Food Insecurity and its relation to Socioeconomic Inequities, Food Diversity and Obesity: A Cross-sectional Pilot Study among Indigenous Women in the Lake Atitlán Area, Guatemala

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2024

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Global Health at the University of Bergen

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Abstract

Background: Guatemala faces several challenges related to high levels of poverty, malnutrition, and food insecurity, despite being classified as an upper-middle-income country. These problems are a reflection of the country's historical inequalities and the perpetuation of conditions that affect the health and economic development of the most vulnerable populations. **Aim:** The present study aimed to assess food insecurity in households of Tz'utujil Maya women living around Lake Atitlán, in Guatemala, and to relate it to socioeconomic factors, dietary diversity, and anthropometric measures. **Methods:** This cross-sectional pilot study investigated the subsample of women responsible for food provision in their households, who had previously participated in the Respiratory Health in the Lake Atitlan (2021). Data were collected via digital questionnaires using the Kobotoolbox software. The assessed variables included food insecurity, measured by the Household Food Insecurity Access Scale (HFIAS), socio-demographic information, dietary diversity assessed by the Minimum Dietary Diversity for Women (MDD-W), and levels of general and abdominal obesity, evaluated through anthropometric measures. The study population comprised 86 Tz'utujil Mayan women aged 18-49 years who were recruited over a three-week period in the municipality of San Pablo la Laguna, Guatemala. **Results**: The prevalence of severe food insecurity stood at 64%, with only one household (1.2%) reported as food secure. Notably, 28% experienced moderate food insecurity, and 7% faced mild insecurity. However, economic hardship was widespread, as 97% of households experienced monetary poverty, and educational attainment was relatively low, with 64% having incomplete or only primary education. Furthermore, just 12.8% of households could afford the daily food basket per household size. Despite these health concerns, the majority (92%) achieved minimum dietary diversity. The average body mass index (BMI) was 30.1 kg/m², with 49% classified as obese. Additionally, 59% had high waist circumference, with 50% showing increased central adiposity, and 29% displaying high central adiposity based on the waist-to-height ratio. **Conclusions**: This study reveals the worrying reality for indigenous Mayan Tz'utujil women in San Pablo, Guatemala, with two-thirds of the assessed households facing severe food insecurity. A complexity of factors relevant for community health were found, such as high levels of poverty, low levels of schooling, as well as high levels of both obesity and stunting.

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List of abbreviations

BMI: Body Mass Index.

CEGSS: Center for the Study of Equity and Governance in Health Systems.

ECLAC: Economic Commission for Latin America and the Caribbean.

HFIAS: Household Food Insecurity Access Scale.

INE: Instituto Nacional de Estadística de Guatemala.

LMIC: Low- and middle-income countrie

MDD-W: Minimum Dietary Diversity for Women.

Q: Quetzales.

REDC *Salud*: *Red de Defensores Comunitarios por el Derecho a la Salud.*

REK: Norwegian Regional Health and Medical Research Ethics Committees.

US$: US dollars.

WHO: World Health Organization.

WC: Waist circumference.

WHR: Waist-hip circumference.

WHtR: Waist-to-height ratio.

Acknowledgments

The last two years of my life have been particularly challenging and exciting at the same time. As a Peruvian, experiencing a master's degree in a country so far away from my own, with high standards of education but separated from my loved ones and the food I cherish, has been particularly difficult.

I couldn't culminate this educational stage without thanking some people who helped me during these two years of adventure. First of all, I want to thank Cecilie Svanes and Juan Pablo López, my supervisor and co-supervisor, who provided me with guidance and contributed constantly to the design and completion of this thesis. I am very grateful for all their comments and advice. Additionally, I want to express my gratitude to Lorena Ruano, who offered me advice, friendship, and guidance in moments of crisis.

I also want to acknowledge Fernando Jerez and Chloë Carpi, with whom I shared the adventure of this fieldwork, sharing experiences. We faced the bitterness of the unfair inequality that many indigenous women face and overcame episodes of risk as we moved around in Tuc Tucs to reach our destination.

Additionally, to all the Maya women who accepted to participate in our research and shared their stories with us, thank you very much. Within this group, I want to extend a special gratitude to Paulina Culum, the leader who guided us, advised us, and made us feel at home during those three weeks.

Lastly, I want to express my gratitude to my parents, sisters, grandmother, and my partner in adventures, Carolina. Without you, this journey would have had no meaning.

1 Introduction

1.1 Food insecurity

According to data published in 2021, approximately 29% of the global population suffered from severe or moderate food insecurity, which was particularly common in low- and middle-income countries (LMICs). However, while Guatemala is not classified as an LMIC (1), severe or moderate food insecurity was reported to be 56% (2).

By examining Guatemala more closely, the situation becomes even more troubling. A food insecurity prevalence of 100% has previously been found in indigenous Guatemalan households, with 49% presenting it at a moderate level and 51% at a severe level (3). Food insecurity in Guatemala is closely linked to economic disparities and inequities within the population. These inequities are particularly pronounced among the historically marginalized indigenous population, where socioeconomic, educational, and nutritional factors are unfavorable (4).

Food security refers to a state in which individuals have, at all times, the possibility of having physical and economic access to food that must be necessary, safe, and nutritious, and which can satisfy dietary needs and preferences for an active and healthy life. It encompasses four main components: availability, physical and economic access, biological use, and stability over time (5). While all are essential, researchers typically focus extensively on physical and economic access to food, as the other three components are derived from it. The access component looks at factors such as the physical availability and economic capacity to purchase food, which also includes fair food distribution and equitable access to food resources (6).

The presence of food insecurity is usually linked to factors such as inadequate political decision-making by states, corruption, a diminished number of job opportunities, political centralization, and environmental conditions (7). Added to these components, global population growth and armed conflicts or wars generate repercussions that directly and indirectly affect the sustainability of food systems (8).

As mentioned, inhabitants of LMICs are particularly susceptible to increased food insecurity. Moreover, these nations are also more likely to have populations with nutritional statuses

below recommended levels (9). The impact of food insecurity and poverty has been assessed, concluding that even mild forms of food insecurity affect child development (10), and women due to their more entrenched caregiving roles in states of economic deprivation (11). A comprehensive analysis of food insecurity must therefore consider the inclusion of socioeconomic inequalities in the assessment process, as these factors are intrinsically interconnected.

1.2 Socioeconomic impact on health and diets

Understanding health from a global perspective must be achieved through an understanding of the social determinants of health, that could help explain the existence of food shortages and food insecurity (12). This is evident when considering specific determinants like the lack of economic resources, a primary cause of disease outbreaks that can persist from one generation to the next, leading to the "circle of poverty" phenomenon. This generational cycle of poverty originates in social disadvantages and lower socioeconomic populations. Childhood undernutrition leaves lasting cognitive effects that may be passed on to the next generation (13). Consequently, parents who experienced it during childhood strive to provide a better quality of life for their children despite lacking access to well-paid jobs with better conditions As a result, there's a high likelihood that children will grow up in a similar poverty situation to their parents, replicating the model with future offspring (14).

The impact of socioeconomic inequities is also noticeable when it comes to households making dietary choices. Parents with lower levels of education and household income often tend to offer diets with fewer fruits and vegetables, and a higher consumption of calorie-dense and processed foods. One of the primary reasons for this is the lack of nutritional education, which influences decision making, coupled with the lower cost of processed foods, allowing parents or those in charge of food management in the house to access a higher calorie intake in relation to the money spent on food (15).

The easy access to calorie-dense foods creates greater inequities in the population concerning malnutrition. The prevalence of malnutrition often varies based on socioeconomic levels, with undernutrition states primarily occurring in poor households. However, the prevalence of

overweight and obesity varies significantly based on geographical location concerning socioeconomic status (16).

Indigenous communities, particularly in Latin America, have been subjected to various aspects of socioeconomic inequity, being part of a population with a historical background of persistent and ongoing racism, mistreatment and social exclusion by the states. This inequity and abuse create an ideal environment for the development of limited trust in the healthcare system, which exacerbates socioeconomic inequities and therefore health inequity (17, 18).

