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ORIGINAL

Hygienic and sanitary conditions in food establishments and their impact on public health

Condiciones higiénico-sanitarias en establecimientos de expendio de alimentos y su impacto en la salud pública

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ABSTRACT

The research was conducted to evaluate the hygienic and sanitary conditions of food establishments in the Esmeraldas canton. A descriptive, cross-sectional, and observational design was applied to 54 establishments—including restaurants, cafeterias, and street vendors—using a checklist based on national regulations and PAHO good hygiene practices guidelines. The results revealed a heterogeneous scenario: while sectors such as Vía Atacames and Comedores-Las Palmas achieved high levels of compliance in most of the parameters evaluated, locations such as the Municipal Market and Codesa presented critical deficiencies in pest control, sanitary maintenance, and staff health. These aspects are identified as the weakest points and pose the greatest risk to food safety. The statistical analysis confirmed significant differences between sectors, demonstrating that not all establishments face the same challenges. Although product safety and the use of materials and equipment yielded favorable results, deficiencies in staff hygiene and basic infrastructure increased vulnerability to foodborne illnesses. In conclusion, the study showed that, despite the existence of national regulations and technical manuals, their implementation on the ground remains uneven. It highlights the need to strengthen health surveillance, implement periodic training, and replicate good practices from the sectors with the best results, to protect public health and guarantee the right to safe food for the Esmeraldas population.

Keywords: Hygiene and Sanitary Conditions; Food Safety; Food Vending.

RESUMEN

La investigación se desarrolló con el objetivo de evaluar las condiciones higiénico-sanitarias de los establecimientos de expendio de alimentos en el cantón Esmeraldas. Se aplicó un diseño descriptivo, transversal y observacional en 54 locales; entre restaurantes, comedores, cafeterías y puestos ambulantes, con ayuda de una lista de verificación basada en la normativa nacional y en las directrices de las buenas prácticas de higiene de la OPS. Los resultados pusieron en manifiesto un escenario heterogéneo: mientras sectores como Vía Atacames y Comedores- Las Palmas alcanzaron altos niveles de cumplimiento en la mayoría de los parámetros evaluados, lugares como el mercador Municipal y Codesa presentaron deficiencias críticas en control de plagas, mantenimiento de baterías sanitarias y sanidad del personal. Estos aspectos se identifican como los puntos más débiles y de mayor riesgo para la seguridad alimentaria. El análisis estadístico confirmo las diferencias significativas entre sectores, lo que evidenció que no todos los establecimientos enfrentan

los mismos desafíos. Aunque la sanidad del producto, el uso de materiales y equipos presentaros resultados favorables, las fallas en la higiene del personal y en infraestructura básica aumentaron la vulnerabilidad frente a enfermedades transmitidas por alimentos. En conclusión, el estudio evidenció que, a pesar de la existencia de normativas nacionales y manuales técnicos, la aplicación en el terreno aún es desigual. Se resalta la necesidad de fortalecer la vigilancia sanitaria, implementar capacitaciones periódicas y replicar las buenas prácticas de los sectores con mejores resultados, con el fin de proteger la salud pública y garantizar el derecho a una alimentación segura en la población esmeraldeña.

Palabras clave: Condiciones Higiénico-Sanitarias; Seguridad Alimentaria; Expendio de Alimentos.

INTRODUCTION

Food directly influences people's health, growth, and development to satisfy their basic physiological functions, in adequate amounts of macro- and micronutrients, which vary depending on multiple factors such as gender, age, physiological status, body composition, physical activity, and individual characteristics.[1] In this regard, it is necessary to take care of food systems, which encompass a range of actors, from agricultural production to food consumption, with a significant increase at present due to the intensification of agricultural industrialization, food processing, and long-distance transport, favoring the import and export of these products.[2]

Food security for the population requires efforts to change the food system and its relationship with individual and collective health,[2] ensuring that it provides healthy diets and becomes a catalyst for ending hunger, food insecurity, and malnutrition in all its forms. Consequently, the World Health Organization (WHO) and the Pan American Health Organization (PAHO) promote the implementation of measures that focus on improving the food supply chain and creating healthier food environments.[3] However, the hygienic and sanitary conditions involved in food handling during production, storage, and distribution can pose a risk to human health, with particular attention being paid to dining rooms and kitchens and food handling during preparation, as these directly influence health, since alteration, adulteration, or contamination, both chemical and biological, can cause serious effects,[4] contributing to morbidity rates in Latin American and Caribbean countries.[5]

