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EDITED BY

Ke Yin,
Nanjing Forestry University, China

REVIEWED BY

Seda Yıldırım,
Namik Kemal University, Türkiye
İşıl Demirtaş,
Giresun University, Türkiye

*CORRESPONDENCE

Ann Trevenen-Jones
✉ atrevenenjones@gainhealth.org

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Wet markets in Southeast Asia and access to healthy diets

Margot Hofman¹ and Ann Trevenen-Jones^{2*}

¹Leiden University College, Faculty of Governance and Global Affairs, Leiden University, The Hague, Netherlands, ²Global Alliance for Improved Nutrition (GAIN), Food Systems Governance Programme, Utrecht, Netherlands

Hunger and malnutrition in all forms continues to rise in Africa and Asia. Urban and rural communities' diets in Southeast Asia (SEA) are increasingly unhealthy, with consumption influenced by affordability and convenience. The cost of a healthy diet is a major barrier to accessing healthy foods in SEA. Wet markets are key places in food environments where people buy and sell a variety of foods. They are especially important for food and nutrition insecure communities. This mini narrative review explores the role that wet markets, in SEA food environments, play in providing local communities with access to healthy foods. Fourteen peer-review papers, published in English between 2017 and 2022, were identified during screening and analysed according to six food environment domains. Findings highlight that convenient access to wet markets facilitates access to fruits and vegetables in peri urban and urban areas. Fresh foods, most notably fruits, were viewed as being more expensive than processed foods which in turn influenced purchasing behavior. Divergent findings were presented in the identified papers regarding affordability of food in wet markets. Concerns about food quality and the use of chemicals and pesticides were raised. This review was constrained by several factors including the lack of consistent and meaningful definitions and typologies of the varied forms of wet markets. Looking ahead, better defined interpretations of wet markets can enhance the development and refinement of appropriate policies and actions and comparison of wet markets, in respect of access to diverse, healthy foods, vendor practices and consumer food choices.

KEYWORDS

Southeast Asia, markets, nutrition, food security, malnutrition, food environment

1 Introduction

Sustainable Development Goal 2 underscores the global commitment to ending hunger and malnutrition, in all forms, for all people, by 2030 (FAO et al., 2020). While the number of people suffering from hunger has plateaued globally, hunger and varying levels of food insecurity continue to rise in some regions, like Africa and Asia (FAO et al., 2022). About 2.4 billion people, most of whom were women and rural residents, lacked regular access to safe, nutritious, sufficient food in 2022; and child malnutrition continues to be "alarmingly high" (FAO et al., 2023). Globalization and urbanization are recognized as significant drivers of food and nutrition (in) security, including within local urban–rural continuums where processed and convenience foods, often high in fats, sugars, and salt, are increasingly consumed (FAO et al., 2023). This is evident, in Southeast Asian countries like Indonesia and Vietnam where diets are rapidly transitioning from more cultural forms rich in cereals and plant-based foods alongside utilization practices like steaming to

‘Western’ diets high in sugar, fat, animal sourced products, and highly processed foods (Colozza and Avendano, 2019; Harris et al., 2020).

The WHO defines a healthy diet as one that is balanced, diverse and consistently-and as relevant to life phase-provides for people’s energy and nutritional needs from a combination of macronutrients and micronutrients (FAO et al., 2020). Notably, such healthy diets are low in saturated fats and salt and should include almost half a kilogram of fruits and vegetables per day with attention to cultural preferences (FAO et al., 2020). A distorted nutrient intake or inadequate utilization of nutrition can lead to malnutrition (WHO, 2024). Malnutrition exists in multiple forms; overweight/obesity, micronutrient deficiencies (hidden hunger), and undernutrition which includes stunting and wasting (Caron et al., 2023). Numerous countries face challenges with multiple co-existing forms of malnutrition within the population – often referred to as the double or triple burden of malnutrition, with an associated rise in non-communicable diseases like diabetes (Turner et al., 2020; Caron et al., 2023). Southeast Asia is facing the growing public health consequences of this burden (Farrell et al., 2021).