1.3 Food diversity

Dietary diversity, defined as the presence of a variety of foods in one's diet, is widely recognized as a fundamental element of optimal nutrition (19). Beyond the quantity of food consumed, ensuring adequate diversity enables individuals to incorporate a broad spectrum of foods, enhancing the nutritional quality by providing a range of essential micro and macronutrients.

Depending on the life stage, individuals require a distinct nutritional profile. Women of reproductive age represent a population group with some of the highest nutritional needs and are particularly vulnerable due to potential physiological demands associated with pregnancy or lactation (20). This is why there is interest and strategies in place to measure this multidimensional component and, in turn, promote dietary diversity in this population. An example of this is the technical document "Minimum Dietary Diversity for Women" (MDD-W), which aims to transition from data collection to formulating appropriate programs and policies targeting women (21).

It's crucial to acknowledge the distinct nutritional needs of women of reproductive age, keeping in mind potential risks associated with the current access to ultra-processed foods fueled by globalization. This growing interdependence in the global food trade has made industrialized foods, known for their high-calorie content and low micronutrient quality, more accessible to people (22). There is already evidence that the dietary diversity introduced by these ultra-processed or unhealthy foods may be a significant factor contributing to the global rise in the obesity epidemic (23).

1.4 General and abdominal obesity

Obesity is a public health problem worldwide and is considered a pandemic, with tripled prevalence since 1975, often explained by a decrease in daily physical activity and the consumption of ultra-processed foods (24). By 2015, it was estimated that the prevalence of obesity and overweight worldwide reached 39% (25). Obesity increases the risk of metabolic diseases such as diabetes mellitus, arterial hypertension, and atherosclerosis, among others (26).

The Americas Region stands out with the highest global prevalence of overweight (61%) and obesity (27%) (27), reflecting significant regional disparities. While historically associated with affluence, obesity is increasingly linked with poverty, particularly evident in socioeconomically disadvantaged populations. In Latin America, obesity rates are progressively rising, especially among those with lower socioeconomic status and limited education. Rural women and urban men, in particular, exhibit a higher prevalence of obesity (28).

The World Health Organization (WHO) describes obesity as abnormal fat accumulation that impairs health status. This diagnosis is usually given through a measurement that considers the values of weight and height called Body Mass Index (BMI). Adults with a BMI within the cutoff points of 18.5 to 24.9 kg/m^2 are considered to have a normal weight for their height; from 25 kg/m2 to 29.9 kg/m^2 are considered overweight; and greater than or equal to 30.0 kg/m^2 are considered to have obesity (29). Despite the wide use of this indicator worldwide, sufficient evidence classifies BMI as a poor indicator (30). The primary disadvantage with the use of BMI is the lack of differentiation between body fat and abdominal fat, the latter being more often associated with the onset of metabolic syndrome (31).

Another parameter that provides more information about the risk of cardiometabolic diseases is called abdominal obesity, which usually is associated to environmental or genetic factors (32). Abdominal obesity can be measured using parameters such as waist circumference (WC), waist-hip circumference (WHR), and waist-to-height ratio (WHtR) (33). The WC, WHR, and WHtR perimeters are quick, simple, and inexpensive obesity indicators that can be applied at any level of care in a health system.

The WC is the simplest way to measure abdominal obesity. An adult is considered to have abdominal obesity if individuals have a WC greater than 88 cm in women, and 102 cm in men (29, 32). The risk of metabolic diseases is increased with values over 94 cm for men and 80 cm for women, and a substantially increased risk with the cut-off point of 102 cm for men and 88 cm for women (29). However, it is worth noting that WC in women can be considered high already starting from 80 cm, and having a measurement within this range may contribute to a higher systolic blood pressure (34).

Another useful indicator for disease risk is the WHtR. For adult men, a WHtR exceeding 0.52, and for women, exceeding 0.53, indicates an elevated risk of developing diabetes, while values of 0.53 for men and 0.50 for women suggest a higher likelihood of cardiovascular diseases. WHtR values of 0.50 for both men and women are associated with increased risk of metabolic syndrome and hypertension (35). To accurately assess abdominal fat, the National Institute for Health and Care Excellence has defined three distinct WHtR cut-off points: 0.4 to 0.49 indicating healthy central adiposity, 0.5 to 0.59 suggesting increased central adiposity, and 0.6 or greater indicating high central adiposity (36).

1.5 Guatemala and indigenous communities

Guatemala, with a population of approximately 17.6 million, is categorized as an upper-middle-income country based on data from the World Bank (1). Despite its apparent economic stability and position as the highest-income country in Central America in terms of population and economic activity by 2022, significant challenges persist in terms of poverty reduction and inequality mitigation. Of particular concern, is the alarming prevalence of chronic malnutrition in the country, surpassing that of any other country in Latin America and the Caribbean (37). Importantly, indigenous communities and rural populations bear the brunt of this issue, experiencing the most severe consequences of malnutrition.

A Guatemalan household is considered to be living in poverty if its monthly income is below 10,218 quetzales (Q) or approximately 1,312 US dollars (US$) at the time of writing (38). The basic daily food basket to feed a family of 4.7 people as for January 2023 was Q109.6, or US$14.07 (39). Although Guatemala is not classified as a low-income country, the incidence of

monetary poverty at the national level is 50.5%, with a rate of 65.8% in rural areas. Specifically, 76.2% of the poverty is concentrated in the indigenous people living in rural sectors (40).

Regarding the ethnic groups, populations are identified as Ladinos, Maya, Xinka, Creole and Garifuna. According to a 2021 report, the largest proportion of these groups identify themselves as Ladino, with 63.4%, 35.0% as Maya, and 2.1% as Xinka (41). Despite the large proportion of the population identified as indigenous, there is structural racism and discrimination towards this group, which is manifested even at public state institutions. Discrimination scenarios in the health sector describe acts ranging from indifference against this population, to violence and coercion (42).

Structural and historical discrimination towards indigenous traditions generated a social consciousness of an exclusive nature toward what it means to be indigenous. Being indigenous is still considered, by a part of the population, as a synonym for backwardness and guiltiness for the country's failure. On the other hand, this feeling of contempt created a sense of identity, belonging, and preservation of cultural traditions within indigenous populations, in which the overprotection of identity also prevents the development and adoption of fundamental human rights, such as that of indigenous women, who are culturally in a state of inferiority compared to men (43).

The Lake Atitlán Respiratory Health Pilot Study, undertaken by researchers from the University of Bergen in 2021, and performed on a difficult-to-reach indigenous Mayan population, highlighted some of the stark realities faced by these communities. The study investigated respiratory health along with a range of general characteristics and risk factors. One notable finding was the population's short stature, with a mean height of 146 cm in women and 159 cm in men. Women additionally had a mean BMI of 30.1 kg/m², categorizing them as obese (44).

1.6 Dietary Factors in the Guatemalan Diet

Traditional Guatemalan diets, primarily prevalent in rural areas, rely heavily on carbohydrates as their main source of calories, with the indigenous population obtaining 71% of their energy from this source, compared to 66% for the non-indigenous population. The corn *tortilla* stands out as the primary carbohydrate source for this population, particularly prevalent in households

with higher levels of poverty (45). However, it is important to highlight that scientific evidence cannot conclude that maintaining diets with a high carbohydrate content is responsible for a possible increase in the prevalence of obesity (46).

Diets in rural areas in Guatemala tend to be less diverse compared to urban counterparts and typically relied on the consumption of plant-based foods (47). This trend is also marked by a progressive increase in the consumption of processed foods and beverages, a shift closely linked to economic factors, effective distribution strategies, and advertising practices prevalent across all supply centers (48).

Moreover, an important component in the history of the Guatemalan diet is the shift from a traditional to a Western diet, influenced by urbanization and economic changes, which is linked to the affordability of processed foods. This change involves introducing and incorporating foods that were not previously or commonly consumed, like red meat and dairy products. Crucially, adhering to the Western diet in Guatemala is associated with elevated annual household expenditures. In essence, as spending rises, the probability of embracing this Western-like dietary pattern also increases. In addition, women with higher educational level may be less likely to stick to the traditional diet (48).