The demand for food outside the family unit has increased over the years, especially among the population living in urban areas. Contamination of the food chain can occur from production to consumption, causing foodborne infections that lead to public health problems.[6] The World Health Organization (WHO) points out that a small number of factors related to food handling are responsible for most cases of foodborne illnesses (FBIs) worldwide, including practices such as preparing food too far in advance and storing it at temperatures that promote the growth of bacteria or toxins, undercooking or reheating food, causing cross-contamination, and maintaining poor personal hygiene during handling.[7]

The WHO estimates that every year, millions of people become ill from consuming contaminated food, causing more than 420 000 deaths, especially in children under 5 years of age. The most common illnesses are diarrheal diseases, a problem that mostly affects populations in low-income countries, although it is growing due to international trade, climate change, and urbanization. This has led to a merger with the United Nations (UN) to create the Codex Alimentarius to work between institutions to establish standards, guidelines, and practices related to food.[8]

The hygienic and sanitary conditions of food in retail outlets are a growing public health concern in Ecuador, especially in urban areas with high population density and limited access to basic services. In response to the errors that can arise in the food chain, the WHO has established the Ten Golden Rules, which offer key recommendations for reducing the risk of contamination, survival, or proliferation of pathogens in food. Although these causes are common globally, cultural diversity requires that these standards be adapted as a reference for developing educational resources that respond to the particularities of each context.[7]

In Ecuador, the sale of food is governed by various laws, such as the Organic Health Law, which establishes the obligation of public and private entities to comply with health surveillance and control standards for products for human use and consumption, defining the National Health Authority as responsible for certifying Good Manufacturing Practices (GMP), verifying safety, quality, technical and sanitary conditions in plants, transport, marketing, sale, etc.[9] The Unified Technical Sanitary Regulations (ARCSA-DE-002-2016-GGG) applicable to processed foods, processing plants, distribution establishments, transport, marketing, and collective feeding establish the hygienic-sanitary requirements at all these stages: from production, processing, and packaging to sale, as well as the requirements for health notifications or registrations according to the risk of the food, requiring GMP for processing plants.[10] The Regulation for the Health Control of Food Sold on Public Roads, Agreement No. 14381, specifically addresses street vending stalls (fixed, mobile, cyclical, carts, kiosks, tricycles, etc.) and requires a health permit for sale issued by the health or municipal authority, valid for one

year for fixed or mobile stalls and 15 days for cyclical stalls.[11]

In Ecuador, several studies have reported deficiencies in the hygiene and microbiological conditions of food sold both on public streets and in formal establishments. In Riobamba, an analysis of ceviche stalls revealed high counts of enterobacteria and *S. aureus*, linked to a lack of drinking water and improper food handling.[12] In the coastal canton of San Pablo, restaurant audits revealed substandard levels of coliforms and partial compliance with Good Manufacturing Practices, estimated at 66 % ± 16 %.[13] At the same time, systematic reviews have shown widespread non-compliance with basic food safety standards in foods prepared and sold in public spaces in Ecuador, revealing that many street foods have microbial levels above the permissible limits, with the recurrent presence of coliforms, E. *coli*, and other pathogens, in addition to inadequate practices in food handling, storage, and preservation. This situation poses a direct threat to public health, especially in populations with low access to health services.[14]

In the canton of Esmeraldas, various social and structural factors such as economic access, geographical availability, and risk perception significantly influence the population's food choices. A qualitative study based on interviews with 20 mothers in Esmeraldas identified that food choices are strongly influenced by confidence in the hygiene of the place of purchase, proximity, safety of the environment, and ease of access, which often leads the population to consume food in conditions that pose a health risk due to the lack of reliable alternatives.[15] Likewise, perceptions of food safety and hygienic access are decisive factors in families' food choices.[16] This evidence, together with the hygiene and health protocols established by ARCSA and the Ministry of Health, underscores the importance of assessing the actual sanitary conditions in retail outlets in the canton of Esmeraldas, considering microbiological, structural, and procedural indicators.

