

## Frameworks of food environments: their scopes and perspectives

### Modelos conceptuales de los ambientes alimentarios: sus alcances y perspectivas.

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#### Abstract:

The study of chronic non-communicable diseases has gone from having a biomedical approach which was emphasized in epidemiological models proposed before the 1970s. After the 1970s, emphasis has been placed on the study of environments as part of the determinants of health. The study of environments has seen the need to focus on specific topics. This is the case of food environments. Food environments have been associated with nutritional health outcomes. For the explanation of food environments, the exposition of the variables and scope that compose them, there have been various proposals for explanatory models. Through this work, the elements and dimensions of the INFORMAS model, Retail Food Environment, Domains of the Food Environment Model, FAO Model, about Urbanization and food security, Organizational Food Environment Model, Types of Food Environment Model and The Innocenti Framework on Food Systems for Children and Adolescents, considering in each of them the elements and dimensions of the food environment, as well as the perspectives from which the concept of food environment is understood.

#### Keywords:

*Food environment, models, dimensions, definition*

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#### Resumen:

El estudio de las enfermedades crónicas no transmisibles ha pasado de tener un enfoque biomédico el cual se enfatizó en modelos epidemiológicos propuestos antes de los años 70. Posterior a los años 70 se ha puesto énfasis en el estudio de los ambientes como parte de los determinantes de la salud. El estudio de los ambientes se ha visto en la necesidad de acostarse a temas específicos. Es el caso de los ambientes alimentarios. Los ambientes alimentarios se han asociado a desenlaces en la salud nutricional. Para la explicación de los ambientes alimentarios, la exposición de las variables y alcances que los componen han existido diversas propuestas de modelos explicativos. A través de este trabajo se exponen los elementos y dimensiones de INFORMAS model, Retail Food Environment, Domains of the Food Environment Model, FAO Model, about Urbanization and food security, Organizational Food Environment Model, Types of Food Environment Model and The Innocenti Framework on Food Systems for Children and Adolescents, considerando en cada uno de ellos los elementos y dimensiones del ambiente alimentario, así como las perspectivas desde los cuales se entiende el concepto de ambiente alimentario.

#### Palabras Clave:

*Ambiente alimentario, modelos, dimensiones, definiciones*

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### INTRODUCTION

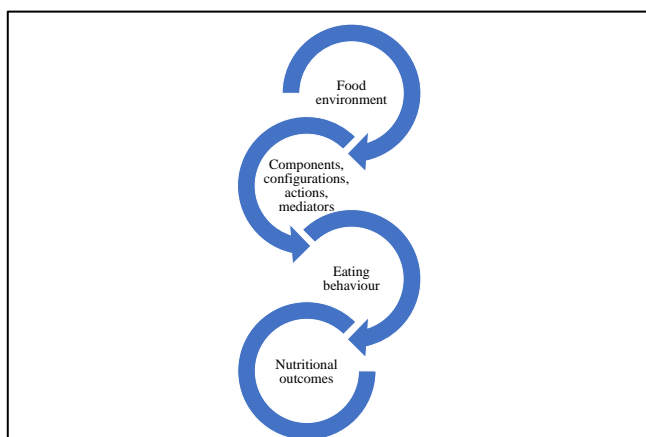
In 1974, the environment (defined as health-related elements that are external to the human body and over which the individual has little or no control) was described as one of the determinants of health.<sup>1</sup> This framework added to the attention and compression of variables that are related to Chronic Non-Communicable Diseases (NCDs). Consequently,

Bronfenbrenner proposed an ecological model that has served as a basis for environmental considerations surrounding and determining NDEs, such as obesity.<sup>2,3</sup> Therefore, in 1998 the term "Obesogenic Environment" was coined in the literature.<sup>4</sup> Somewhat later, to strengthen the concept of "Obesogenic Environment", Swinburn in 1999, postulated the first ecological model that described the elements of the obesogenic environment. The "ANGELO" model explains that obesogenic

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environments are shaped by physical, political, economic and socio-cultural elements.<sup>5</sup> This conceptual framework covers many areas of intervention focused on addressing obesity, and has even been used to narrow down actions to promote healthy diets.<sup>6</sup> Therefore, it was considered relevant to define environments in differentiated areas, or what Swinburn mentioned as "microenvironments" to specific elements, such as food. Later, Nancy Krieger, based on the Bronfenbrenner model, considered the ecosocial model for epidemiological approaches to NTDs, such as childhood obesity.<sup>7,8</sup> Since then, several authors have associated the variables that configure obesogenic environments to Food Environments (FEN) not favorable to behaviors, food consumption and outcomes that affect nutritional health. Adiposity gain has been linked to the variety of variables in FEN, particularly at young ages.<sup>9-11</sup> (Figure 1).