Worldwide, the cost of a healthy diet is a leading barrier to accessing healthy foods that can support people’s nutritional well-being. In Southeastern Asia, the cost of a healthy diet in 2021 was approximately USD 4.20 per person per day, well above the World Bank’s defined international poverty line of USD 2.15 per person per day, and outside the reach of 55% of this region’s population (FAO et al., 2023). For the purposes of this paper, the focus region of Southeast Asia comprises the following countries: Indonesia, Malaysia, Philippines, Timor-Leste, Cambodia, Laos, Myanmar, Thailand, Vietnam, Singapore, and Brunei. This includes all ten members of the Association of Southeast Asian Nations, and the prospective 11th member, Timor-Leste (The ASEAN Secretariat, 2022). Little data is available for Timor-Leste. Data for 2021, as presented in the 2023 State of the Food Security and Nutrition Report, highlights six of the 10 Southeastern Asian countries as having healthy diets above the cost of aforementioned regional average. Regionally, Indonesia with 71% of the population being unable to afford a healthy diet, is the country with the most expensive healthy diets, i.e., USD 4.70 per person per day. While the cost of a healthy diet is marginally less expensive than compared to Indonesia, Laos, Myanmar, and the Philippines, respectively have 75, 71 and 70% of country populations unable to afford a healthy diet (FAO et al., 2020).

Formal and traditional or informal food markets play a crucial role in food security and nutrition because they are places that connect rural and urban communities through the buying, selling and talking about food (Carrara et al., 2022). This is especially so in the informal food markets with respect to those vulnerable to food and nutrition insecurity, like poor urban residents in low- and middle-income countries (LMICs), frequent as a primary means of selling and accessing food (Tefft et al., 2017). A wide variety of these markets exist alongside multiple definitions and terminology. This paper will use the term wet markets. In Asia traditional food markets are referred to as ‘wet markets’ because of the routine washing of floors, cleaning stalls, and managing of ice that is used to keep some food fresh (Zhong et al., 2020). In many east and Southeast Asian countries, urban and rural wet markets comprise a selection of local, independent small-scale vendors, who operate in semi open complexes with narrow aisles, selling predominately fresh produce, like fruits and vegetables, and/or

wild-caught wildlife, other agricultural and/or seafood products (Zhong et al., 2020; Lin et al., 2021; Davies et al., 2022).

Food environments located within the wider High Level Panel of Experts on Food Security and Nutrition (HLPE, 2017) structured food system framework offer a strategic entry point to understanding and more inclusively and sustainably reshaping where and how people sell, buy, prepare, consume and even waste food; especially in LMICs where diets are rapidly becoming less healthy and face an increasing double burden of malnutrition (Downs et al., 2020; Turner et al., 2020). They are the: “consumer interface with the food system that encompasses the availability, affordability, convenience, promotion, and quality, and sustainability of foods and beverages in [...] spaces that are influenced by the socio-cultural and political environment and ecosystems within which they are embedded” (Downs et al., 2020, 5). Broadly speaking this is where people access food including those which support healthy diets. The domains are defined in Table 1. While a uniform definition thereof has yet to be established, the food environment offers a useful theoretical framework for research on determinants of food intake and nutrition (Toure et al., 2021).

A comprehensive review of the current food environment evidence is lacking (Turner et al., 2020). The authors initial exploratory study of the literature, as part of formulating the research question, further supported this assessment with the additional finding that little was available on wet food markets as part of food environments in Southeast Asia and their role in access to healthy diets.

2 Methods

This study aims to better understand the role of wet markets in providing access to foods that can support a healthy diet, in Southeast Asia in the format of a mini narrative review (Ferrari, 2015). A systematic search of peer reviewed and gray literature via four databases, namely PubMed, Embase, Web of Science, and Science Direct, was conducted between December 2022 and May 2023. This literature search was further enhanced using an adapted Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework which is presented in Appendix 1 (Page et al., 2021). Papers published in English between 2017 and 2022 were

TABLE 1 Food environment domains as defined by Downs et al. (2020).

Domain	Definition
Convenience	Time cost of obtaining, preparing, and consuming a food item
Affordability	The prices of food items relative to other foods or to a defined income standard
Availability	Whether a food item is present within a given physical range
Quality	External characteristics of food including its freshness, integrity, safety, nutrient and phytochemical profiles, objective sensory attributes
Promotion	How a food item is presented, marketed, promoted, and front-of-pack labeling which is designed to influence the desirability of food
Sustainability	The environmental and social impact associated with the food item

included. Language is acknowledged as a study limitation, recognizing that papers in this region could have been published in several country specific local languages. Even though papers exist on COVID-19 and wet markets, especially emphasizing public health and food safety, these were not selected for within this mini-review.