1.7 Statement of problem and rationale

Food security has gradually evolved from being considered primarily as a necessity to being recognized as a fundamental human right. However, indigenous communities have historically faced exclusion and socioeconomic inequities, with lower economic income, low levels of schooling and poorer nutritional status. Within these communities, women typically bear the responsibility of providing food, but still experience disproportionally the adverse effects of malnourishment. Conforming to their gender roles within the family unit, women are frequently marginalized, consuming less food to prioritize the nourishment of their children or allocating larger food portions to men, who are assumed to need more energy to work and fulfill their role as economic providers for the family (49).

The global prevalence of obesity among women is on the rise across all socioeconomic levels, with a pronounced increase observed among those with lower incomes. This increase in obesity

rates among the economically disadvantaged has been particularly pronounced in the last few decades, especially in LMICs and rural areas, the latter being the setting in which Guatemala's traditional indigenous communities live (28).

The Lake Atitlán area, located in the Guatemalan highlands and surrounded by numerous rural villages, is considered a major tourist attraction. However, what many tourists may not realize is the presence of inherent health conditions among the population, such as a worrying trend of high BMI among its residents. Notably, two studies found that the local residents exhibited obesity, with women presenting a mean BMI of 30.1 in one study (50), and a mean BMI of 29.1 in the second, which included an adult population with both men and women in the area (44).

Moreover, in countries like Guatemala, globalization has led to increased access to affordable, ultra-processed foods, directly contributing to the global obesity epidemic (23). This concern underscores the importance of understanding how food insecurity and food affordability are linked with factors such as dietary diversity and overweight/obesity, which are particularly crucial in children, adolescents, and women of reproductive age.

Even with the well-established health risks associated with obesity, there remains a notable scarcity of research conducted within the context of poverty and obesity in rural areas, such as in indigenous communities in Guatemala. While it is commonly believed that food insecurity is linked to states of malnutrition resulting from deficits in essential nutrients, the potential role of food insecurity in relation to obesity is largely unexplored.

Investigating this in hard-to-reach populations, such as Maya communities, poses challenges due to mistrust of health workers and language barriers, making such populations difficult to access for researchers and authorities alike (17). This scenario highlights the urgent need to study and understand the complex interplay of factors that may influence the daily lives, circumstances and challenges faced by women in Mayan communities. By bringing attention to these issues, further research can contribute to the development of targeted interventions and policies that address the intricate relationships between food insecurity, socioeconomic inequity states, dietary diversity and the alarming prevalence of obesity in vulnerable populations.

1.7.1 Research question

What is the level of household food insecurity reported by Tz'utujil Maya women around Lake Atitlán, Guatemala, and how does this food insecurity correlate with socioeconomic factors, dietary diversity, and obesity within these communities?

1.7.2 Aim

This pilot field study aimed to investigate food insecurity levels in households of Tz'utujil Maya women living around the Lake Atitlán in Guatemala and to assess its relation with socioeconomic factors, dietary diversity and obesity in the same population. For this reason, the following specific objectives are further presented:

1.7.3 Specific objectives

1. Assess the level of household food insecurity in this Tz'utujil indigenous population using the Household Food Insecurity Access Scale (HFIAS).
2. Determine socioeconomic factors such as monetary poverty, educational level and household food expenditure in the households.
3. Investigate the associations of household food insecurity with socioeconomic factors, dietary diversity and obesity in this population.

2 Methods

This master's project was conducted as part of a field study carried out over a three-week period in February 2023 in the municipality of San Pablo La Laguna, situated by the Lake Atitlán in Guatemala. It focused on food insecurity, and the data were collected at the same time as two other projects focusing on food diversity and on chemical occupational exposures, respectively. These three field investigations included different subgroups of persons who had previously participated in the Lake Atitlán Respiratory Health Study in 2021 (44).

2.1 Study design

We conducted a cross-sectional study in San Pablo la Laguna, located by Lake Atitlán in Guatemala. During this study, participants were interviewed using the Household Food Insecurity Access Scale (HFIAS) questionnaire to assess and characterize levels of food insecurity at the household level and the "Minimum Dietary Diversity-Women"(MDD-W) to measure dietary diversity. Additionally, we collected information on socioeconomic variables, including the number of people living in each household, marital status, educational level, experience of monetary poverty, individual level food budget within the household (to assess coverage of the basic family basket), and whether study participants' households had received support from any food assistance program in the last 6 months. Furthermore, we measured height, weight, and abdominal circumference in all participants to describe their physical status and determine the presence of general or abdominal obesity.

2.1.1   Location and Setting

The study was conducted in the Southwestern region of Guatemala, specifically in the Sololá department, around the Lake Atitlán (Figure 1). Numerous indigenous villages surround the lake, and San Pablo la Laguna was selected for examination because the Lake Atitlán Health Respiratory Study was conducted there. It is estimated that as of June 2022, the population of San Pablo la Laguna was approximately of 8,063 inhabitants (51), with 99.68% identifying themselves as indigenous, belonging to the Maya community (52).
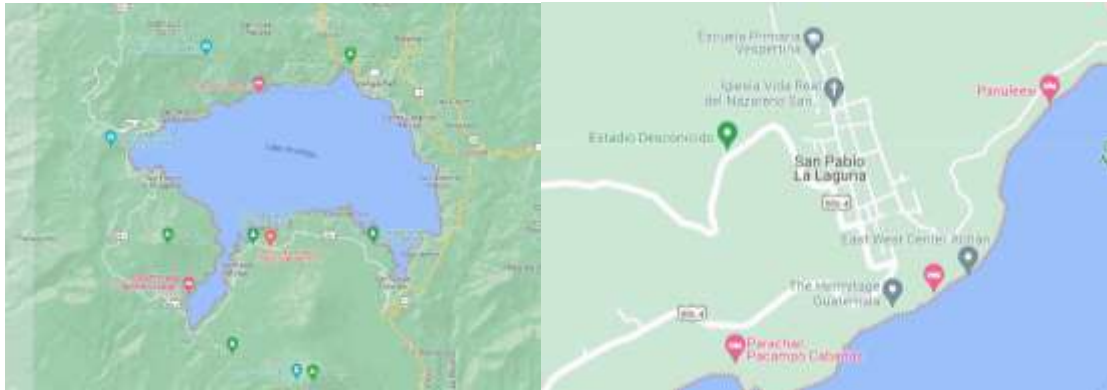
Figure 1 Map of the localization of the Lake Atitlán and San Pablo la Laguna. From Google maps, 2023. Google Maps (online). https://www.google.com/maps/place/Lake+Atitl%C3%A1n/@14.7157389,-91.2702958,14.38z/data=!4m6!3m5!1s0x85894ac7c083b493:0xa6e33f7d6b54910!8m2!3d14.6906713!4d-91.2025207!16zL20vMDN3NXpy?entry=ttu

2.1.2 Target population

The Lake Atitlán Respiratory Health Study implemented a two-stage sampling approach when it was conducted in 2021. In the initial phase, the researchers engaged with weavers' organizations in the Sololá region that had established collaborations with the non-governmental organization Center for the Study of Equity and Governance in Health Systems (CEGSS) to evaluate their interest in participating in the study on respiratory health. The adoption of a community-driven approach was essential to address any apprehension or uncertainty surrounding involvement in a study conducted by foreign institutions. Once the interest of the organizations was confirmed, a community leader and member of the weaver´s organization *Red de Defensores Comunitarios por el Derecho a la Salud* (REDC *Salud*) was selected to facilitate the recruitment process of the participants. The initial recruitment process followed a convenience sampling method, inviting weavers from the REDC *Salud* organization, located in San Pablo la Laguna, where the community leader resided, based on recommendations from CEGSS.

In the second phase of sampling, a snowball sampling method was used. This approach involved asking the weavers in the REDC *Salud* organization to propose individuals who would be suitable

for the study, specifically, women who engaged in knitting or weaving activities and who met the inclusion criteria. Each selected woman had the opportunity to invite to the study up to three household members, including children, husbands, siblings, or parents. As a result, the study included a total of 291 participants.

For the purpose of this research, the target population was defined as women aged 18-49 years old who were responsible for food provision in their households, and who had previously participated in the Lake Atitlán Respiratory Health Study in 2021.

2.1.3 Number of participants and sampling of the study population

From the sampling frame of 291 study participants of the Lake Atitlán Respiratory Health Study, we identified 147 women aged between 18 and 49 years who were in charge of the household food provision. These women were approached by the same community leader who recruited the study participants in 2021. Her task was to reach out to these 147 women through phone calls, WhatsApp messages, and home visits. This approach resulted in a final sample of 86 women, yielding a response rate of 58%.