**Figure 1. General effect of food environments on nutritional outcomes (Own elaboration).**<sup>5-11</sup>

Therefore, there are different proposals to study food environments, which from their models, and from the ecosystem approach, describe elements and determinants of FEN. The above is relevant since with the advance of the studies different perspectives have been proposed that configure the FEN. Knowing these models helps the approach of interventions at different levels and with different approaches, ranging from policies and legislative actions, such as the INFORMAS network proposal (International Network for Food and Obesity/NCDs Research, Monitoring and Action Support) models with approaches to food systems and in turn with the recognition of internal aspects of the subjects exposed in these environments; or with a focus on the actions of the mediators of the environments. Therefore, the objective of this narrative review is to expose the perspectives and elements of conceptual models that describe and explain food environments.<sup>12,13</sup>

## BACKGROUND OF THE STUDY OF THE FOOD ENVIRONMENT

For many years, the approach to diseases was understood predominantly through a biomedical model approach. This assumption was that pathogens were causal agents and that when receiving treatment, the disease would heal. Later, with the epidemiological and nutritional transition, NCDs became more prevalent than infectious diseases. It was also described that diseases, in addition to having a biological component, were also determined by social elements.<sup>14</sup> In addition, in 1974, Mark Lalonde described four determinants of population health, which included, in addition to the biological component, the genetic component, the organization of health services and the environment.<sup>15,16</sup>

Following the limitations of the biomedical model for the care of NTDs, including obesity, the understanding of the etiology of this and other pathologies has evolved to a proposal that considers an Eco-Social approach (ECS) directed to seeing a human being beyond his disease, where not only does biology and a causal entity play a leading role in the occurrence and, with the application of a treatment, the cessation of the disease; but it also considers the influence of ecological aspects, psychological and social.<sup>17</sup>

The ECS model is preceded by Bronfenbrenner's ecological theory, which is based on the mutual influence between the individual and the elements of his environment close to him (and manages to make an adaptation that identifies new dimensions, represented as spheres around the individual, full of variables that continually interact reciprocally with each other, with interpersonal relationships or the social environment being the ones that can mostly influence individual behavior with an effect on their state of well-being.<sup>2</sup>

The National Heart, Lung and Blood Institute modified this ECS model to address environmental factors that contribute to childhood obesity.<sup>18</sup> In addition, a recent review proposes from the etiology and approaches of childhood obesity with this model, to identify the variables that are associated with the development of obesity and interact with the intrapersonal level of children and adolescents.<sup>19</sup> Figure 2 shows the general graphs of the ecological model and the ecosocial model, which have served as theoretical bases for the study of the descriptive frameworks of the FEN (Figure 2).

FEN is studied in a complex manner, with the use of ecology and the eco-social framework and is defined as a system that encompasses all aspects, conditions, opportunities, physical, socio-cultural, and economic factors that affect and influence the availability, supply, and choice of food.<sup>2,20</sup>

The FEN can influence individual aspects like perceptions, attitudes, knowledge, and behaviors. The individual will make healthy decisions about their diet if their own FEN favors it, which will impact their long-term nutritional health.<sup>11,20-22</sup>

## MODELS TO DEFINE AND DESCRIBE THE FOOD ENVIRONMENT

The concept of FEN is broad, so to be able to break it down and understand its components as part of research to help address

global malnutrition, several proposals have emerged from authors who have created explanatory models that have identified new aspects and dimensions, as well as perspectives that create and maintain an FEN.<sup>5,23-29</sup>

The Table 1 summarizes proposals for models that describe the FENs, including its characteristic and general elements like accessibility, availability, offers, promotions, affordability, convenience, desirability, infrastructure, regulations, community support, agricultural production and sustainability, information, and nutritional quality of food. These are the dimensions most frequently reported in the literature (Table 1). Among all these models, several authors stand out who have been watersheds in the way the FEN is defined and focused.

