original peer-reviewed articles meeting inclusion criteria provide insights into the diverse economic contexts of food environments. The study delineates the key concepts, domains, and dimensions explored in these articles, emphasizing the predominance of the external food environment domain in research. A majority of studies adopt quantitative methods, with a focus on cross-sectional designs. In analyzing packaged goods brands, the study finds a prevalence of sugary drinks in village restaurants, with variations based on village size. Notable findings include positive correlations between fruit diversity and village size, suggesting potential pandemic-related disruptions in larger villages. The study underscores the importance of assessing village market access for a comprehensive understanding of the food supply chain. The findings contribute to the limited literature on external food settings in South Asia and highlight the need for inclusive measures for assessing external food environments. The study concludes by emphasizing the vital role of informal food sectors in reshaping food distribution and calls for regulatory measures to address the prevalence of unhealthy foods. It serves as a foundational resource for studying food environments in nearby nations, providing valuable insights for policymakers, researchers, and practitioners.

Keywords: Food Environments, Undernutrition, Village Market, Packaged Goods Brands, Economically Developing Nations.

Introduction:

Research on the food environment is gaining significance in economically developing nations with the initiation of the UN Decade of Action on Nutrition 2016–2025. Policymakers, aiming to address global food and nutrition security along with the dual challenge of malnutrition, are increasingly directing their focus toward the impact of food environments on diets, nutrition, and health in these regions [1]. The term "food environments" refers to the interface where individuals engage with the broader food system to obtain and consume food. Recent conceptual work has endeavored to define domains within external and personal food environments that are applicable on a global scale. The external domain encompasses external factors such as food availability, pricing, characteristics of vendors and products, as well as marketing and regulations. On the other hand, the personal domain involves individual-level factors like food accessibility, affordability, convenience, and desirability. A more comprehensive understanding of the interactions between these domains and dimensions is crucial to addressing the dual burden of malnutrition in low and middle-income countries. This burden is characterized by persistent undernutrition among women and children alongside the escalating prevalence of overweight, obesity, and nutrition-related chronic diseases [2].

The transformation observed in diets and nutritional statuses throughout the last century is commonly labeled as the "nutrition transition" [3]. The shift from rural to industrial food systems, influenced by globalization, urbanization, and economic expansion, has profoundly shaped dietary patterns. This transformation has led to the emergence of a dual challenge in the form of increased prevalence of various types of malnutrition, a phenomenon commonly termed the "Double Burden of Malnutrition" [4]. In 2017, a study on the Global Burden of Disease revealed that inadequate diets were associated with 255 million disability-adjusted life years and 11 million deaths [5]. In South Asia, there has been a notable rise in the prevalence of the Double Burden of Malnutrition in recent years, and it is anticipated that the ongoing COVID-19 pandemic will exacerbate this trend [6]. There is a widespread acknowledgment in the region that diets have become less diverse and more uniform, with a substantial portion of dietary energy now derived from affordable, easily accessible foods that are high in fat, salt, and sugar [7].

The Sustainable Development Goals Report 2021 indicates modest advancements in achieving Sustainable Development Goal (Good Health and Well-Being), though insufficient progress has been made overall to meet the goals. Regrettably, Pakistan is experiencing limited headway concerning SDG, which aims to eliminate hunger [8]. The assertion is reinforced by the findings of the 2018 National Nutrition Survey, indicating that malnutrition in all its forms is a pervasive issue among mothers, children, and teenagers in Pakistan. Comparable to other South Asian countries, Pakistan is experiencing a significant uptick in the prevalence of non-communicable diseases, attributed to factors such as its substantial aging population, swift urbanization, and lifestyle shifts promoting increased energy intake and reduced physical activity [9]. In 2020, the population endured a series of challenges, including heightened food costs, locust infestations, and exacerbated monsoon rains, all compounded by the impact of the COVID-19 pandemic [10]. Comprehending the settings where food is consumed is crucial for initiating efforts to tackle the Double Burden of Malnutrition. The term "food environment" encapsulates the complex interplay of sociocultural, political, economic, and physical factors that shape individuals' dietary preferences and overall nutritional well-being. These influences are interconnected and can emanate from both internal and external sources within an individual's surroundings [11]. In high-income countries like the US and Canada, standardized metrics and survey instruments are frequently used to evaluate the food environments in neighborhoods and around schools [12]. Many people consider the Nutrition Environment Measures Survey, which