2.1.4 Inclusion and exclusion criteria

Based on the selection criteria of the two questionnaires used, it was decided to work exclusively with adult women over 18 years of age who were responsible for planning, purchasing, and/or preparing household food, as outlined in the HFIAS food insecurity questionnaire. It is important to note that only one woman per household, specifically the individual responsible for family food planning, was eligible to participate.

Women with diagnosed conditions such as diabetes, hypertension or renal insufficiency, which would prevent them from adhering to the same dietary practices as the rest of the household members, were excluded from participation in the study. Likewise, pregnant women were also excluded from the research, as these specific health situations require tailored dietary considerations that might not align with the study's parameters. Figure 2 shows the process of study sample selection.
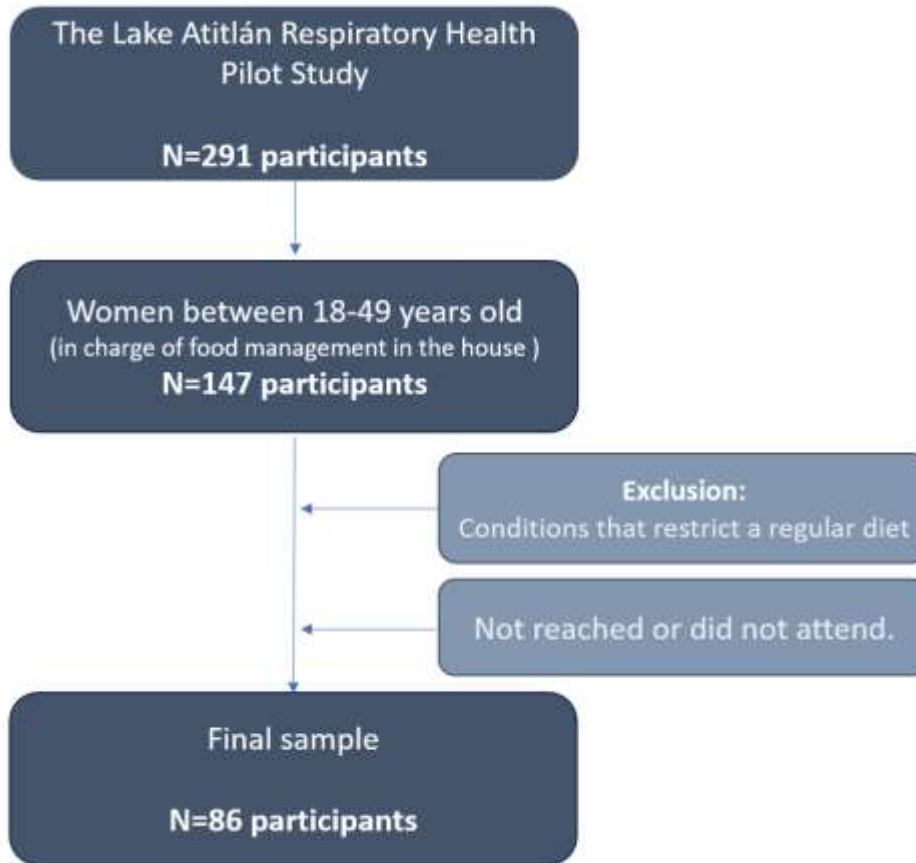
Figure 2: Flowchart of the study participant sampling process

2.2 Assessing food insecurity using the Household Food Insecurity Access Scale

The HFIAS (Appendix 1) is a standardized food insecurity measurement tool developed by the United States Agency for International Development and the Food and Nutrition Technical Assistance Project (53).

The HFIAS questionnaire consists of nine main occurrence questions inquiring whether a particular condition took place within the last four weeks. The possible answers are limited to either "yes" or "no"; as the questions progress, an affirmative answer could represent a higher level of food insecurity. The nine occurrence questions are grouped under three components: "Anxiety and uncertainty about the household food supply," "Insufficient Quality," and

"Insufficient food intake and its physical consequences" (53). Finally, a frequency sub-question follows each of the occurrence questions to know the periodicity of each condition.

First, the component "Anxiety and uncertainty about the household food supply" focuses on concerns related to food availability within households. It is assessed through a single question: Q1) "Did you worry that your household would not have enough food?" (53).

Secondly, the component "Insufficient Quality" is subdivided into three questions which are about the perception of the individuals regarding the inadequacy of the quality of available food within the household (53):

- Q2) "Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?"
- Q3) "Did you or any household member have to eat a limited variety of foods due to a lack of resources?"
- Q4) "Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?"

Finally, the last component "Inadequate food intake and its physical consequences" examines how insufficient food intake affects people's physical health and is subdivided into five questions (53):

- Q5) "Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?"
- Q6) "Did you or any household member have to eat fewer meals in a day because there was not enough food?"
- Q7) "Was there ever no food to eat of any kind in your household because of a lack of resources to get food?"
- Q8) "Did you or any household member go to sleep at night hungry because there was not enough food?"
- Q9) "Did you or any household member go a whole day and night without eating anything because there was not enough food?

Based on the collected responses, households can be classified into different levels of food insecurity, ranging from food security to mild, moderate, and severe food insecurity. A household is classified as having a certain level of food insecurity based on affirmative responses to specific conditions or frequencies. A more severe classification of food insecurity is assigned if the respondent acknowledges more severe conditions or experiences them more frequently. For example, for a household to be classified as experiencing severe food insecurity, the household's food provider must respond affirmatively to situations such as lack of food for consecutive days (questions Q5a and Q6a) or the inability to meet basic food needs due to lack of resources (questions Q7a, Q8a, and Q9a) (Appendix 1) (53).

The HFIAS is officially translated into three different languages: English, French, and Spanish (53), with the latter being the version used in this research. Two studies conducted in rural Tanzania and India (54, 55) have demonstrated its acceptable internal validity, particularly in relation to the components addressing insufficient food quality and intake.

2.3 Socioeconomic inequities

The assessment of socioeconomic inequities included questions regarding educational level, daily food budget, household size, coverage of the daily food basket per household size, participation in a food assistance program, the number of children aged 0 to 12 years in the household, the number of adults aged 18 to 49 years in the household, marital status, and estimated monthly income. Subsequently, these data were contrasted with national documents from the National Statistics Institute of Guatemala (*Instituto Nacional de Estadística de Guatemala,* in Spanish*,* INE).

The variable "educational level" required special consideration due to the inclusion of the level known as "diversified education". In Guatemala, diversified education enables individuals to pursue specialized studies within the school system, focusing on the professions they intend to pursue. For the purposes of this analysis, the term "diversified education" has been replaced by "high school" and grouped with university education for the analysis.

To assess monetary poverty or expenditure on the basic daily family basket, the latest INE report from January 2023 was consulted. According to this report, the suggested monthly basic

basket to feed 4.7 individuals in the household was Q3,638.16 (56). As there is no distinction in this estimate between adults or children, an approximate daily expenditure was calculated per person, resulting in a daily basic personal basket of Q22.98.

INE defines monetary poverty for individuals earning less than Q10,218 per year (57). Since the information gathered from the participants was about the average monthly household income, these monthly figures were divided by the number of household members and then extrapolated to an annual estimate based on 12 months.

2.4 Dietary diversity

MDD-W, short for Minimum Dietary Diversity for Women (Appendix 2), is a technical questionnaire developed by the Food and Agriculture Organization of the United Nations. It is specifically designed to evaluate the dietary diversity of women aged 15 to 49 years. This involves categorizing the necessary food groups into ten distinct categories, with an additional inclusion of three categories specifically for unhealthy food groups (21).

A woman is considered to meet the minimum dietary requirement or the minimum diversity score if she consumes at least five out of the ten food groups. It is important to note that no groups classified as unhealthy food groups are included in the count. This indicator directly helps determine whether there is a higher level of micronutrient sufficiency in the individual or population being assessed (21).