**Model of community organization**

In the first instance Glanz in 2005 organizes for the first time the food environment at the community level and associates it with changes in eating patterns and, subsequently, with the development of NDCs. The FEN model proposed by Glanz defines 4 types of food environment: 1) the community environment, 2) the organizational environment, 3) the consumer environment, and 4) the information environment. In his model he proposes that FENs have two ways of influencing feeding patterns.<sup>23</sup>

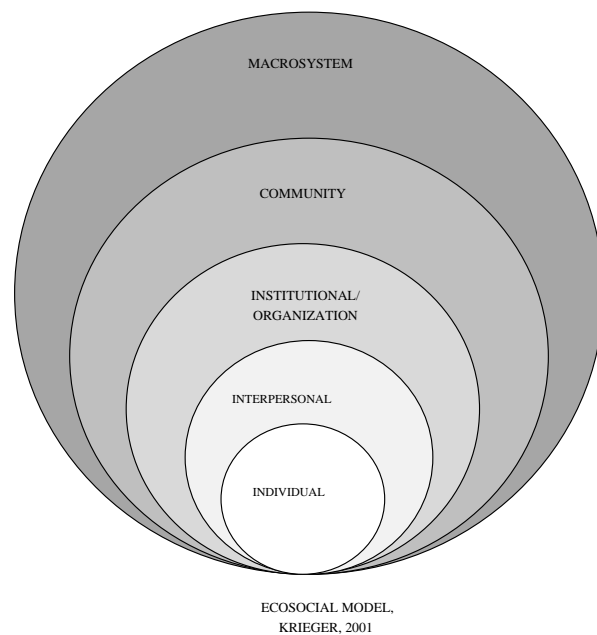
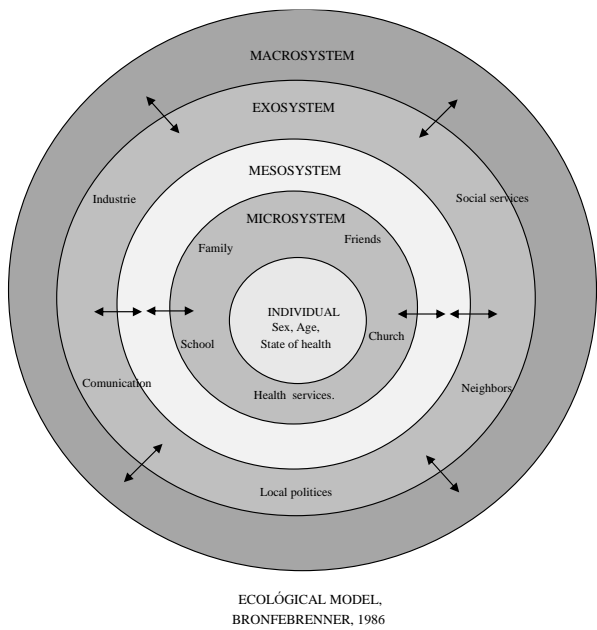
The model is developed in three dimensions: 1) the political dimension, 2) the environmental dimension (including the four types of environments mentioned), and 3) the individual behavior. According to this model, considering these dimensions influence and obtain the dietary patterns of communities, mediated by socioeconomic elements. These dimensions are intended to characterize the various aspects of FENs. The policy dimension focuses on policies and regulations that influence the food environment, such as zoning laws and food aid programmes.<sup>23</sup>

The environmental dimension is concerned with the physical aspects of the food environment, which include the availability and accessibility of healthy food choices. The Individual dimension takes into account individual food-related behaviors and choices, such as dietary preferences and shopping habits. Within the types of environments that the model proposes considers that the community environment is observed the distribution of food sources, that is, the number, type, location and accessibility of food outlets. Accessibility can include direct access windows and hours of operation. Shops and restaurants are the most numerous food outlets.<sup>23</sup>

Organizational nutrition environments encompass food sources like homes, schools, workplaces, and other locations like churches and health care facilities that are generally accessible to specific groups. In this type of environment, it is emphasized that the home could be the most complex and dynamic food source. This is because food in the home is affected by the availability of food in other outlets.<sup>22,30</sup> The frequency of purchases can affect the effect of the environment on the choice of food; in addition to considering the primary buyer and food preparer as a means of influencing the feeding patterns of others in the home.<sup>23,31</sup>

Finally, the consumer environment data reflect what consumers find in and around a food retail store and most of these characteristics will also apply to food sources in organizational settings, like at home. Added to the above, the model considers relevant nutritional qualities, price, promotions, location, range of options, freshness and nutritional information.<sup>31</sup>

It should be noted that this model focuses on FEN drivers of consumption of undesirable foods (rich in fat, sugar, high