In response to these issues, the Ecuadorian Ministry of Public Health has established technical and regulatory guidelines aimed at ensuring minimum hygiene conditions in food outlets. The health control manual published in 2017 specifies clear criteria on infrastructure, access to drinking water, pest control, waste management, staff clothing, and process documentation, with the aim of reducing the risks associated with ETAs.[16]

In addition to this, aspects such as the microbiological quality of the water used in food preparation and handling are an essential component of hygienic and sanitary conditions, particularly in vulnerable urban contexts. In the city of Esmeraldas, a recent study revealed alarming levels of contamination in daily drinking water. Of a total of 121 samples analyzed, *Escherichia coli* was identified in 20 % of the samples, *Salmonella spp.* in 10 %, and *Shigella spp.* in 4 %, as well as environmental fungi such as *Mucor* and *Aspergillus fumigatus*. These findings reflect not only direct exposure to the risk of waterborne diseases, but also a potential scenario of cross-contamination in food establishments operating under similar conditions.[17] In this regard, assessing the hygienic-sanitary situation of these businesses cannot be separated from the structural problems affecting the community in general, such as limited access to sanitation services and safe drinking water

Given these findings, monitoring the hygienic and sanitary conditions in food establishments is important not only as a measure to prevent waterborne diseases, but also as an essential component in guaranteeing the population's right to health.[18] In the canton of Esmeraldas, where there are structural and social factors that can compromise food safety, it is necessary to generate local evidence to guide health control actions and capacity building among actors in the food system. Therefore, the objective of this study was to evaluate the hygienic and sanitary conditions in food establishments in the canton of Esmeraldas, in order to identify possible risks to public health and contribute to the design of strategies for improving local health control.

METHOD

This study was conducted using a quantitative approach, with a descriptive, cross-sectional, and **observational** design, with the aim of evaluating the hygienic and sanitary conditions in food establishments in the canton of Esmeraldas.

The study population consisted of 54 food outlets, including restaurants, soup kitchens, cafeterias, and street vendors in different urban and peri-urban areas of the Esmeraldas canton, in order to obtain a diverse representation of existing conditions. Non-probability convenience sampling was used to select the locations evaluated, considering factors such as accessibility, location, and willingness to participate in the evaluation.

A checklist based on Ecuador's Food Safety Regulations and the Good Hygiene Practices (GHP) Guidelines issued by the Pan American Health Organization (PAHO) was used as a data collection tool. This list included specific criteria for evaluating key aspects such as: infrastructure conditions (condition of floors, walls, ceilings, ventilation, drinking water, and lighting), food handling (storage temperatures, storage and handling methods), staff conditions for food preparation and/or handling (use of appropriate clothing, hand washing, and personal hygiene practices), pest control, materials and equipment, waste disposal, and sanitation services. Each item was rated under two categories: Compliant (1) or Non-compliant (0), allowing for a structured and comparative assessment between different establishments.

Data collection was carried out between August and December 2024 through on-site visits by the research team. During these visits, the checklist was applied through direct observation and informal interviews with

the managers of each establishment. The confidentiality of the information was guaranteed, and the collection of sensitive personal data was avoided, protecting the identity of those evaluated. For data analysis, Microsoft Excel software and the R programming language with its integrated development environment RStudio were used, where the results obtained were processed using descriptive statistics through a radar diagram and inferential statistics using a non-parametric Kruskal-Wallis test and Dunn's post-hoc tests with Bonferroni adjustment for the analysis of significant differences between hygiene and health parameters.

In terms of ethical considerations, the study was conducted under the principles of confidentiality, respect, and verbal informed consent to enter the establishment and carry out the verification checklist. The study did not involve any intervention or the collection of personal or sensitive information, ensuring the integrity and respect of the participants.

RESULTS

Descriptive Analysis

The 54 establishments that made up the sample are grouped into seven sectors of the city: Municipal Market, Valle San Rafael – La Tolita, Vía Atacames, Children's Park, Comedores – Las Palmas, Parque – Las Palmas, and Codesa, in which the percentage of compliance with six hygiene and sanitation parameters was evaluated using a radar chart (see figure 1).