The ten essential food groups comprise: "grains, white roots and tubers, and plantains"; "pulses (beans, peas and lentils)"; "nuts and seeds"; "milk and milk products"; and "meat, poultry and fish";"eggs"; "dark green leafy vegetables"; "other vitamin A-rich fruits and vegetables"; "other vegetables"; and "other fruits". Additionally, there are three groups identified as unhealthy food groups, which include "fried and salty foods"; "sweet food", and "sweet beverages" (21).

The MDD-W guidelines emphasize the alignment of food choices with local dietary habits (21). Therefore, the adapted MDD-W questionnaire incorporates pictures of foods and focuses on the seven most commonly consumed food categories to ensure an accurate representation of dietary patterns. Additionally, consultation with the indigenous community leader was

undertaken to tailor the questionnaire to the population's preferences, culminating in the final version (Appendix 2) (58).

2.5 General and abdominal obesity

The categorization of general and/or abdominal obesity in the sample was determined through anthropometric measurements (i.e., height, weight and waist circumference). To assess general obesity, BMI was utilized, calculated by dividing weight in kilograms by height in meters squared. In this context, women with a BMI equal to or greater than 30 kg/m² were classified as obese.

On the other hand, for abdominal obesity, two distinct indicators were employed: WC and WHtR. Women with a WC equal to or greater than 80 cm were categorized as having an elevated WC. Concerning the WHtR, women with ratios equal to or greater than 0.5 and 0.6 were considered to have increased and high central adiposity, respectively.

Anthropometric measurements were obtained using standardized equipment. A Seca 813 model flat scale and a portable AnthroFlex wall-mounted stadiometer were used for weight and height measurements, respectively. Also, a pocket tape measure was employed to measure WC, following established Standard Operating Procedures for anthropometric assessments (59).

Women in the Lake Atitlán area typically wear traditional clothing, consisting of several layers, and removing these clothes to obtain the measurements could have been challenging, uncomfortable and even disrespectful. Therefore, anthropometric measurements were conducted with clothes on. Additionally, the complete traditional attire, including a blouse, skirt, and wide belt, was provided by the community leader to the team to facilitate measurements and weighing. Three measurements were taken, both with and without the attire, using a single female to calculate the adjustment value. The average weight obtained was 1.62 kilograms with a standard deviation of 0.12, and there was an increase in waist thickness by 12.2 centimeters with a standard deviation of 0.28.

2.6 Attendance of participants

At the beginning of the research, the data collection initially planned to conduct surveys and measurements in the municipal hall of San Pablo. With the assistance of the community leader, who spoke with the mayor of the municipality and obtained permission for its use throughout the intervention period, this plan was established. However, while the initial days of data collection experienced a good turnout of participants, the number gradually declined over time. Therefore, starting from the third week, we opted to modify our approach and initiate home visits rather than awaiting participants' attendance, thereby achieving the final sample.

2.7 Statistical analyses

The Kobotoolbox© software was utilized for administering digital-based questionnaires, including the population baseline questionnaire, HFIAS, and the MDD-W. This platform facilitated data collection on portable devices such as tablets, smartphones or laptops, even in offline mode. It also provided notifications for incomplete survey fields, simplifying the data digitization process.

Statistical analyses were conducted using STATA version 18. Descriptive analyses were conducted to summarize various aspects, including general characteristics, socioeconomic inequities, anthropometric status, food insecurity, and food diversity. Fisher's exact test was utilized to explore potential associations between food insecurity categories and other variables. Food insecurity was categorized into mild and moderate levels, with severe food insecurity chosen as the reference category. Similarly, when examining the relationship between food insecurity and anthropometric variables of general obesity, obesity was classified as either obese or non-obese, with overweight individuals included in the non-obese category.

2.8 Ethical approvals

The ethics protocol for the pilot study had previously been received for the Lake Atitlán Respiratory Health Pilot Study, which obtained ethics approval from the Norwegian Regional Health and Medical Research Ethics Committees (REK) (Appendix 3) (reference number 203917) and the Guatemalan Ministry of Health Ethics (Appendix 4) (reference number 29-2020). The

substudy protocol was submitted for review as an extension of the first pilot study to the Norwegian and Guatemalan committees, receiving approval from both entities.

The research was considered low risk for participants as data collection exclusively employed non-invasive methods, such as questionnaire administration. Physical contact with participants was limited to anthropometric measurements. Additionally, participation in the study did not mandate any alteration to participants' habits or diet. It was clarified to them that participation was entirely voluntary, and that they could stop with the questions or anthropometric measurements at any time if they saw fit. Finally, the participants received information regarding the benefit of participating in the research.

3   Results

3.1 Characteristics of the study population

A final sample of 86 indigenous Maya Tz'utujil women (Table 1), responsible for daily meal planning in their households, was included in the study. The mean age of the participants was 34.4 years of age (range 19-94 years).

In terms of food insecurity, only one household could be identified as potentially food-secure, while the remaining households had some degree of food insecurity. The notable prevalence of severe food insecurity stands out at 64%. Additionally, a substantial proportion of surveyed households experiences moderate food insecurity, reaching a prevalence of 28%, and only 7% were categorized as mildly food insecure.

With regard to minimum dietary diversity, 92% of the interviewed population consumes five or more groups considered to be healthy or, in other words, reached a minimum dietary diversity according to the MDD-W guide. In contrast, only 8.1% reported not meeting this requirement, nor reaching an adequate intake of micronutrients.

In the educational component, the participants showed relatively low levels of education, with 64% of the sample indicating that they have not completed or have only completed primary level studies, and 18.6% reporting a similar status with respect to secondary education. Those who studied or completed high school represented 17.4% of the population, along with one participant who reported having some form of university education.

The data about the economic situation by households reveals an estimated 97% of monetary poverty, with an average monthly family income of Q1000 (ranging from Q112 to Q4000). On average, approximately Q12.3 are spent per individual in the household to buy food, and only 12.8% of households can cover the daily food basket per household size.

This intricate economic scenario also underscores the diverse family structures within the community, with only 59% of surveyed women reporting being married or having a partner. Similarly, household size varies significantly, ranging from 1 to 15 persons, with some households having up to 6 children aged between 0 and 12 years old.

Finally, the anthropometric measurements showed uniform data within the population, revealing an average height of 144.9 cm with a standard deviation of 4.6. A considerably high prevalence of overweight and obesity was also identified in relation to the BMI, with an average BMI of 30.1 kg/m². Specifically, 30% of the women were classified as overweight, while 49% were categorized as obese. Additionally, a significant proportion of participants showed a high WC (59%), and the WHtR predominantly ranged from increased to high central adiposity, with percentages of 50% and 29%, respectively.

Table 1. Characteristics and Anthropometric Measurements of Indigenous Tz'utujil Women Aged 19-49 Responsible for Household Food Provision in San Pablo la Laguna, Guatemala

	All participants (n=86)
Age, years	
Mean (SD)	34.4 (7.9)
Househlod food insecurity, n (%)	
Food secure	1.0 (1.2)
Mildly food insecure	6.0 (7.0)
Moderate food insecure	24.0 (28)
Severely food insecure	55.0 (64)
Educational level, n (%)	
Primary incomplete/completed	55.0 (64)
Secondary incomplete/completed	16.0 (18.6)
Highschool/University	15.0 (17.4)
Monetary poverty, n (%)*	
Households in monetary poverty	82.0 (97)
Households in non-monetary poverty	3.0 (3.5)
Food budget per person, median (range)	
Daily food budget per family member in quetzales	12.3 (3.2-67)
Estimated monthly income, median (range)	
Estimated monthly income per household in quetzales	1000 (112-4000)

Household size, median (range)	
Number of members	4.0 (1 - 15)
Number of children aged 0-12 years, per household	1.0 (0-6)
Number of adults aged 18-49 years, per household	2.0 (1-15)
Food basket, n (%)	
Families that covered daily food basket per household size	11.0 (12.8)
Food assistance, n (%)	
Participants who received food assistance in the last 6 months	14.0 (16.5)
Marital status, n (%)	
Single	23.0 (27)
Married or in a relationship	51.0 (59)
Separated/divorced	8.0 (9.3)
Widow	4.0 (4.7)
Food diversity score, n (%)	
Reached minimum dietary diversity†,	79 (92)
Did not reach minimum dietary diversity	7 (8.1)
Anthropometric measurements	
Height cm, mean (SD)	144.9 (4.6)
Weight kg, mean (SD)	64.6 (11.6)
BMI, kg/m²‡, Mean (SD)	30.1 (5.8)
BMI, categories, n (%)	
Normal	18.0 (21)
Overweight	26,0 (30)
Obesity	42.0 (49)
Waist circumference cm§, Mean (SD)	93.2 (9.2)
Waist circumference, categories, n (%)	
Elevated waist circumference	51.0 (59)
Normal waist circumference	35.0 (41)

Waist-to-height ratio ¶	0.6 (0.7)
Waist-to-height ratio, categories, n (%)	
Healthy, no central adiposity	10.0 (11.6)
Increased central adiposity	43.0 (50)
High central adiposity	25.0 (29)

FOOTNOTES:

- *For this indicator, the average monthly income per household has been calculated, divided by the number of members in the household and multiplied by 12 months. If the value was equal to or greater than 10,218 quetzales, it was considered a Households in non-monetary poverty.