**Figure 2. Ecological and ecosocial Models.<sup>2,8</sup>**

calories) and associated with the development of obesity and chronic non-communicable diseases.<sup>30</sup>

**International Network for Food and Obesity Non-communicable Diseases Research, Monitoring and Action Support (INFORMAS) model**

As already mentioned, the study of food environments is based on the eco-social framework. From the higher levels, the macro system would contain the variables involved in legislation and public policies that are associated with food environments. In

this sense, in New Zealand it was proposed to develop an index called "The Healthy Food Environment Policy Index (Food-EPI)", which would evaluate different public policies and their regulatory actions to promote healthy food environments. This index was developed and promoted by the IINFORMAS.<sup>32</sup>This model defines FENs as "The collective environment, opportunities and physical, economic, political and socio-cultural conditions that influence food and beverage choices and the nutritional status of individuals".<sup>12</sup>

**Table 1.** Models to describe the components and dimensions of the food environment (FEN).<sup>5, 23-26,82, 41,44,45</sup>

Author and Model Name	Component	Dimensions
(Glanz et al., 2005) Community Food Environment. <sup>23</sup>	Organization Information Community Consumption	Type and location of food establishments, accessibility, availability, price, promotion
(Swinburn et al., 2013) INFORMAS model. <sup>5</sup>	Physical Economic Political Sociocultural	Availability, quality, promotion, cost, regulations, norms, beliefs
(Ni Mhurchu et al., 2013) Retail Food Environment. <sup>24</sup>	Consumption Community	Availability, price, promotion type, availability, accessibility to food establishments, food sold
(Turner et al., 2018a) Domains of the Food Environment Model. <sup>25</sup>	External Domains Personal Domains	Availability, prices, properties, brand, regulations, accessibility, affordability, desirability
FAO Model, about Urbanization and food security. <sup>26</sup>	Food deserts Food swamps	Productions Intermediate segment Concluding segments consumer behaviors and diets
(Bird et al., 2018; Downs et al., 2020) Types of Food Environment Model. <sup>41</sup>	Natural Food Environment Built Food Environment:	Wild and farmed areas, fields, habitats Formal market (supermarkets, restaurants) and informal market (street stalls, kiosks)
(de Castro & Canella, 2022) Organizational Food Environments. <sup>28</sup>	Surroundings Decision Level Institutional Level Internal Level	Acceptability, Affordability, Availability, Accessibility, Quality, Nutritional Information, Promotion, Convenience, Environment, Infrastructure
(UNICEF & GAIN, 2019) The Innocenti Framework on Food Systems for Children and Adolescents. <sup>41,44</sup>	Staff Caregiver Behaviors Production chains External environment	Accessibility, affordability, convenience Intrafamily dynamics, food preparation, desirability and acceptability, eating patterns, socioeconomic factors Postharvest process, processing, distribution, natural resource management, agricultural research Availability, price, quality and safety, marketing, information
(Gálvez, 2017). Food Environment Study in Chile. <sup>45</sup>	Foodservice food environment, Street food environment Domestic food environment Institutional and organizational food environment	Socioeconomic, ecological and political context Food public policies and health systems Food industry Food supply environment

The FEN model proposed by INFORMAS is proposed as a framework for public and private institutions or stakeholders, to promote and develop, from political and organizational levels, capacities, promotion actions, promotion of participation, and evaluation of public policy on FEN. The INFORMAS model

consists of four components: the institutional level, the internal level of eating spaces, the environment, and the decision level. These components are in turn divided into 10 dimensions, which include availability, accessibility, affordability, quality, food and nutritional information, and food promotion, drinks, and

culinary preparations at the institutional and internal level of eating spaces. The model also considers the availability, acceptability, convenience, environment, and infrastructure of the dining space. The elements of this conceptual model seeks to understand the FEN from the organizational perspective, so it also sets the standard to guide the evaluation from the organization of different levels to promote the improvement of the FEN.<sup>12,33</sup>

As a result, INFORMAS, in addition to being a conceptual model, is an international network, which aims to monitor key aspects of FEN in a standardized manner, from its member countries.<sup>33</sup> It should be noted that Mexico, from governmental sectors belong to this Network; and its indicators have been evaluated in our country, (components of policies and infrastructure support). Mexico has public policies that are considered good practices at the international level, to promote healthy food environments, such as taxes, frontal labeling, reformulation, and legislation before the marketing of food products. However, in this assessment, the retail environment scored the lowest, as there is a high availability and affordability of foods considered as undesirable.<sup>13</sup> Access to and supply of unhealthy foods in detail is one of the greatest challenges in our context, as this could be due mainly to socioeconomic needs and behavioral elements and convenience of individuals.<sup>6</sup>