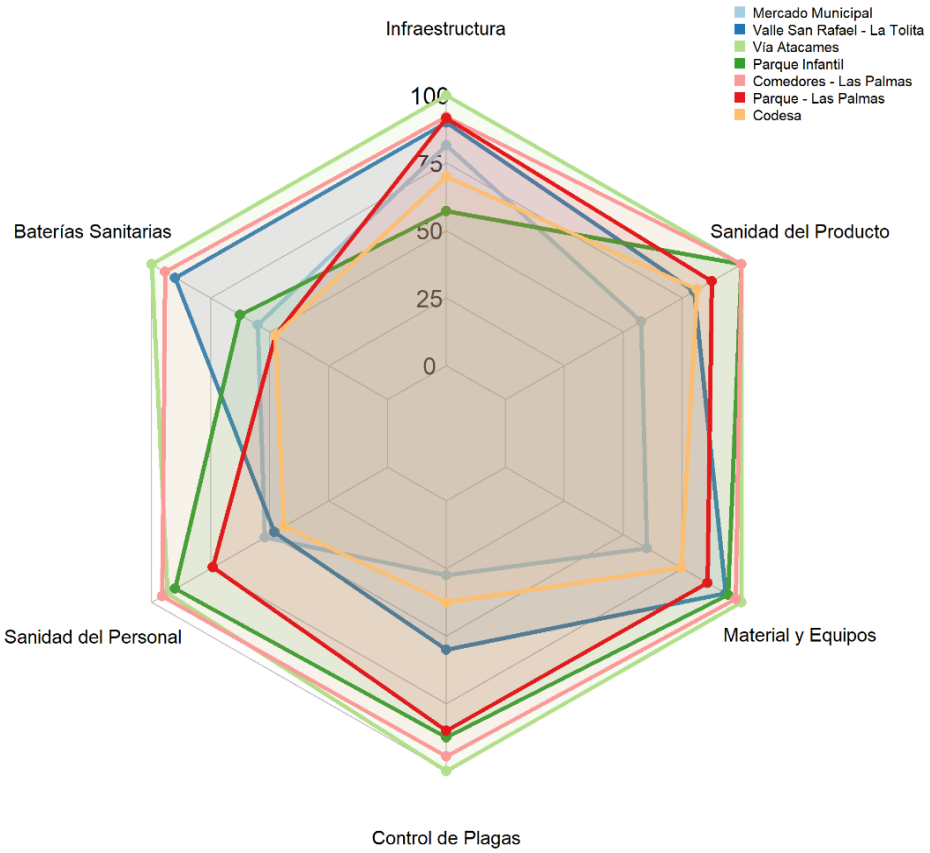

Figure 1. Average percentage of compliance with hygiene and sanitation parameters by sector in Esmeraldas

"Product Sanitation" shows the highest and most consistent compliance overall. Sectors such as Vía Atacames, Children's Park, and Las Palmas Dining Halls achieve 100 %, while Valle San Rafael - La Tolita (80 %) and Codesa (81,25 %) also show solid figures. Only Municipal Market (57,5 %) and Parque - Las Palmas (87,5 %) record slightly lower percentages.

In terms of "Materials and Equipment," compliance is generally high. Vía Atacames reaches 100 %, closely followed by Comedores - Las Palmas (97,53 %), Playground (94,44 %), and Valle San Rafael - La Tolita (93,33 %). Municipal Market (60 %) and Codesa (74,44 %) show more moderate values.

"Infrastructure" is a parameter that shows wide variation. Vía Atacames achieves 100 %, and Comedores - Las Palmas (92,06 %) and Parque - Las Palmas (91,43 %) also show high compliance. However, the Children's Park has the lowest value (57,14 %), and Codesa (70 %) and Municipal Market (81,43 %) are in the middle range.

Similarly, "Sanitary Batteries" show notable variability. Via Atacames stands out with 100 %, and Valle San Rafael - La Tolita (90 %) and Comedores - Las Palmas (94,44 %) show excellent compliance. In contrast, Parque

- Las Palmas (47,5 %) and Codesa (47,5 %) have the lowest values, even below Municipal Market (55 %).

Pest control is an area of lower compliance in several sectors. Vía Atacames is the only one with 100 %. Comedores - Las Palmas (94,44 %) and Parque Infantil (87,5 %) show respectable values. However, Mercado Municipal (27,5 %) and Codesa (37,5 %) have critically low compliance, being the areas of greatest concern in this parameter.

Finally, "Staff Health" is one of the parameters with the lowest compliance in several sectors. Vía Atacames (93,33 %) and Comedores - Las Palmas (95,56 %) are the only ones with high figures. At the other extreme, Codesa (44 %) and Valle San Rafael - La Tolita (48 %) have the lowest percentages, with Mercado Municipal (52 %) also showing poor compliance.

Based on the descriptive analysis, it can be seen that "Pest Control" and "Staff Health" are critical global parameters and represent the greatest challenges in several sectors. Furthermore, it is important to emphasize that there are sectors that need urgent intervention: the Municipal Market requires a comprehensive review, as five of its six parameters are below 60 %, with a critical 27,5 % in "Pest Control." Codesa needs substantial improvements, especially in "Staff Health" (44 %), "Pest Control" (37,5 %), and Sanitary Facilities (47,5 %). Although strong in some aspects, the Children's Park's "Infrastructure" (57,14 %) and "Sanitary Facilities" (62,5 %) are critical weaknesses.