Additional inclusion criteria were any Southeast Asian countries that featured data on access to nutritious foods through wet markets and/or the linkage between markets and any form of malnutrition. Furthermore, forward snowballing in Google Scholar and backward snowballing was conducted. In forward snowballing citations from identified papers that link to papers that can offer further insights into the research question are used. Backward snowballing relies on selecting further papers which may be of interest based on a review of an identified paper's reference list (Wohlin, 2014). Applying the same inclusion criteria, gray literature was selected using Google Scholar and ProQuest. Given time constraints, and attentive to existing practice, only the first 50 results were screened. Review articles were excluded. Papers were also excluded if they did not differentiate between formal markets and wet markets and/or had insufficient explicit focus on wet markets and nutrition.

The key terms "wet market," "malnutrition," and "Southeast Asia" form the basis for the search strategy. After an initial scoping of literature, the following search string was composed:

("Southeast* Asia*" OR "South east* Asia*" OR "Indonesia*" OR "Malaysia" OR "Philippines" OR "Timor-Leste" OR "East Timor" OR "Cambodia*" OR "Laos" OR "Myanmar" OR "Thai*" OR "Vietnam*" OR "Viet Nam" OR "Singapore*" OR "Brunei") AND ("traditional market" OR "local market" OR "wet market" OR "open-air market" OR "open air market" OR "informal market" OR "market") AND ("nutrition" OR "malnutrition" OR "undernutrition" OR "stunting" OR "wasting" OR "micronutrient deficiency" OR "overweight" OR "obesity")

Citations of peer-reviewed articles were exported to Rayyan (alternative to excel spreadsheet) for title and abstract screening. For full text review, the following data was extracted: author(s), year of publication, study location, research design, study population, sample size, the conceptualization of wet markets, measure of malnutrition, summary of findings, and results related to each domain of the food environment, i.e., convenience, affordability, availability, quality, promotion, and sustainability. The Quality Appraisal for Diverse Studies (QuADS) was used to assess the quality of included papers (Harrison et al., 2021). This tool is designed to conduct an integrated assessment of studies with diverse designs within health sciences research. Each study is awarded a score out of 39, composed of 13 methodological components with four categories of quality.

3 Findings

3.1 Selection and characteristics

After searching the databases Web of Science, PubMed, Embase, and CAB, 1,429 articles were identified. The search of ProQuest and Google Scholar initially yielded 2,320 results. No relevant papers were identified with the screening of the first 50 results. Snowballing led to the identification of 4 sources. In total, 14 papers were included. See Appendix 1 for the selection process.

The characteristics of the included papers are presented in Table 2. The quality of the studies is moderate-high, with a mean score of 27.4 and a median of 27 out of 39. The geographical distribution of the studies is as follows; Vietnam (7), Indonesia (2), Cambodia (2), Thailand (2), Myanmar (1). Ten studies were urban-focused, five peri-urban, and five rural. Six studies had a comparative character as they focused on multiple settings. Most study populations were adult (13) and focused on females (10). The methodological approach varied. Six articles were quantitative in nature, five articles were mixed methods, and three were solely qualitative.

Studies used different definitions, indicators, and tools to assess diets and nutrition. Half of the studies focused on food consumption patterns, habits, or behavior. Three studies focused on dietary diversity, one on micronutrient intake, and two specifically on undernutrition. Data collection tools included questionnaires, 24-h dietary recall data, in-depth interviews, and focus groups to assess nutrition and the market experiences.

3.2 Main findings

The importance of wet markets as the primary source of food for local communities in Southeast Asia was highlighted in most identified studies, for rural, peri-urban, and urban settings (Downs et al., 2019; Sang-ngoen et al., 2019; Wertheim-Heck and Raneri, 2019, 2020; Bell et al., 2021; Nguyen et al., 2021; Duong et al., 2022). The value and challenges of these markets in providing access to healthy diets, as per the literature, are presented in the sections below, according to the food environment domains: convenience, affordability, availability, quality, promotion, and sustainability.