- † Obtained through the MDD-W questionnaire. Previously published results by MSc Chloë Carpi.

- ‡Body mass index classifies individuals with a BMI ≥ 25 as overweight and individuals with a BMI ≥ 30 as obese.

- §Waist circumference is considered elevated when women have > 80 cm.

- ¶Waist-to-height ratio measures abdominal fat, with healthy values below 0.5, increased between 0.5 and 0.59, and high at 0.6 or more.

- **Missing values**: Monetary poverty(1); Money used to purchase food(1); Estimated monthly income (1); Food budget (1); Food assistance program (1); Household with children from 0-12 years old (3); Household with adults from 18-49 years old (4)

3.2 Aspects of food insecurity accessibility

Furthermore, the food insecurity assessment using the HFIAS instrument showed that in the component "Anxiety and uncertainty about household food supply" (Figure 3), only 13% of the participants had not shown this concern in the last 7 days and only 16% expressed "rarely" worries about it. In contrast, the most recurrent responses were "sometimes" and "often", with 47% and 24% respectively.
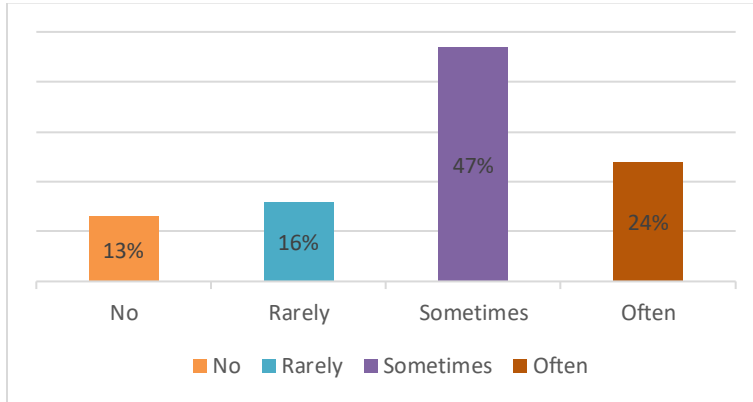

Figure 3: Frequency of anxiety and uncertainty about the household food supply

The component "Insufficient quality" (Figure 4) was assessed by using three questions and allowed an analysis of the impact of resource constraints on food preferences. Specifically, in question number 2 (Q2), 43% of the women stated that, in their households, have "sometimes" occasional difficulties in consuming their favorite foods, followed by "often" (27%) and "rarely" (9%). In addition, only 15% indicated that they did not have to limit their food choices due to limited resources (Q3). Finally, 45% revealed that they "sometimes" consumed food that they did not really want to eat, followed by 16% who indicated that this occurred "often" (Q4).
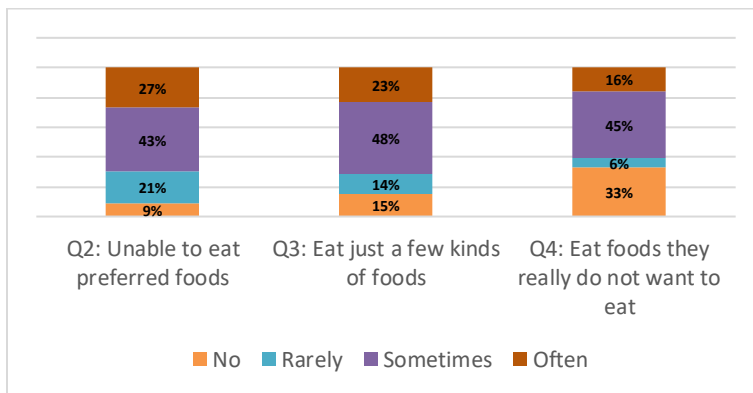

Figure 4: Frequency of Insufficient Quality about the household food supply

Figure 5 shows five responses relating to the last component of the HFIAS, "Insufficient food intake and its physical consequences". 41% of respondents reported that they "sometimes" encountered cases where insufficient food availability led them to consume smaller meals than necessary, followed by 16% who reported that this happens "often" (Q5). Regarding Q6, 41% of respondents reported that they "sometimes" had a reduction in the frequency of daily meals due to insufficient food resources, followed by 21% reporting that it happens "often". In addition, 50% of the women surveyed state that in their household, at least in the last week prior to the survey, there was no meal during the day for any member of their family within the household (Q7). However, 63% claimed not to have gone to bed hungry due to lack of food (Q8); but an alarming 31%, at different frequencies, reported having spent at least one day and one night without eating anything at all (Q9).
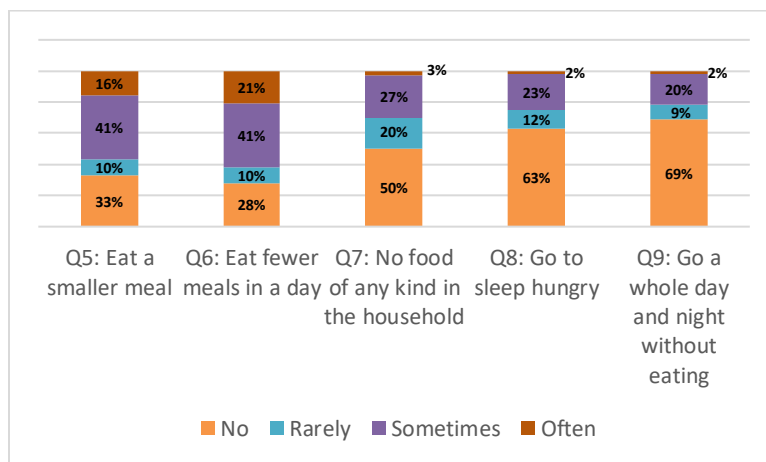

Figure 5: Frequency of insufficient food intake and its physical consequences about the household food supply

3.3 Association of food insecurity with socioeconomic factors, anthropometry and food diversity

Since only one household was classified as food secure, it was excluded from the main analysis. Consequently, we focused on examining different levels of food insecurity. Given the absence of a reference group of food-secure households and the imbalanced distribution (with very few experiencing mild food insecurity at 7% and the majority facing severe food insecurity at 67%), analyzing factors associated with food security would not yield meaningful results. Therefore, we provide descriptive tables for socioeconomic, anthropometric, and dietary diversity data (Tables 2 and 3), categorized into two groups: mild/moderate food insecurity and severe food insecurity (used as a reference). In Table 4, we retained the p-value from Fisher's exact test due to its proximity to 0.1, which could suggest a possible association in studies with small sample sizes or uneven distributions (60).

When analyzing the socioeconomic variables related to food insecurity (Table 2), we found that 97% of those facing mild/moderate food insecurity were financially poor and 96% of those facing severe food insecurity were also in this economic situation. Only 13% within each level of food insecurity had sufficient resources to cover the daily food basket by household size.

Regarding the distribution of food aid from assistance programs among households with varying levels of food insecurity, no clear trend of improvement or decline was observed. Only 20% of households experiencing mildly/moderately food insecurity received food assistance. Among women with severe food insecurity, a similar pattern emerged, with only 15% receiving aid.

In terms of marital status, the majority of mildly/moderately and severely food insecure women surveyed were married, with 63% and 56% respectively. Single women accounted for 27% of the women in both levels of food insecurity. Finally, an analysis of the level of education in relation to food insecurity shows that 57% of the mildly/moderately food insecure women had an incomplete or completed primary education, compared to 67% of this same group which presented severely food insecure women.