### **Retail food environment**

As has been mentioned, being exposed to conditions of the environments, it has been necessary to describe and limit these particularities. Therefore, Ni Mhurchu in 2013, considered the definition of the FEN study and review, based on the INFORMAS model, regarding retail food environments. The foregoing means that this environment takes great relevance at the community level, since the density and type of these, are considered of great influence on dietary behaviors and health outcomes. In turn, this author considered Glanz's perspective to define the retail environment, which they classify into the community food environment (the type, availability, and accessibility of food outlets) and the consumer food environment (availability, prices, promotions and nutritional quality of products available in stores). This author's contribution to FEN studies is the perspective and necessity of evaluation.<sup>23</sup>

### **Domains of the food environment model**

Later in 2018 Turner defined the FEN as *"the interface that mediates in the acquisition and consumption of people's food within the broader food system. Covers external dimensions such as availability, prices, supplier and product properties, and promotional information; and personal dimensions such as accessibility, affordability, convenience and convenience of food sources and products"*.<sup>25</sup> The contribution of this author, from the ecosocial model, has been considered relevant in the following ways:

a) Inclusion of the food system of nations and the configuration of this system, from a very broad perspective, considering the public policies and the

economic systems of the countries themselves, as guiding elements for FEN and elements of food safety for individuals.

- b) The link between the food system and FEN, where systems provide guidelines for food sources. This model also makes the distinction between market-based and non-market-based food sources. Non-market-based food sources play a key role in food environments in low- and middle-income countries. Traditional food environments, particularly in low- and middle-income rural settings, are typically characterized by limited food availability and accessibility, and many people purchase at least part of their own-produced food, as well as transfers and gifts in kind. Non-market-based food sources may also be important in some urban food environments, for example in the form of urban agriculture.
- c) The individual and his role as intermediary manager with the capacity to decide, to his possibilities and convenience, the food he buys and consumes.<sup>25</sup>

In connection with the FEN configurators, the Turner model includes four types of food sources: market-based food sources, own production, food harvested in the wild and food from food programs. Likewise, it recognizes that Food Systems can favor and not these food sources, and thus a planetary health.<sup>25</sup>

On the other hand, the Turner model also mentions that FEN identify two key domains: a) the external domain, and b) the personal domain. External dominance relates to the world of opportunities and limitations that are within a given context, and not the individual has no influence over him. This domain includes dimensions such as food availability, prices, seller and product properties, and marketing and regulation. On the other hand, the personal domain includes a set of individual level dimensions, including food accessibility, affordability, and convenience. Another contribution that includes this model within the NPS models is that, within the internal domain, it includes the concept "degree of effort" of the individual.<sup>25</sup>

### **Food and Agriculture Organization (FAO) model about urbanization and food security**

For FAO, from a general and broad perspective, food environments are not de-linked from agri-food systems, which are embedded in a food system, which determines food security and nutrition.<sup>34</sup> Accordingly, for FAO, food systems are also shaped by the demographic transition, described and focus on elements of urbanization. This urbanization, from a dietary approach, is undergoing a nutritional transition, that is, in many rural areas or contexts there is a shift from traditional diets to marketing, retail sale and trade of non-traditional foods, such as ultra-processed products. This is also due to a longer, more formal and complex food value chain. This value chain has increased supply and demand for non-traditional food products. The elements mentioned interact with consumer behaviors and diets. In the model of food environment that is generated by a rural and urban continuum has allowed diets to be more diverse,

although with the disadvantage of an increase in foods of minimum nutritional value and a high content of sugary fats salt.<sup>35</sup>

FAO gathers definitions from various authors to propose a model that identifies FENs by the type and accessibility of the offer in the context. It should be noted that this FEN model not only focused on the considerations and outcomes of excess malnutrition, as do the other models, but its perspective is also in the FEN where food security is compromised since scarcity. Accordingly, it defines food deserts as "geographical areas where residents' access to diverse, fresh or nutritious food is limited or even non-existent due to the absence or low density of "food entry points" at a practical distance". In addition to the classic concept of food desert, the most extensive recognition of a spatial issue has been added to this concept. Since the most recent definitions recognize food deserts with elements of social, economic and political interactions that are interrelated with income, mobility, transport, time, seasonality, family structure, the presence of different types of retail location, dietary diversity, education, structural inequalities, etc.<sup>36</sup>