3.2.1 Convenience

Nine studies focused on convenience of wet markets within local food environments. Shopping at wet markets and consuming fruits and vegetables was enabled by easy access to wet markets in several peri- and urban Vietnamese studies (Wertheim-Heck and Raneri, 2019, 2020; Bell et al., 2021; De Filippo et al., 2021). Shopping at wet markets was often seen as convenient, with the opening hours in line with their routine and a quicker shopping trip, which made it more preferable than shopping at modern retail outlets (Wertheim-Heck and Raneri, 2020). However, cooking (utilization) with produce from wet markets was viewed as more labor intensive, which made some women in urban areas of Indonesia preference the purchase of fast-food options (Sufyan et al., 2019).

Nguyen et al. (2021) reported significant differences in the average distance to markets in rural vs. peri-urban settings, 9.3 km versus 1.2 km, respectively. Brown et al. (2022) also reported financial constraints hindered women getting to the markets in peri-urban settings. Despite the aforementioned studies indicating an influence of convenience on food purchasing behavior at markets, physical proximity to the wet markets could not be statistically linked to dietary diversity or quality (Wertheim-Heck and Raneri, 2019; Mehraban and Ickowitz, 2021).

A few papers showed that having access to wet markets - of which convenience is a key part - can potentially improve nutritional outcomes. However, no direct relationship was proven. Duong et al. (2022) demonstrated that close proximity to local wet markets was associated with a reported higher nutrient-rich food consumption for mothers and children in peri-urban Cambodia. Additionally, market

TABLE 2 Characteristics of included studies.

Authors (year)	Study location	Study setting	Methods	Study population	Sample size	Conception of wet markets	Outcome measure	Summary of findings	Quality appraisal score ¹
Bell et al. (2021)	Vietnam	Peri-urban	Mixed methods (survey and focus group)	Women of reproductive age (18–49)	<i>n</i> = 264 (survey) and <i>n</i> = 40 (focus group)	Unclear ²	Drivers of food choice	Wet markets continue to be the main source of food. Quality of food is the most important driver of food choice, but women are faced with trade-offs between safety, nutrition, price, and convenience.	30
Brown et al. (2022)	Cambodia	Urban and peri-urban	Qualitative (cross-sectional survey and interviews)	Female primary caregivers	<i>n</i> = 26	Informal wet markets: mostly purchase of fruits, vegetables, and animal-source food products in open-air	Nutritional habits	Women face boundaries in accessing healthy foods, including the market, due to the cost of accessing the market and safety concerns	26
De Filippo et al. (2021)	Vietnam	Urban and peri-urban	Mixed methods (interview)	Adults from low-income households	<i>n</i> = 96	Unclear	Fruit and vegetable consumption	Market access is a significant determinant of fruit and vegetable consumption. Other determinants include family habits, perceived benefits, and action efficacy.	26
Downs et al. (2019)	Myanmar	Urban and rural	Mixed methods (focus group, market census, and survey)	Women (focus group) and market consumers (survey)	<i>n</i> = 32 (focus group), <i>n</i> = 20 (market census) and <i>n</i> = 400 (survey)	Unclear	Food consumption pattern	Food availability at markets has increased but the quality of food decreased over time. Physical proximity was not a barrier, but perceived availability and affordability were.	27
Duong et al. (2022)	Cambodia	Peri-urban	Quantitative (cross-sectional survey)	Women with children aged 6–24 months	<i>n</i> = 198	Unclear	Dietary diversity	Wet markets are the main source of food for the respondents. Perceived food access was significantly associated with nutrient-rich food consumption of mothers and children.	24
Genova et al. (2022)	Vietnam	Rural	Quantitative (cross-sectional household survey)	Children aged 6–60 months	<i>n</i> = 234	Local market in the village /commune district, selling to fellow farmers, and selling to collectors that visit the farm(s)	Height-for-age, weight-for-height, weight-for-age, stunting, wasting, and underweight	Market participation is significantly associated with improvements in HAZ and WHZ for girls and reducing underweight and stunting among boys.	27
Mehraban and Ickowitz (2021)	Indonesia	Rural	Quantitative (longitudinal survey)	Rural farmer households	<i>n</i> = 2,785	Unclear	Household Dietary Diversity Score	Market access is positively associated with household dietary diversity and the consumption of all food groups.	27

(Continued)

TABLE 2 (Continued)