In contrast, sectors such as Vía Atacames and Comedores – Las Palmas can serve as models of good practice for the implementation of hygiene and sanitation measures, given their high or perfect compliance in almost all parameters.

Inferential Analysis

The descriptive analysis shown in figure 1 suggested notable variations in compliance with hygiene and sanitation parameters among the different sectors of Esmeraldas. To statistically validate these observations, the non-parametric Kruskal-Wallis test was applied for each parameter, given that the assumptions of normality for the residuals were not met and the sample size per sector was small (between 2 and 10 establishments). Subsequently, Dunn's post-hoc tests with Bonferroni adjustment were performed to identify specific differences between pairs of sectors.

The Kruskal-Wallis results confirmed that there is a statistically significant difference between each hygiene and sanitation parameter evaluated and the different sectors of the city ($p < 0,05$). A closer look at the results of Dunn's post-hoc tests the observations of the descriptive analysis are validated and quantified, revealing that the Municipal Market emerges as the sector with the most pronounced challenges, showing significantly lower compliance in Sanitary Facilities, Staff Health, Pest Control, Materials and Equipment, and Product Health compared to high-performance sectors such as Las Palmas, Vía Atacames, and Valle San Rafael - La Tolita, positioning it as a critical point of intervention. Similarly, Codesa also shows significantly lower compliance in Sanitary Facilities, Staff Health, Pest Control, and Materials and Equipment compared to the best-performing sectors.

Although the Kruskal-Wallis analysis indicated overall differences in Infrastructure, post-hoc tests did not identify significant pairs, suggesting that while variability exists, individual gaps are not robust enough to be detected with the strict Bonferroni correction. These statistical findings confirm the need for specific interventions, directing attention toward the sectors with the lowest compliance in order to improve hygiene and sanitation conditions in food service establishments in Esmeraldas.

DISCUSSION

Within the food system, health determinants are essential to ensuring food security and protecting public health. This study showed that, although food is available in different sectors of Esmeraldas, access and use are conditioned by poor hygiene and sanitation that compromise safety. The absence of pest control, the poor condition of sanitary facilities, the lack of access to drinking water, and inadequate personal hygiene practices among food handlers represent specific risks that, according to the scientific literature, are associated with a higher potential for foodborne illnesses (ETA). These findings reflect that failures in sanitary infrastructure and safety practices not only affect the immediate quality of the food sold, but also undermine the stability of the local food system, increasing the population's exposure to adverse health consequences.[19]

The results obtained reflect a heterogeneous situation in terms of compliance with hygiene and sanitation parameters in establishments in different sectors of the city of Esmeraldas. In general, good practices were identified in some sectors and critical deficiencies in others, highlighting the need for differentiated interventions that reflect a heterogeneous situation in terms of compliance with hygiene and sanitation parameters, identifying both good practices in some sectors and critical deficiencies in others, which highlights the need for differentiated interventions. These trends underscore the need for formal training in food safety to address barriers that limit the implementation of good hygiene and sanitation practices.[20]

First, the descriptive analysis showed that parameters such *as Product* and *Material and Equipment*

Sanitation generally have high compliance in most sectors, suggesting a basic awareness of the importance of offering products in safe conditions and using appropriate tools. However, this positive trend is affected by low compliance in parameters such as *Pest Control* and *Personnel Sanitation,* which emerge as critical issues globally. These deficiencies are particularly concerning, as both parameters are directly related to significant risks to public health and disease transmission.

In the Codesa and Municipal Market sectors, staff health and food handling are critical factors in the weakest sectors and contribute significantly to contamination.[21] Although no microorganisms were identified here, these findings are reinforced by preliminary research on the hygienic-sanitary quality of food vending machines, in which Gram-negative bacteria were most frequently isolated, with *Enterobacteria* predominating, reasonably related to contact with consumers' hands[22] and the study conducted by Bejarano & Fandiño[23], who establish that food quality and safety are related to poor manufacturing practices throughout the food chain associated with poor hygiene habits among staff, ignorance of critical limits for biological hazards such as temperature management and disinfection times for certain foods.

Inferential analysis, using the Kruskal-Wallis test, statistically confirmed that there are significant differences in compliance with all the parameters evaluated between the different sectors. This finding validates the observation that not all sectors face the same challenges or have the same strengths. Dunn's post-hoc tests, with Bonferroni adjustment, identified the sectors with the most marked differences. Specifically, the *Municipal Market* and *Codesa* stand out as sectors with significantly lower compliance in multiple parameters compared to areas such as *Vía Atacames* and *Comedores - Las Palmas,* which are positioned as benchmarks for good practices.