On the other hand, it also describes the characteristics of food marshes as "areas where there is an overabundance of high-calorie foods and with a minimum nutritional value. They offer few affordable and nutritious food options".<sup>37</sup>

In contrast, some studies that have considered this model to describe the FENs have integrated the concept of food oasis, which may be elements associated with programs that support access bags to healthy food, either locations or outlets where you can access healthy foods. Instead, it should be noted that with urbanization, food oases could also interact or coexist with food marshes, deepening the spatial component of inequality in access to food in urban areas.<sup>36</sup>

It should be noted that this classification has been discussed and criticized because there are vulnerable rural and urban contexts that may not obey the description of this model. In the case of Mexico, where urban food deserts may exist, they have limited relevance to measure indicators, such as food insecurity.<sup>38</sup> In addition, the recent national health and nutrition survey has shown that there are no longer any significant differences in the consumption of undesirable foods (excess calories, sugar, saturated fats, trans fats, sodium) in rural areas.<sup>39</sup>

On the other hand, what stands out about this model is that it considers the elements of food insecurity, meaning situations that could lead to a shortage of healthy foods and consequently, famines. This model would be a proposal that works in two ways: it can identify the elements that are driving malnutrition due to excess, as well as the elements that could be driving malnutrition due to deficiency, by considering food deserts with variables that could determine the scarcity of food.<sup>38,39</sup>

In addition, this model, being focused on urbanization elements, has measurable elements for food desert considerations.<sup>36</sup> These elements are listed in Table 2.

Likewise, food deserts have been measured with the Traditional Retail Food Environment Index, (TRFE). The classical variables as extended proposals are listed in Table 2.<sup>37,40</sup>

### Types of food environment model

This model was proposed by Dows and partners in 2020. In addition to considering elements of previous definitions, the authors emphasize the need to emphasize the sustainability of food systems and environments.<sup>27</sup>

**Table 2.** Index and variables considered to measure food deserts and swamps.<sup>36,37, 40</sup>

Food swamp	Food desert
Traditional TRFE* Number of fast food / limited service establishments + convenience stores, among the number of grocery stores and supermarkets	Distance to supermarket >0.4 km (>0.25 miles)
The expanded proposals that consider:	Median household income ≤185 % of federal poverty level
a) Fast food / limited service establishments + convenience stores + supercenters, among grocery stores / supermarkets + farmers markets + specialty stores	Less than 30 % of households have no vehicle available
b) Fast food/limited service establishments + convenience store, among grocery stores/supermarkets + farmer' s markets + specialized stores + supercenters	Low HFAI** Index score (between 0 and 8.7 points)

\*Measure by Traditional Retail Food Environment Index (TRFE).<sup>37</sup>

\*\*HFAI: Healthy Food Availability Index: indicates the quality and quantity of healthy foods available for supermarkets and neighborhood stores, the full range is 0-26.<sup>36,40</sup>

In order to present this model its elements and dimensions, the authors carry out an exhaustive and critical search regarding the background, complexity and variability of the FEN. Some of the relevant contributions of this model describe natural FENs, which can be of two types. The first formed by elements of the field (such as forests, jungle, aquatic areas, open grassland areas available, disturbed habitat. Another type of natural food environment is "cultivated", which includes fields, greenhouses, orchards and orchards or gardens. On the other hand, this model also considers that food environments can be built. Constructed FENs are constituted by a formal market, which considers hyper markets, mobile vendors, online vendors, retailers, institutions, restaurants, farmers markets, supermarkets. Part of the

contributions of this typology of food environments is that it already considers digital food environments, and in turn the possibility of including points that could be food oases in coexistence with other elements of food availability. The other type of built food environment consists of the informal market, which includes street vendors, kiosks, mobile vendors, and farmer s/Wet Markets.<sup>27</sup>

The model's proposed construction considered aspects of the ecosystem model. This is the first model that describes FEN that is graphically attached to the model. In the case of the social ecosystem model, higher levels are considered elements of the ecosystem influencing socio-cultural space and environmental policies; these in turn influence organizational sectors of influence. These three levels will be those that influence the FEN. Within the FEN it is proposed that there are key elements: which include the availability, affordability, convenience, promotion and quality, and sustainability of food and beverages in wild, cultivated and built spaces. This is one of the models that suggests that FEN can be built and configured.<sup>27,41</sup>