Table 2. **Association between food Insecurity and various socioeconomic factors in women aged 19 to 49 years, responsible for household food provision in San Pablo la Laguna, Guatemala.**

	Food Insecurity	
	Mildly/Moderate food insecure	Severely food insecure
Monetary poverty, n (%)		
No	1 (3)	2 (4)
Yes	28 (97)	53 (96)
Cover basic family basket expenses, n (%)		
No	26 (87)	48 (87)
Yes	4 (13)	7 (13)
Food assistance program, n (%)		
No	24 (80)	46 (85)
Yes	6 (20)	8 (15)
Marital Status, n (%)		
Married	19 (63)	31 (56)
Separated	2 (7)	6 (11)
Single	8 (27)	15 (27)
Widow	1 (3)	3 (6)
Education, n (%)		
Primary incomplete/completed	17 (57)	37 (67)
Secondary incomlete/completed	6 (20)	10 (18)
Highschool/University	7 (23)	8 (15)
Footnote: Fisher's exact test was calculated; however, the p-values for difference were greater than 0.5 (or 50%) for all associations		

Upon analyzing anthropometric variables in relation to the level of food insecurity (Table 3), no significant differences were found. Notably, 50% of women classified as mildly/moderately food insecure and 47% of women classified as severely food insecure were obese.

High WC was observed in 60% of individuals with mildly/moderate food insecurity, and a similar prevalence (58%) was found among participants with severe food insecurity. Regarding the WHtR, 80% of women with mildly/moderate food insecurity exhibited high and increased central adiposity, in contrast to 20% with normal central adiposity. A similar pattern was noted among severely food insecure women, with 87% displaying high and increased central adiposity.

Table 3. Association between food insecurity and anthropometric measurements in women aged 19 to 49 years, responsible for household food provision in San Pablo la Laguna, Guatemala.

	Food Insecurity	
	Mildly/Moderate food insecure	**Severely food insecure**
BMI , n (%)		
Non-obese	15 (50)	29 (53)
Obese	15 (50)	26 (47)
Waist circumference, n (%)		
Elevated Waist circumference	18 (60)	32 (58)
Normal	12 (40)	23 (42)
Waist-to-height ratio, n (%)		
Healthy central adiposity	6 (20)	7 (13)
High and increased central adiposity	24 (80)	48 (87)
Footnote: Fisher's exact test was calculated; however, the p-values for difference were greater than 0.5 (or 50%) for all associations		

Regarding the use of the MDD-W questionnaire, as shown in Table 4, we observed that among those experiencing mildly/moderate food insecurity, only 3% could be categorized as not achieving the minimum dietary diversity or not being "food diverse". On the other hand, 11% of women with severe food insecurity would fall into the same classification of not achieving a diet with food diversity.

Among women experiencing mild to moderate food insecurity, there was a notable consumption of food groups considered healthy and contributing to a diverse diet according to the MDD-W. This group showed significant consumption of grains, white roots, and tubers, including plantains (97%), pulses (93%), dairy products (57%), meat (77%), eggs (97%), other vitamin A-rich fruits and vegetables (83%), other vegetables (97%), and other fruits (80%). Conversely, among severely food insecure women, a slightly higher percentage reported consuming nuts and seeds (49%) and dark green leafy vegetables (84%).

When analyzing the unhealthy food groups identified by the MDD-W, women experiencing mild/moderate food insecurity notably displayed a high consumption of fried and salty foods (90%). The severely food insecure group, in comparison, showed higher consumption levels for sweet foods (67%) and sweet beverages (93%).

Table 4 Association between Food Insecurity and Minimum Dietary Diversity in women aged 19 to 49 residing in San Pablo la Laguna, Guatemala.

	Level of Food Insecurity		
	Mildly/Moderate food insecure	**Severely food insecure**	**p-value***
MDD-W†			
Sufficient diversity scores			
No	1 (3)	6 (11)	0.23
Yes	29 (97)	49 (89)	
MDD-W required food groups			
Grains, white roots and tubers, and plantains			
No	1 (3)	1 (2)	>0.5‡
Yes	29 (97)	54 (98)	
Pulses (beans, peas and lentils)			
No	2 (7)	7 (13)	0.39
Yes	28 (93)	48 (87)	
Nuts and seeds			
No	16 (53)	28 (51)	>0.5
Yes	14 (47)	27 (49)	
Milk and milk products			
No	13 (43)	31 (56)	0.25
Yes	17 (57)	24 (44)	
Meat, poultry and fish			
No	7 (23)	15 (27)	>0.5
Yes	23 (77)	40 (73)	
Eggs			
No	1 (3)	3 (5)	>0.5
Yes	29 (97)	52 (95)	

Dark green leafy vegetables			
No	9 (30)	9 (16)	0.14
Yes	21 (70)	46 (84)	
Other vitamin A-rich fruits and vegetables			
No	5 (17)	19 (35)	0.08
Yes	25 (83)	36 (65)	
Other vegetables			
No	1 (3)	9 (16)	0.07
Yes	29 (97)	46 (84)	
Other fruits			
No	6 (20)	12 (22)	>0.5
Yes	24 (80)	43 (78)	
MDD-W unhealthy food groups			
	Mildly/Moderate food insecure	**Severely food insecure**	**p-value**
Fried and salty foods			
No	3 (10)	8 (15)	>0.5
Yes	27 (90)	47 (85)	
Sweet food			
No	11 (37)	18 (33)	>0.5
Yes	19 (63)	37 (67)	
Sweet Beverages			
No	5 (17)	4 (7)	0.18
Yes	25 (83)	51 (93)	

Footnote:

*Fisher's exact test p-value.

†Minimum Dietary Diversity for Women

‡ A p-value of 0.5, indicating a 50% probability, was reported for Fisher's exact test when the calculated p-values were greater than or equal to this value.

4   Discussion

We have used the internationally validated HFIAS questionnaire and together with an assessment of socioeconomic information, dietary diversity and anthropometric status, we have been able to investigate the levels of food insecurity and the possible associated factors in 86 hard-to reach indigenous Maya Tz'utujil women responsible for the daily meal planning of their households in the Guatemalan village of San Pablo la Laguna. Overall, the present study shows the high prevalence of food insecurity, along with significant poverty, and high rates of overweight and obesity in this community. Moreover, our project points out to a complicated interrelationship between nutrition, economic circumstances, and cultural factors, which are a reflection of the challenges faced by women and households in the Tz'utujil community every day.

The assessed study sample revealed a worryingly high prevalence of food insecure households (98%), as only one household could be classified as food secure. These results were, to some extent expected, given the precarious situations of certain families observed during data collection. Among the levels of food insecurity, the most prevalent was severe, affecting 64% of the households, followed by moderate insecurity at 28%, mild insecurity at 7.0%, and only one household (1.2%) considered food secure.

Our results differ slightly from those presented in 2022 by the national food insecurity assessment in Guatemala, which reported an overall high prevalence of severe food insecurity exceeding 56% (2). We believe the differences could be explained by significant inequalities related to food security within the country, more visible among indigenous populations like ours. Potential food inequality was also expressed by another study conducted in 2016 among indigenous communities in Guatemala, in the village of Xejuyu in the municipality of Tecpán. Similar results were obtained in this community using the same data collection tool, showing a prevalence of food insecurity of 100%, with 51% of the household reaching severe insecurity and 49% reaching moderate insecurity 49% (3).

The usefulness of utilizing the HFIAS lies in its capability to segment food insecurity access into components that evaluate quality, anxiety and uncertainty, and insufficient food intake. For

instance, food scarcity was also observed in the responses regarding food availability and variety, obtained through the "Insufficient quality" component of the HFIAS. 43% of women reported "sometimes" being unable to consume the foods they desired due to resource constraints, while 27% "often" experienced this. Similarly, almost half (48%) of the participants reported "sometimes" consuming a limited variety of foods, which could have a significant impact on the quality or the diversity of the community's daily diet, leading to possible states of malnutrition in household members.