has been widely adapted for use internationally, especially in China [13], to be one of the most frequently used assessment instruments. Data on the cost and availability of different food items specifically, those that support health are collected by the Nutrition Environment Measures Survey tools. They do not, however, take into consideration the subtle differences that are seen in casual shopping environments or the changing nutritional scene [14]. This has led to ongoing debate about a comprehensive and inclusive set of measures (objective and subjective) for assessing external food settings [15]. Micro, small, and medium-sized enterprises in the mainstream sector and unregistered mobile food vendors in the informal sector dominate the food business in economically developing nations [16]. Surprisingly, there is a dearth of research in South Asia that describes the external food settings at the market or retail level [17].

The primary focus of this study is twofold. Firstly, it aims to devise a novel survey instrument meticulously designed to evaluate the retail food environment within a peri-urban district in Pakistan. This instrument will take into account crucial factors influencing the food environment, contributing to a more comprehensive understanding of the local dynamics. Secondly, the study endeavors to scrutinize the availability, accessibility, and marketing approaches adopted by food establishments, categorizing them according to the size of the village namely, small, medium, and large. By examining these aspects across varying village sizes, the research aims to uncover potential disparities and patterns that can inform strategies for addressing and enhancing the food environment in the study area.

Methodology:

Systematic Scoping Review:

This study adopted a systematic scoping review methodology, recognized as an effective approach for synthesizing knowledge from a diverse body of literature that has not been previously reviewed. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, Extension for Scoping Reviews checklist and guidelines, ensuring a rigorous and replicable process. The protocol detailing the review process is available upon request from the corresponding author.

Data Collection:

A systematic search was conducted across six electronic databases, Medline, Embase, Global Health, EconLit, Web of Science, and Scopus, covering the period between June 2008 and April 2022. The search terms, including "food environment," "nutrition environment," "obesogenic environment," "food deserts," and "food swamps," were informed by a priori knowledge and aimed to encompass the breadth of nomenclature used in food environment research. The search strategy incorporated the 115 Economically Developing Nations as defined by the World Bank in 2017. No language restrictions were imposed, and the cutoff year of June 2008 was determined through scoping initial search results [18][19].

Inclusion Criteria:

Original peer-reviewed articles were considered for inclusion in this systematic scoping review if they satisfied the following criteria: Firstly, the articles had to incorporate at least one of the specified search terms, ensuring relevance to the focus on food environment research. Secondly, the studies were required to center their investigation on at least one low-income country, aligning with the scope of interest in understanding the dynamics of food environments in economically disadvantaged settings. Thirdly, the selected articles needed to either describe or assess the food environment or explore its associations with diets, nutrition status, or health outcomes, contributing valuable insights to the overarching research objectives.

Exclusion Criteria:

Conversely, articles were excluded from consideration if they met any of the following criteria: Firstly, studies that did not primarily assess the food environment or key concepts were excluded, ensuring a direct alignment with the research focus. Secondly, articles that did not feature at least one low- or middle-income country were excluded, maintaining the specific

geographic scope of interest. Thirdly, non-original peer-reviewed research articles were excluded from consideration, ensuring the inclusion of robust and validated scientific studies. Lastly, articles lacking sufficient evidence from a low- or middle-income country were excluded to uphold the integrity and relevance of the findings to economically challenged regions. These criteria were systematically applied to ensure the selection of studies that met the stringent requirements for inclusion in the systematic scoping review [20][21].

The study explores various facets of the food environment, encompassing factors such as the presence, pricing, accessibility, affordability, promotion, and regulatory framework governing fast-food establishments. Three primary aspects were emphasized: availability, accessibility, and environmental promotion of food. The evaluation of accessibility considered the types of food outlets, their operating hours, and their proximity to educational institutions. "Availability" denoted the presence of both healthy and unhealthy food and beverage items across diverse merchants. Promotion involves the utilization of branding, packaging, advertising, and food marketing to target specific audiences through various media channels.