The authors suggest a method for studying FEN that takes into account their complexity and typology. That is, the study of different concepts and elements by classifying phenomena according to common points or differences. For this model, understanding the typology of the FEN aims to better understand the conditions and factors of a given phenomenon and how they relate to each other. The typology, derived from a qualitative and rigorous approach, is a suggestion that is relevant when considering that the FEN contain both quantitative and qualitative variables.<sup>41,42</sup>

### **Organizational food environments model**

The proposal of this model, being one of the most recent, made by Castro and Canella in 2022, has presented a very broad definition that combines several perspectives of the models previously presented. The authors who propose this model define the FEN as *"the space, opportunities and collective physical, economic, political and socio-cultural conditions that influence food and beverage choices and the nutritional status of people. FENs interact with supply chains and individuals, influencing and being influenced by them. They are the subject of public policies, national plans and international recommendations to promote adequate and healthy food"*.<sup>43</sup>

The model proposed by the authors seeks to focus on improving the health of FENs from an organizational point of view. The model consists of four components: the institutional level, the internal level of eating spaces, the environment and the decision level.

The higher level of the model contemplates the surroundings, these are understood as the physical and "virtual" contexts related to food that is available to people attending a particular organizational environment and that is not interfered with by the management of this organization. This element is considered as an external sphere encompassing national and subnational

policies, laws and regulations that regulate the dynamics of the functioning of organizations.<sup>28</sup>

As regards the institutional level, which is at the mid-level of the model, are considered physical elements influencing food choices and practices as well as all formal or informal arrangements for these elements to exist and that organizations make available to users: spaces to eat (including commercial food services, non-commercial food services, food and beverage vending machines and mini-kitchens (which may be staff of the organization itself). This level also considers the informal market that is sometimes regulated by elements of governance. It is important to highlight this model considers the organizational arrangements for instrumental elements that organizations allow for the preparation or conservation of foods such as microwaves and/or refrigerators. This model has based its examples on instances such as workplaces, universities, hospitals and companies located in large buildings; that is, it could be focused on organizations within urban areas.<sup>43</sup>

There is space for eating and placement at the innermost level of this model. This level is where payment methods, schedules, prices, food and nutritional information, promotion, infrastructure characteristics and adequacy of installed capacity for storage, preparation (where applicable), heating are considered (where applicable) and food. All the alternate elements could be modulating the convention for consumption.<sup>43</sup> This model raises the decision-level component, which refers to the governance of the food environment of the organization, which occurs in two areas: external and internal to the organization. The model conceptualizes this component as power relations (power to, power over); as well as decision-making processes on this environment. This component of the conceptual model does not refer to individual decision-making in the sense of individual food choices; it focuses on decision-making processes that shape the food environment.<sup>43</sup>

The interaction and reciprocal effect between the surroundings, institutional and dining spaces, determines the conformation of the food environment. In addition to the four components mentioned, this model includes 10 dimensions, distributed in each component, which are decisive for the food choices of those who live and work in these environments. These dimensions include availability, accessibility, affordability, quality, food and nutritional information, and promotion of food, beverages and culinary preparations and availability, acceptability, convenience, environment, and infrastructure of eating spaces.<sup>43</sup> Although other models had already commented that there were qualitative elements found within the FEN, this model proposes the systematization of tangible and intangible elements. The study of the interaction and weight of these tangible and non-tangible elements in different contexts where people exposed to FEN are given food choices and practices remains a challenge in the FEN study.<sup>43</sup>

### **United Nations International Children's Emergency Fund (UNICEF) model**

As already mentioned, FEN have complex and diverse elements that can configure them. So far the models mentioned are focused on variables associated with food systems, policies, location, accessibility, price, etc. And the outcomes proposed are in general population.

However, UNICEF is again focusing on food systems as shaping elements of FEN but focusing on the drivers of the food system (ranging from structural factors including demographic change, the political and economic environment, technological developments, natural resource management and social and cultural norms); as well as on key points (which are defined by processes and conditions including food supply chains and food environments). Finally, this framework, called "The Innocenti Framework on Food Systems for Children and Adolescents" contributes by giving weight to the influencing factors, which includes individual factors (consider behaviors) that interact or are dynamically mediated in the diets of children and adolescents through interpersonal level caregivers, In other words, it places responsible adults around children and adolescents as important mediators of FEN both at school and at home, able to influence the dynamics and patterns related to the child's diet.<sup>44</sup>