Authors (year)	Study location	Study setting	Methods	Study population	Sample size	Conception of wet markets	Outcome measure	Summary of findings	Quality appraisal score ¹
Nguyen et al. (2021)	Vietnam	Urban, peri-urban, and rural	Mixed methods (survey, geospatial, and interview)	Primary food shopper	<i>n</i> = 25 (survey), <i>n</i> = 30 (geospatial) and <i>n</i> = 56 (interview)	Formal open market, i.e., wet market: a market formally established by local authorities feature diverse vendors selling a variety of fresh food products often on a tiny space. Vendors do not need a business license nor a store setup	Height-for-age, weight-for-height, weight-for-age, stunting, wasting, and underweight	Wet markets remain the most important food outlet. Rural areas had higher rates of undernutrition; this is associated with low retail diversity and household dependence on own production.	25
Sang-ngoan et al. (2019)	Thailand	Urban and rural	Quantitative (cross-sectional survey)	Women of reproductive age (19–50)	<i>n</i> = 128	Unclear	Food consumption	Urban and hill-tribe women mostly shop at traditional and mobile markets, either to buy ready-to-eat food or ingredients for home-cooking.	26
Sang-ngoan et al. (2020)	Thailand	Urban and rural	Quantitative (cross-sectional survey)	Women of reproductive age (19–50)	<i>n</i> = 128	Unclear	Iron and vitamin C intake	Despite similar availability of iron/vitamin C food items at markets, hill tribe women had lower intake of both micronutrients compared to urban women	28
Sufyan et al. (2019)	Indonesia	Urban	Qualitative (interviews)	Women (19–60)	<i>n</i> = 18	Unclear	Food purchasing behavior	Time/cost efficiency, food availability, family, exposure to ready-to-eat foods and food store marketing strategies influenced women's food purchasing behavior at local markets	21
Wertheim-Heck and Raneri (2019)	Vietnam	Urban	Mixed methods	Women of reproductive age (20–50)		Formal traditional markets, i.e., wet market: open-air covered market space for fresh food; Informal street market: vendors selling products collectively			34
Wertheim-Heck and Raneri (2020)	<i>Qualitative component of Wertheim-Heck and Raneri (2019) study (interview)</i>			Women of reproductive age (20–50)	<i>n</i> = 14 (28 women)	Formal traditional markets, i.e., wet market: open-air covered market space for fresh food; Informal street market: vendors selling products collectively	Food consumption practices	Traditional markets continue to play a vital role in providing healthy food for the urban poor and constitute inter-generational shopping practices	32
Wertheim-Heck et al. (2019)	<i>Quantitative component of Wertheim-Heck and Raneri (2019) study (market census and survey)</i>			Women of reproductive age (20–50)	<i>n</i> = 563 (market census) and <i>n</i> = 400 (survey)	Formal traditional markets, i.e., wet market: open-air covered market space for fresh food; Informal street market: vendors selling products collectively	Diet Diversity Score	Geographic proximity to retail outlets was not significantly associated with dietary quality. Traditional outlets continue to be the main source of food, due to habit, availability, convenience, affordability, and quality.	30

¹ Results of the quality appraisal for diverse studies by Harrison et al. (2021); each paper is awarded a score out of 39.

² Unclear: no clear conceptualization or definition of wet markets is given in the paper.

access was shown to be positively correlated with dietary diversity and the consumption of foods from different food groups in rural Indonesian households (Mehraban and Ickowitz, 2021). However, nutritional outcomes were not assessed in these studies. The study of rural Vietnamese households by Genova et al. (2022), showed improvements in girls' height-for-age and weight-for-height z-scores as well as a decrease in underweight and stunting in boys. This was not directly associated with consumption of healthy foods but rather the household selling of produce at the local market.

3.2.2 Affordability

Eight studies focused on affordability, with contradictory results. The majority reported concerns among participants about the cost of a healthy diet (Downs et al., 2019; Sufyan et al., 2019; Wertheim-Heck et al., 2019; Wertheim-Heck and Raneri, 2020; Nguyen et al., 2021; Brown et al., 2022). In two studies, fresh foods, especially fruits, were perceived as more expensive than processed foods in the markets, making the latter a more favorable option (Downs et al., 2019; Sufyan et al., 2019). Several studies listed the perceived lower price of foods such as fruits, vegetables, and animal sourced foods, as an important reason to shop at wet markets (Downs et al., 2019; Wertheim-Heck et al., 2019; Wertheim-Heck and Raneri, 2020; Nguyen et al., 2021; Brown et al., 2022). A market survey in urban Vietnam confirmed higher prices of vegetables in supermarkets, on average 35% (Wertheim-Heck et al., 2019). While affordability is a recognized barrier to accessing healthy diets, Bell et al. (2021) and De Filippo et al. (2021) found that price is not a significant determinant factor of purchasing behavior and fresh food consumption.