Under the guidance of regional experts, a comprehensive set of indicators was incorporated to enable consistent and reliable assessments across different contexts and over time. Qualified enumerators were engaged by 90 restaurants to conduct a pretest of the original survey method in February 2020. The pretest identified several issues, including missing data, the need for language and content enhancements, and the exclusion of grains as a food category despite their widespread consumption. These variables were omitted due to the impracticality of collecting information on food safety and economic availability (e.g., food prices) during the pandemic. Additionally, considering market saturation, the decision was made to analyze only five food outlets in each category. Data from the pretest were not included in the final study [22][23][24].

Data Screening:

All records underwent independent screening by two authors based on eligibility criteria, including title and abstract screening followed by retrieval and screening of full-text articles. A screening protocol was piloted for consistency, and any disagreements were resolved through discussion.

Data Charting:

Data charting was conducted by two authors, focusing on study design, key concepts, food environment domains and dimensions, and exposure, confounding, and outcome variables. Methods were categorized as either geospatial or observational. The data charting form was piloted on a random sample of 12 articles and refined in consultation with a third reviewer.

Quality Assessment:

Articles examining associations between food environment exposure and dietary, nutrition, or health outcomes underwent quality assessment by two authors, utilizing the National Heart Lung and Blood Institute checklists or the Mixed-Methods Appraisal Tool as appropriate. Rigor in controlling for confounding was noted, and the quality was rated as good, fair, or poor. Discrepancies between reviewers were resolved through discussion.

Outcomes:

The studies incorporated in the analysis spanned 15 economically developing nations, providing a comprehensive overview of diverse economic contexts. A significant portion of the studies, comprising 72%, focused on upper-middle-income countries, while 24% included lower-middle-income countries. Interestingly, no studies were identified in low-income countries. A subset of studies, constituting 4%, involved multiple countries from different income quartiles, with two studies drawing comparisons between upper-middle-income countries and high-income countries, and one study comparing a lower-middle-income country with a high-income country.

At the regional level, Latin America and the Caribbean emerged as the most studied regions, contributing 29 publications, followed by East Asia and the Pacific with 15 publications, Sub-Saharan Africa with 10, South Asia with 3, and Europe and Central Asia with 5. Despite Sub-Saharan Africa ranking third on the regional scale, South Africa played a dominant role, accounting for a significant proportion of the studies, while only four studies originated from other regions within Sub-Saharan Africa. Nationally, 4 economically developing nations were particularly well-represented, each featuring more than two studies. These countries included Brazil, China, Mexico, South Africa, India, and Guatemala, highlighting the variability and depth of research focus across different geographical and economic contexts.



Figure 1: The Geographic Distribution of Included Articles across Low and Middle Income Countries [13].

In delineating the conceptualization of food environments in economically developing nations, sixty studies utilized individual key concepts from search terms, encompassing "food environment", "obesogenic environment", "food desert", and "nutrition environment". A noteworthy observation is that only 37% of the articles provided explicit definitions for the key concepts applied, with a majority referring to existing definitions, while a smaller fraction proposed their own interpretations.

An exploration into the key domains and dimensions of food environments in economically developing nations revealed a predominant emphasis on the external food environment domain. This encompassed dimensions such as availability, vendor and product properties, prices, and marketing and regulation. In contrast, the personal food environment domain received comparatively less attention, exploring dimensions such as accessibility, desirability, convenience, and affordability. Although a significant majority of studies (63%) incorporated multiple dimensions of the food environment, approximately half (47%) specifically addressed aspects from both the external and personal food environment domains. Among these, a third (33%) exclusively focused on the combination of availability and accessibility, the two most frequently studied dimensions from each respective domain. Despite an overall acknowledgment of both external and personal food environment domains, only a limited number of articles delved into the analysis of interactions between dimensions within or across these domains.

Regarding the employed study designs, methods, and measures in economically developing nations, a predominant 64% of articles utilized quantitative methods. Within this category, 87% featured cross-sectional study designs, with a minority utilizing longitudinal data, experimental designs, or modeling approaches. Quantitative articles employed diverse

measurement methods, encompassing market-based, stakeholder-based, and geographic information systems-based measures. Conversely, 24% of articles employed qualitative stakeholder-based methods, predominantly relying on single methods such as semi-structured interviews, in-depth interviews, focus group discussions, and stakeholder workshops. A smaller yet noteworthy fraction (11%) of articles incorporated mixed methods, combining stakeholder-based, market-based, and geographic information systems-based approaches in varying configurations.