The framework describes the dependence of agents, drivers and interactions within the food system that strongly influence and dictate how food moves from production to consumption, and how people interact with their environment to acquire, prepare and consume food, whereas external and proximal (personal) FEN exist. External FEN are those that are in the community, retailers and schools. Proximal (personal) FEN are their own or individual, family and domestic. External and proximal FEN interact with the food system for children and adolescents. This framework also considers the agency and capacity of each to make food decisions, which may depend on age, autonomy and opportunities, and social influencing factors such as "power dynamics" or mediator influence, gender norms, economic gaps and governance.<sup>29</sup>

The above model emphasizes the responsibilities that exist in very particular groups such as infants and gives weight to the intrinsic capacities of those responsible.<sup>29,43</sup>

### **Food environment from Chile**

In the Latin American context, Galvez and colleagues, through a pertinent bibliographic review focused on the country, and based on the ecological model defined by Glanz regarding dietary practices and the model of social determinants of health, as well as considering the variables that define the Chilean food system, proposed a conceptual model to systematize the factors conditioning the food environment and how these elements manifested in the dietary behavior of the Chilean population. This model proposal resembles an ecological model, where the most distal parts consider the socioeconomic, ecological, and political context. In a month system, public food policies and the health system as well as the food industry are found. At this level, the model considers the interactions between these areas relevant, as they would be determining the internal first level

and defining the food supply environment. This type of environment modulates the possibilities of other environments and conditions the availability and access to food. The variables considered at this level include the price of food, its promotion, location, quality, variety, availability of healthy options, modes of preparation, nutritional information, degree of food processing (including branded and locally produced foods), distance and means of transportation to acquire food, and access times. It is worth noting that in this macro food supply environment, the concepts and variables defining food deserts have been considered.<sup>45</sup>

The variables mentioned in this model are again present in the restaurant food environment but at a level closer to the individual and mainly affecting the socioeconomic level. On the other hand, this model contributes particular variables of the domestic food environment, such as the primary transmission of dietary preferences, the reproduction of cooking practices, techniques, and knowledge. This level is defined by high diversity and complexity. The aforementioned variables also recur in the institutional and organizational food environment, but also include food programs, the social aspect of eating, and legislative and organizational regulation of eating in different institutions. Finally, in the public street food environment, access to and consumption of food would be determined by the economy and the practicality of quick consumption. A critical point of this type of environment would be food and nutritional safety.<sup>45</sup>

The authors recognize the complexity of the interactions of the identified elements, and the need to construct models in a multidisciplinary and intersectoral manner, in order to propose strategies that help improve food environments in Chile. For the authors, it is relevant to include variables such as social class, education, gender, and access to health as intermediate elements; which, through coherence and interaction, as well as their evaluation, could trigger persistent problems that influence dietary behavior, exercise, and even the outcome of obesity.<sup>45</sup>

### **SCOPE AND SIMILARITIES OF CONCEPTUAL MODELS DESCRIBING FOOD ENVIRONMENTS**

As mentioned earlier, food environments are complex, comprising multiple levels with variables interacting both within the same level and across lower levels. Systematizing the study of a phenomenon such as the configuration of food environments and their outcomes on population and individual dietary behavior, as well as their effects on nutritional health, becomes relevant from a theoretical perspective to guide possible interventions and understandings of these environments. However, the models presented have a conceptual background in social epidemiology and therefore incorporate regulatory variables primarily located in the macro system. Therefore, the similarities in conceptual models seem to converge on the importance of having designs and considerations in public policies, healthcare systems, and regulatory elements that could effectively impact the



accountability of all structural, regulatory, informational, and educational components.<sup>46</sup>

## CONCLUSION

Based on the recognition of the environment as a determinant of health, and its relationship with the development of chronic noncommunicable diseases such as obesity, several proposals have been developed to describe food environments. Each model comprises definitions and elements that have added to the understanding and description of food environments.

From the recognition of the food environment and the variables that construct it, theoretical proposals have been developed to help describe the interaction of these variables in nutrition outcomes. Most of these models focus on detecting variables that drive consumption and relate it to malnutrition due to excess. From a nutritional perspective, at the primary care level, disease prevention, and health promotion, it is of utmost importance to recognize the variables that shape food environments. Likewise, at an epidemiological level, recognizing these variables at different levels of influence on eating behavior could help understand the relationship and prediction of these variables regarding the nutritional status of populations.

Understanding and knowing the perspectives of each model can help in the design of interventions in food environments as well as can provide the conceptual basis for the assessment and measurement of food environments.

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