3.2.3 Availability

Six studies focused on food availability. Several studies found a large variety of foods in wet markets, especially fresh produce, as an important reason for people to shop here (Downs et al., 2019; Wertheim-Heck and Raneri, 2019; Nguyen et al., 2021). However, this large variety of choice did not necessarily affect micronutrient status, e.g., a study in Thailand demonstrated discrepancies in iron and vitamin C intake between urban and rural women despite similar availability of food items high in these micronutrients at markets (Sang-ngoen et al., 2020). Furthermore, studies in Indonesia, Myanmar, and Vietnam reported that the availability of processed foods in wet markets as well as the number of fast-food outlets close to wet markets was increasing (Downs et al., 2019; Sufyan et al., 2019; Wertheim-Heck and Raneri, 2019).

3.2.4 Quality

Seven studies considered food quality. Only the study by Sang-ngoen et al. (2020) evaluated the food's nutritional value directly, with an analysis of available food high in iron and vitamin C at urban and rural markets in Thailand. Approximately one fifth of animal and vegetable items were high in iron in both settings. For fruits, about one fifth was high in vitamin C in rural markets compared to one third in urban markets. As Downs et al. (2019) noted differences between perceived nutritious meals and actual healthy diets, the connection with malnutrition is most likely complex. Most studies focussed on wet markets and consumer concerns about the use of chemicals and pesticides (Downs et al., 2019; Bell et al., 2021; Brown et al., 2022). In a study of Cambodian wet markets, this concern was associated with a decrease in vegetable consumption (Brown et al., 2022). Moreover, wet markets, in contrast to supermarkets, did not display visual food

safety claims, exemplifying the difference between formal and informal outlets (Wertheim-Heck and Raneri, 2019). However, even though vegetables at supermarkets were considered safer, vegetables at wet markets were considered fresher (Wertheim-Heck and Raneri, 2019). Risk mitigating strategies of women in studies from Cambodia, Indonesia, and Vietnam included personal contact with the seller, selecting the produce based on looks, and incorporating specific washing or preparation techniques before consumption (Sufyan et al., 2019; Wertheim-Heck and Raneri, 2019, 2020; Brown et al., 2022).

3.2.5 Promotion

Two studies investigated the role of promotion at wet markets (Downs et al., 2019; Nguyen et al., 2021). Most markets were found not to engage in marketing of produce in a study on urban and rural markets in Myanmar (Downs et al., 2019). However, some study participants did note the increasing sophistication of packaging (Downs et al., 2019). Nguyen et al. (2021)'s study in urban Vietnam reported that several participants preferred shopping at wet markets precisely because of the absence of marketing.

3.2.6 Sustainability

The domain of sustainability was not specifically addressed in the papers that were finally selected. Purchasing food at wet markets was shown to be a custom passed down through generations (Wertheim-Heck and Raneri, 2019, 2020; Nguyen et al., 2021). As noted in Chapter 3.2.4 quality, concerns about the use of pesticides for produce, including those sold at the market, were expressed. Additionally, some participants in the study by Downs et al. (2019) raised concerns about the food production process, noting a lack of ethics and transparency along the food chain.

4 Discussion and conclusion

This narrative mini review, aimed to better understand the role of wet markets in providing access to foods that can support a healthy diet, in Southeast Asia. According to the literature analysed wet markets in Southeast Asia are critical places in the food environment which facilitate access especially to fresh food for many people. The food environment domains of convenience, affordability, availability, and quality were most highlighted as factors influencing shopping and dietary behavior. Wet markets were perceived as cheaper, more accessible, and offering a wider variety of fresh produce compared to modern food retailers. People did have concerns about safety, due to the use of chemicals and pesticides. This concern is evidently shared more widely in LMICs based on a recent study of food safety perceptions which concluded the persistent presence of concerns regarding pesticide usage among consumers, especially at informal food outlets (Liguori et al., 2022).