Promoting and Advertising Goods and Services:

We conducted an extensive analysis of various packaged goods brands with potential health risks. Surprisingly, nearly 15% of all restaurants in the villages included in the study offered sugary drinks, with Pepsi and Mountain Dew emerging as the most popular choices. Intriguingly, statistically significant variations in beverage availability were observed based on the size of the village ($p < 0.001$ for Pepsi and $p = 0.004$ for Mountain Dew) (Supplementary). This study represents a pioneering effort to characterize the retail food environments in a Sindhi peri-urban neighborhood. Despite the original intent for data collection predating the pandemic, the presence of a diverse array of both healthy and unhealthy food options, correlated with the size of the village. However, it is crucial to acknowledge that our research lacks conclusive evidence to firmly ascertain the extent of COVID-19-related disruptions in food ecosystems. Additionally, there is a noticeable lack of comparable pre-pandemic data, posing challenges to evaluating the true impact of the pandemic on the region's food landscape.

Noteworthy findings include a positive correlation between the diversity of fruits and the size of the hamlet, while no such relationship was observed with vegetables. Except for fruits, larger communities exhibited better access to a wider variety of food products. This raises the possibility that global supply and demand shocks induced by the pandemic may have disproportionately affected the availability of fruits in larger villages, given their longer food value chains compared to smaller villages. Furthermore, the easy accessibility of popular, highly processed packaged foods and fast food across villages of all sizes in our peri-urban area suggests a contemporary shift in food supply chains, supplementing traditional markets and catering to both national and regional markets, particularly those in urban areas. Despite potential precedents, the authors emphasize the importance of assessing village market access in future studies to gain a comprehensive understanding of the food supply chain [25][26][27].

During COVID-19, the World Food Program performed nation-level case studies on urban food systems in eight cities in Asia and the Pacific, including Cox's Bazar, Bangladesh; Peshawar, Pakistan; and Kabul, Afghanistan. Our conclusions are supported by the information presented in these case studies [28]. To comprehend the resilience of food ecosystems in rural and peri-urban areas, which is the primary focus of the study and its implications for food supply and availability, two crucial aspects have been identified. Metropolitan areas, given their length and complexity, have exhibited a heightened vulnerability to disruptions in the food supply chain compared to rural areas. Additionally, a significant portion of cities display high absorptive capacity but lack resilience. The confluence of escalating food costs and diminishing incomes has adversely affected the affordability of food for the urban poor. Notably, the majority of those impacted comprise daily wage workers and individuals employed in the unorganized sector, who, due to their reluctance to engage in social welfare programs, face pronounced challenges [29].

Similar to their influence in other South Asian nations, the unorganized food sector and micro, small, and medium-sized companies in Pakistan's agrifood system have drastically changed the distribution, processing, and wholesaling of food [30]. Moreover, it has been demonstrated as imperative for upholding food security amid the challenges posed by the COVID-19 pandemic. In the present study, corner stores played a pivotal role as primary suppliers of a diverse array of ultra-processed packaged goods while concurrently serving as

convenient hubs offering a broad selection of fresh produce and essential food items. The proximity of many convenience stores to schools in larger communities hints at potential implications for forthcoming legislative endeavors. Additionally, our investigation revealed that mobile food vendors predominantly operated in smaller and mid-sized towns, specializing in vending fresh produce like fruits, vegetables, root vegetables, and fast food. Throughout the epidemic, these mobile vendors may have strategically relocated within their respective areas to capitalize on business opportunities, potentially expanding the range of food items to meet consumer demands. Moreover, data suggests that during economic downturns, the informal sector tends to burgeon, becoming a crucial lifeline for maintaining food security when formal employment prospects and purchasing power decline. Recognizing street sellers as catalysts for change, it is imperative for governments and other stakeholders in the food sector to foster an environment that empowers and enhances food systems. Despite the fact that 42% of Pakistan's labor force is engaged in agriculture, the country grapples with a dangerously high 36.9% food insecurity rate [31].