The case of *the Municipal Market* is particularly worrying, as it presents a critical level of non-compliance in five of the six parameters evaluated, with emphasis on *Pest Control* (27,5 %) and *Staff Health* (52 %). This environment represents a potential source of health risks, especially considering the high traffic of people who tend to frequent these types of spaces. Similarly, *Codesa* shows structural and operational weaknesses, especially in the maintenance of *sanitary facilities* and the implementation of personal hygiene measures, which also warrants urgent attention. On the contrary, sectors such as *Vía Atacames* and *Comedores – Las Palmas* stand out for their high or perfect compliance in almost all parameters, becoming potential models for the replication of improvement strategies. Identifying these sectors as benchmarks allows for the consideration of mentoring or technical support strategies between sectors, where those with best practices can transfer knowledge or effective methodologies to the sectors that are lagging behind.[23]

An important finding of the inferential analysis is the difference observed in the *Infrastructure* parameter, which was significant at the overall level, but with no specific differences detected in the paired comparisons. This could be due to a wide distribution, but without extreme concentrations, suggesting that, while inequalities exist, they are not as pronounced as in other parameters.

The results found in Esmeraldas should not be classified as an isolated incident but rather as part of a broader national reality. Between 2015 and 2019, more than 113 695 cases of ETAs were reported in Ecuador, with an incidence of more than 100 cases per 100 000 inhabitants. The main causes were associated with salmonellosis, hepatitis A, typhoid fever, shigellosis, and food poisoning. This reveals that the hygiene and sanitation deficiencies observed in markets, street stalls, and formal establishments not only have an impact at the local level but also reflect a nationwide epidemiological pattern. A clear relationship has been established between the failure to comply with basic hygiene measures, the lack of safe water, the improper handling of food, and poor pest control, and the persistence of ETAs in the country. In this regard, the findings in Esmeraldas provide concrete evidence that reinforces the need to strengthen health surveillance and ongoing training for food handlers in order to reduce the gap between what is established in the regulations and what occurs in everyday practice.[24]

These findings coincide with those reported by Hernández et al.[12], who highlight that the lack of safe drinking water, inadequate handling practices, and poor infrastructure conditions significantly increase the risk of microbial contamination of food sold in public spaces. The difference in compliance may also be related to socioeconomic and cultural factors that determine the prioritization of investments in hygiene by establishment owners.

Taken together, the findings of this study highlight the need for targeted health planning, where resources and interventions are directed primarily to the sectors with the greatest deficiencies, as well as the importance of maintaining controls in sectors that already meet high standards, in order to avoid setbacks, highlighting the usefulness of a combined approach of descriptive and inferential statistical analysis to identify sanitation gaps and guide evidence-based decisions and the implementation of strategies to improve food safety, including modernization of the regulatory framework, investment in infrastructure development, private sector participation and enforcement support, as well as education, training, public awareness, and intersectoral collaboration with the "One Health" approach.[21]

Although this study did not directly evaluate microbiological indicators or population health data, the

results suggest a possible negative impact on public health, considering that the scientific literature directly associates poor hygiene and sanitation with an increased risk of foodborne diseases (FBD).[21,23] In contexts such as Esmeraldas, characterized by limited access to health services and safe drinking water.[17] Chila García et al, the population is more vulnerable to outbreaks of gastrointestinal and infectious diseases. For this reason, it is necessary to strengthen local health surveillance and control capacities, implement regular training for food handlers, and improve basic infrastructure, especially in the most critical sectors, to reduce the potential risk to public health.

CONCLUSIONS

This study revealed a heterogeneous situation in the hygienic and sanitary conditions of food establishments in Esmeraldas, with sectors such as Vía Atacames and Comedores – Las Palmas adequately complying with the parameters evaluated, while the Municipal Market and Codesa present critical deficiencies in pest control, staff health, and maintenance of sanitary facilities. Although microbiological indicators and clinical data were not directly evaluated, the literature shows that these shortcomings are directly related to an elevated risk of foodborne diseases, which has a negative impact on public health.

The results underscore the need to strengthen local health surveillance and control capacities and call on local authorities to implement permanent training programs for food handlers in food safety and sanitation, as well as in the identification of potential gaps that prevent compliance with regulations to establish intervention protocols that essentially guarantee food safety and the right to health in Esmeraldas.

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CONFLICT OF INTEREST

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