Conflicting and often indirect quantitative evidence was found with respect to the link between wet markets and nutritional wellbeing. Physical proximity to markets was reported as not statistically significantly associated with dietary diversity or quality, while perceived access and market participation indicated positive influence on food consumption and nutritional outcomes. This unclear relationship is reaffirmed by previous reviews in food environment research (Turner et al., 2020; Gaupholm et al., 2022; Méjean and Recchia, 2022). The variation in definitions and methods throughout the literature potentially also contributes to these inconsistencies.

Wet markets were found to offer less ultra-processed foods, which are associated with an increasing burden of malnutrition (Popkin et al., 2020). The reduced exposure to ultra-processed foods in comparison to modern outlets in combination with almost complete absence of marketing in wet markets could generate possibilities for promoting healthy food purchasing behavior.

Gender appears to play an important role in (mal)nutrition as viewed through the lens of wet markets in Southeast Asia. Most of the identified literature centred on women. This could be because women in Southeast Asia are often perceived to have the primary role in household nutritional well-being (Sang-ngoan et al., 2019; Wertheim-Heck and Raneri, 2019; Roy et al., 2023). Moreover, women are more vulnerable to malnutrition as they tend to prioritize the nutrition of other family members (Quisumbing et al., 1996; Wertheim-Heck and Raneri, 2019; Biswas et al., 2020). However, men must also have a role to play in addressing family (mal)nutrition and improving their knowledge and participation in household activities are key areas to address (De Filippo et al., 2021). Furthermore, how men and women shop for food in wet markets is a potential intervention area.

A study limitation but also an area for future research is the lack of: (a) consistent and comprehensive literature covering all countries in Southeast Asia, (b) nuanced insights into urban and rural contexts, and (c) an explicit focus on the studying and reporting on the relationship/s between wet markets, diets and nutrition, e.g., shopping behavior and dietary and nutritional outcomes. The latter is underscored by a recognized lack of longitudinal data on dietary behavior and nutritional outcomes in Southeast Asia (Wertheim-Heck and Raneri, 2019; Turner et al., 2020). The development of extensive databases with this data is encouraged.

Moreover, there were inconsistencies in methods and theory across the papers. Papers mostly failed to adequately conceptualize wet markets and definitions were at times conflicting. These limitations have also been emphasized by previous food environment reviews (Turner et al., 2020; Toure et al., 2021; Gaupholm et al., 2022). Environmental and social sustainability in relation to nutrition was not explored in the selected papers outside of some mention of food safety and use of chemicals in production. The eradication of hunger and malnutrition is key to sustainable development including goals of well-being, health, and prosperity. It is also key to realizing sustainable and inclusive food systems transformation. While the literature does provide insights into the challenges of sustainability and indicates the some of the value of wet markets there are many areas related to access to healthy diets that need further address within the food environment.

As illustrated by this mini review, wet markets are a valuable food environment component amidst a diversity of food retail in Southeast Asia - including an increase in fast food outlets near markets. This highlights the need for greater inclusion of the role wet markets in food and nutrition policy and food systems transformation rather than only relying on regulations to manage food access in these markets. Moreover, as Lin et al. (2021) assert given the wide variation in physical types and produce sold in wet markets as well as their importance in supplying food to 'millions of people', moving forward, policymakers need more useful typologies of wet markets than presently available to better inform policy and refine targeted actions that benefit public health and biodiversity without depriving people of 'ready access to food'. The convenience factor of these markets and perceived affordability of fresh produce can be leveraged to promote greater access to affordable healthy diets. While the availability of fresh fruits

and vegetables in the wet markets provides an opportunity to encourage a return to preferencing healthy, cultural diets. Food safety continues to be a concern, and one that needs to be addressed as a key barrier to affordability and nutritional value of foods. Furthermore, policy actors should seek further evidence and be more attentive to the role gender plays in wet markets and regarding access to healthy diets, e.g., practices, views, and knowledge. Accomplishing health equity requires policy and activities to reduce the vulnerability to hunger and malnutrition among low-income households as well as women and improving nutritional knowledge among men. Previously raised recommendations included education initiatives for vendors and consumers, improved regulations and enforcement, and safety accreditation schemes with labeling (Liguori et al., 2022).

Author contributions

MH: Writing – original draft, Writing – review & editing, AT-J: Supervision, Conceptualization, Formal analysis, Funding acquisition, Project administration, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/frsus.2024.1320959/full#supplementary-material>

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