In response to the pandemic, the Pakistani government initiated the Ehsaas Emergency Cash Program in April 2020. The program aimed to alleviate financial strain on economically disadvantaged and vulnerable groups while ensuring access to essential food supplies and augmenting healthcare expenditures to some extent. Fines were imposed by federal and provincial governments on businesses engaging in price gouging and stockpiling. Efforts were also made to ensure that food sales were not hindered during lockdowns, discouraging impulsive food purchases by consumers. Research indicates that isolated shutdowns and disruptions negatively impacted agricultural output, influencing the overall food supply. Empirical data from the Asian Development Bank reveals adverse effects on farm communities in Pakistan's Sindh province, including a decline in the market for perishable commodities and an increase in the cost of agricultural inputs, particularly seeds. Additionally, the kharif season from June to November saw challenges such as locust infestation and crop devastation. Market research conducted by the Global Alliance for Improved Nutrition in Peshawar, Pakistan, in December 2020–January 2021 revealed a drop in sales for food vendors during the pandemic. To stimulate sales or expand their customer base, 40% of suppliers employed marketing techniques such as extra discounts, promotions, and credit purchases.

This report raises several issues, primarily related to the survey methodology. The cross-sectional design of this study limits the ability to draw conclusions about causality. Furthermore, a lack of trustworthy and validated sources relevant to Pakistan and the target audience is evident. Pretests on the survey instruments and consultations with local specialists were crucial to ensuring the survey's effectiveness. Adjustments to the study design were made due to the pandemic's effects, and data on the food environment were collected during the COVID-19 outbreak, making it challenging to compare with pre-pandemic conditions or assess differences across rural, peri-urban, and metropolitan areas. The analysis was also restricted to a limited set of variables related to food advertising and accessibility due to modifications in the study's design. Social and economic factors, as well as the influence of social media and other marketing channels on consumer behavior, were not comprehensively addressed. Future research should employ diverse techniques to provide a comprehensive account of food ecosystems in Pakistan, including new quantitative indicators and qualitative research to evaluate complex and dynamic interactions. Improved survey instruments should be validated for precision and uniformity, supporting targeted public health policies [32].

The global COVID-19 pandemic underscored the vulnerability of national, regional, and local food systems and the challenges in ensuring sufficient food acquisition, storage, and preservation of public health and nutrition during crises. The study highlighted the essential role played by corner stores and mobile food vendors in providing food to communities of different sizes during the pandemic, offering both unhealthy and nutritious eating options. Governments

and food system stakeholders must implement regulations that encourage the distribution of nutrient-rich foods through the informal sector and micro, small, and medium-sized enterprises to create favorable conditions. Incorporating these goods into social protection schemes in retail food settings can ensure food security and target socioeconomically disadvantaged demographic groups. Additionally, the study revealed that peri-urban food contexts offer a wide selection of heavily processed, commercially marketed foods and drinks. These findings suggest the need for regulations governing the production, promotion, and distribution of unhealthy foods to reduce the incidence of double-burden malnutrition and non-communicable diseases. The study, focusing on peri-urban food situations in a lower-middle-income country, employed rigorous sampling and a culturally sensitive questionnaire to produce valuable scientific data. This research serves as a foundational resource for studying the food environments of nearby nations.

References:

- [1] A. Afshin et al., “Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017,” *Lancet*, vol. 393, no. 10184, pp. 1958–1972, May 2019, doi: 10.1016/S0140-6736(19)30041-8.
- [2] “Characterizing Retail Food Environments in Peri-Urban Pakistan during the COVID-19 Pandemic - PubMed.” Accessed: Feb. 16, 2024. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/35886466/>
- [3] E. Workie, J. Mackolil, J. Nyika, and S. Ramadas, “Deciphering the impact of COVID-19 pandemic on food security, agriculture, and livelihoods: A review of the evidence from developing countries,” *Curr. Res. Environ. Sustain.*, vol. 2, p. 100014, Dec. 2020, doi: 10.1016/J.CRSUST.2020.100014.
- [4] T. Reardon, L. S. O. Liverpool-Tasie, and B. Minten, “Quiet Revolution by SMEs in the midstream of value chains in developing regions: wholesale markets, wholesalers, logistics, and processing,” *Food Secur.*, vol. 13, no. 6, pp. 1577–1594, Dec. 2021, doi: 10.1007/S12571-021-01224-1/TABLES/1.
- [5] A. Drewnowski and B. M. Popkin, “The Nutrition Transition: New Trends in the Global Diet,” *Nutr. Rev.*, vol. 55, no. 2, pp. 31–43, Feb. 1997, doi: 10.1111/J.1753-4887.1997.TB01593.X.
- [6] D. Headey et al., “Impacts of COVID-19 on childhood malnutrition and nutrition-related mortality,” *Lancet*, vol. 396, no. 10250, pp. 519–521, Aug. 2020, doi: 10.1016/S0140-6736(20)31647-0.
- [7] A. Mustafa, M. Zulfiqar, B. Anam Ali, and L. Naseem, “Frequency of β -Thalassemia Trait among Pregnant Women Presenting at Pakistan Institute of Medical Sciences,” *Natl. J. Heal. Sci.*, vol. 3, pp. 118–121, 2018, doi: 10.21089/njhs.34.0118.
- [8] C. Schuftan, “Commentary on CFS50, FAO Committee on Food Security,” *World Nutr.*, vol. 13, no. 4, pp. 90–91, Dec. 2022, doi: 10.26596/WN.202213490-91.
- [9] C. Turner et al., “Concepts and critical perspectives for food environment research: A global framework with implications for action in low- and middle-income countries,” *Glob. Food Sec.*, vol. 18, pp. 93–101, Sep. 2018, doi: 10.1016/J.GFS.2018.08.003.
- [10] R. A. McKinnon, J. Reedy, M. A. Morrissette, L. A. Lytle, and A. L. Yaroch, “Measures of the Food Environment: A Compilation of the Literature, 1990–2007,” *Am. J. Prev. Med.*, vol. 36, no. 4, pp. S124–S133, Apr. 2009, doi: 10.1016/J.AMEPRE.2009.01.012.
- [11] K. Glanz, J. F. Sallis, B. E. Saelens, and L. D. Frank, “Nutrition Environment Measures Survey in Stores (NEMS-S). Development and Evaluation,” *Am. J. Prev. Med.*, vol. 32, no. 4, pp. 282–289, Apr. 2007, doi: 10.1016/j.amepre.2006.12.019.
- [12] B. Carducci et al., “Gaps and priorities in assessment of food environments for children and adolescents in low- and middle-income countries,” *Nat. Food* 2021 26, vol. 2, no. 6, pp. 396–403, Jun. 2021, doi: 10.1038/s43016-021-00299-5.
- [13] C. Turner, S. Kalamatianou, A. Drewnowski, B. Kulkarni, S. Kinra, and S. Kadiyala,

- “Food Environment Research in Low- and Middle-Income Countries: A Systematic Scoping Review,” *Adv. Nutr.*, vol. 11, no. 2, pp. 387–397, Mar. 2020, doi: 10.1093/ADVANCES/NMZ031.
- [14] “View of Agriculture Sector in Pakistan (A Historic Analysis).” Accessed: Feb. 22, 2024. [Online]. Available: <https://journal.50sea.com/index.php/IJASD/article/view/428/509>
- [15] Y. Liu et al., “Adaptation and Validation of the Chinese Version of the Nutrition Environment Measurement Tool for Stores,” *Int. J. Environ. Res. Public Heal.* 2019, Vol. 16, Page 782, vol. 16, no. 5, p. 782, Mar. 2019, doi: 10.3390/IJERPH16050782.
- [16] P. A. Martins, E. C. Cremm, F. H. M. Leite, L. R. Maron, F. B. Scagliusi, and M. A. Oliveira, “Validation of an adapted version of the nutrition environment measurement tool for stores (NEMS-S) in an Urban Area of Brazil,” *J. Nutr. Educ. Behav.*, vol. 45, no. 6, pp. 785–792, Nov. 2013, doi: 10.1016/j.jneb.2013.02.010.
- [17] J. A. B. Baxter, Y. Wasan, A. Hussain, S. B. Soofi, I. Ahmed, and Z. A. Bhutta, “Characterizing micronutrient status and risk factors among late adolescent and young women in rural Pakistan: A cross-sectional assessment of the mapps trial,” *Nutrients*, vol. 13, no. 4, p. 1237, Apr. 2021, doi: 10.3390/NU13041237/S1.
- [18] R. Nandi, S. Nedumaran, and P. Ravula, “The interplay between food market access and farm household dietary diversity in low and middle income countries: A systematic review of literature,” *Glob. Food Sec.*, vol. 28, p. 100484, Mar. 2021, doi: 10.1016/J.GFS.2020.100484.
- [19] B. Carducci, E. C. Keats, M. Ruel, L. Haddad, S. J. M. Osendarp, and Z. A. Bhutta, “Food systems, diets and nutrition in the wake of COVID-19,” *Nat. Food* 2021 22, vol. 2, no. 2, pp. 68–70, Feb. 2021, doi: 10.1038/s43016-021-00233-9.
- [20] B. M. Popkin, “Nutrition, agriculture and the global food system in low and middle income countries,” *Food Policy*, vol. 47, pp. 91–96, Aug. 2014, doi: 10.1016/J.FOODPOL.2014.05.001.
- [21] J. Sachs, G. Schmidt-Traub, C. Kroll, G. Lafortune, G. Fuller, and F. Woelm, “Sustainable Development Report 2020: The Sustainable Development Goals and Covid-19 Includes the SDG Index and Dashboards,” *Sustain. Dev. Rep.* 2020, Jun. 2021, doi: 10.1017/9781108992411.
- [22] S. N. Wulan et al., “Energy Metabolism in Relation to Diet and Physical Activity: A South Asian Perspective,” *Nutr.* 2021, Vol. 13, Page 3776, vol. 13, no. 11, p. 3776, Oct. 2021, doi: 10.3390/NU13113776.
- [23] B. Kelly et al., “Monitoring food and non-alcoholic beverage promotions to children,” *Obes. Rev.*, vol. 14, no. S1, pp. 59–69, Oct. 2013, doi: 10.1111/OBR.12076/SUPPINFO.
- [24] L. A. Lytle and R. L. Sokol, “Measures of the food environment: A systematic review of the field, 2007–2015,” *Health Place*, vol. 44, pp. 18–34, Mar. 2017, doi: 10.1016/J.HEALTHPLACE.2016.12.007.
- [25] H. Charreire et al., “Measuring the food environment using geographical information systems: a methodological review,” *Public Health Nutr.*, vol. 13, no. 11, pp. 1773–1785, Nov. 2010, doi: 10.1017/S1368980010000753.
- [26] K. Glanz, J. F. Sallis, B. E. Saelens, and L. D. Frank, “Healthy nutrition environments: Concepts and measures,” *Am. J. Heal. Promot.*, vol. 19, no. 5, pp. 330–333, May 2005, doi: 10.4278/0890-1171-19.5.330/ASSET/0890-1171-19.5.330.FP.PNG_V03.
- [27] S. K. Mistry and S. Puthussery, “Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence,” *Public Health*, vol. 129, no. 3, pp. 200–209, Mar. 2015, doi: 10.1016/J.PUHE.2014.12.004.
- [28] D. Toure, A. Herforth, G. H. Pelto, L. M. Neufeld, and M. N. N. Mbuya, “An Emergent

- Framework of the Market Food Environment in Low- And Middle-Income Countries,” *Curr. Dev. Nutr.*, vol. 5, no. 4, Apr. 2021, doi: 10.1093/cdn/nzab023.
- [29] F. Golfin, C. Murillo, M. L. Jensen, and E. A. Frongillo, “Adaptation and Validation of the Nutrition Environment Measures Survey in Stores (NEMS-S) in Costa Rica,” *J. Hunger Environ. Nutr.*, Jun. 2022, doi: 10.1080/19320248.2022.2088262.
- [30] S. M. Downs, S. Ahmed, J. Fanzo, and A. Herforth, “Food Environment Typology: Advancing an Expanded Definition, Framework, and Methodological Approach for Improved Characterization of Wild, Cultivated, and Built Food Environments toward Sustainable Diets,” *Foods* 2020, Vol. 9, Page 532, vol. 9, no. 4, p. 532, Apr. 2020, doi: 10.3390/FOODS9040532.
- [31] T. Lobstein and S. Davies, “Defining and labelling ‘healthy’ and ‘unhealthy’ food,” *Public Health Nutr.*, vol. 12, no. 3, pp. 331–340, Mar. 2009, doi: 10.1017/S1368980008002541.
- [32] R. G. Russo et al., “Assessing changes in the food retail environment during the COVID-19 pandemic: opportunities, challenges, and lessons learned,” *BMC Public Health*, vol. 22, no. 1, Dec. 2022, doi: 10.1186/s12889-022-12890-x.



Copyright © by authors and 50Sea. This work is licensed under Creative Commons Attribution 4.0 International License.