The impact of food insecurity on mental health requires further analysis, as demonstrated by the HFIAS component "Anxiety and uncertainty about household food supply". Specifically, 47% of respondents reported experiencing this concern "sometimes" and 24% "often". This could have implications for emotional well-being at the individual and household level, as already observed in a meta-analysis which concluded that food insecurity has a significant effect on the likelihood of being stressed or depressed (61).

Concerning the last HFIAS component, "Insufficient food intake and its physical consequences", the results obtained show that 41% of the participants "sometimes" reduce the amount of food eaten, while 21% "often" reduce the number of meals taken during the day due to this food insecurity. This may seem paradoxical given the high levels of obesity found among the participants, as even 20% of women reported that they "sometimes" had no food at all in their household due to a lack of resources. However, it should be noted that there is scientific evidence linking higher rates of obesity with socioeconomic status (16), suggesting possible consumption of foods that may appear to be insufficient in quantity but high in calories.

The high proportion of food insecurity in this population raises concerns for future generations, especially for children in this community. Even low levels of food insecurity can affect child development by perpetuating states of poverty in the future (10).This is particularly alarming considering that severe levels of food insecurity were found in at least two-thirds of households, some of which may have as many as six children under the age of 12. These children are likely to grow up at a disadvantage compared to others and may pass these disparities on to the next generation, perpetuating the cycle of poverty (13).

An example of these disparities is the scarcity of agricultural land available for their own benefit, as a result of historical exclusion and discrimination against these communities (4). Access to agricultural land is limited for indigenous people in the area, as most of it is owned by non-indigenous individuals. While precise estimates are challenging to obtain, local activists report that indigenous families in the area have access to less than half a hectare of land (62).

4.1 Food Insecurity and socioeconomic inequities

In the present study, we were able to gather information about other potential factors that may explain the high levels of food insecurity in this population, including socioeconomic characteristics. Despite being a country classified as upper-middle-income (1), a report presented in 2022 by the Economic Commission for Latin America and the Caribbean (ECLAC) determined that national poverty levels reached 51%, with 76% of this poverty concentrated among indigenous people living in rural areas (40). However, the specific monetary poverty prevalence in the obtained sample was 97%, which could be attributed to the assessment being conducted solely for the population of San Pablo la Laguna, unlike the broader coverage of communities in the ECLAC report. This assessment may not fully consider the limited access to educational resources, healthcare, household conditions, and economic opportunities experienced by the inhabitants of San Pablo who live in a geographical location with a mountainous topography.

The presence of high levels of monetary poverty in almost the entire sample underlines the importance of changing the perspective on how to address inequality in the indigenous population and start considering how these social determinants affect health. As observed in this study, 64% of the population had educational levels not exceeding primary education, which could also influence the impact on their own and their children's dietary intake. Parents with lower levels of education tend to choose higher calorie and processed foods over diets with higher fruit and vegetable content (15), as observed in the study by Sausenthaler et al., and may thus generate inappropriate dietary habits that might persist in generations to come.

Beyond the notable issues of low educational attainment and significant monetary poverty among most of the population, other socioeconomic components stand out in this community.

Economic complexity is reflected in the diversity of family structures, with only 59% of the women receiving financial support from a partner, which can have a significant impact on household income, and household sizes ranging from 1 to 15 people (with some having up to 6 children) highlighting overcrowded conditions that may contribute to various health problems.

Socioeconomic inequalities have historically been observed throughout Latin America and the Caribbean. Despite increased allocations in health budgets at the national level in Guatemala, the exclusion of these communities from participation in policy remains a contributing factor in preventing them from accessing quality health care (18, 63). This exclusion can also create situations of discrimination (42), which increases disparities between this community and the rest of Guatemalans.

This discrimination perpetuates certain social roles, hindering the development of resistance against the status quo and perpetuating itself over time. The health impacts of such inequalities, which disproportionately affect indigenous peoples, are direct manifestations of an underlying power imbalance. For that, acknowledging and addressing these disparities is crucial, given the existing resistance to change from powerful groups and political parties seeking to perpetuate privileges (18).

Despite the inequality and discrimination that exists for indigenous peoples, it is crucial to consider the intersectional impact, which refers to the overlapping effects of various forms of discrimination, particularly for women, encompassing both sex and gender (11). This intersectional component is not only present at the state level but also within the community, perpetuating gender stereotypes such as the assumed role of women in the home (64). Generalizing the presumed domestic responsibilities of women restricts access to better education and higher-paying jobs for the family, among other factors that could affect the ability to access quality food and reduce the impact of food insecurity in the household (65).

4.2 Food security as related to dietary factors

At first glance, it appears paradoxical that nearly all households experience food insecurity, while 92% of the women responsible for food provision in these households achieve a minimum level of dietary diversity. It seems that households facing severe food insecurity tend to

consume fewer vegetables, and there is an indication that the minimum dietary diversity score is slightly less frequently attained in such households. However, overall, the high level of food insecurity does not seem to be reflected in reported dietary factors as measured by the MDD-W questionnaire.

Dietary choices are closely linked to the economic accessibility of food, where it is more calorically efficient, in terms of price, to purchase processed and ultra-processed foods (15). For this reason, low household income becomes a problem for accessing or maintaining a good quality diet, which could be affected in any context and not only in this population. Such choices are more likely to be made when, as in this sample, only 12.8% of households can afford the basic food basket and therefore access a healthier diet.

On the other hand, another significant aspect contributing to food insecurity, besides identifying the variety of foods consumed, is the consideration of portion size. Ensuring a sufficient intake of diverse foods is crucial for fostering an active and healthy lifestyle among the population. Nonetheless, as the primary focus of the MDD-W is on assessing dietary diversity, it does not capture specific portion sizes or amounts consumed, and other tools are recommended for this assessment like a as a photographic food atlas that could guide in making quantity estimates.

4.3 Food insecurity and obesity

It also appears contradictory that there was such a high prevalence of food insecurity based on the anthropometric measures obtained. In general, women exhibited high levels of overweight and obesity, elevated WC, and high and increased central adiposity.

The rates of overweight and obesity in the sample assessed exceeded the average for the Americas Region (27). However, it is important to acknowledge the established association between poverty and excess weight. This association is particularly prevalent in populations with lower economic income, as indicated by a research conducted in Latin America and the Caribbean (28), aligning with the obtained results.

By 2022, Guatemala had the strongest economy in Central America, but poverty levels and inequalities remained among the highest in Latin America (1). A meta-analysis presented by

Moradi et al. suggests that in countries with emerging economies, the probability of being undernourished due to deficiencies is 35% higher than the risk of being overweight or obese, which is 30% and 17% respectively (66). In the present study, no underweight women were identified, and only high levels of obesity and overweight were observed. These findings are not consistent with the meta-analysis, but it is important to note that the factor of socioeconomic inequality within the country was not taken into account in the latter.

The paradoxical association between food insecurity and obesity, as documented in previous research (66, 67), raises questions given that weight gain usually occurs when caloric intake surpasses expenditure (67). Evidence suggests that this paradox is prevalent in households experiencing greater economic stress (68), as observed in our study. The heightened financial pressure in such households may lead to lower diet quality and, consequently, weight gain. While the surveyed Maya women showed coverage of minimum dietary diversity, indicating a potentially nutritious diet, the MDD-W scale overlooks portion sizes (21), which may lead to increased consumption of foods that do not contribute to nutritional adequacy.

The impact of different levels of food insecurity is another crucial factor to consider when exploring their association with obesity. Previous observations have shown that the risk of obesity increases by 29% in households facing severe food insecurity (66). In our study, a different trend was slightly indicated, with more individuals identified as non-obese (53%) than obese (47%) within this level of food insecurity. A similar pattern was noted in the WC component, with a higher proportion of women deemed to have a normal WC (42%). These inconsistencies may be attributable to chance and the tendency of Mayan women to limit their food consumption to larger quantities of unhealthy food groups, which are often high in calories but low in cost.

However, a higher prevalence of women with increased central adiposity (87%) was observed among those experiencing severe levels of food insecurity. This result is consistent with the aforementioned higher risk of obesity at greater levels of food insecurity (66), and may be attributed to the WHtR being slightly more accurate in predicting cardiometabolic risk (69). Additionally, these findings align with a National Longitudinal Study of Adult Health in the

United States, which revealed a positive association between food insecurity components and a high WHtR, with the odds increasing by 36% (70).

4.4 Methodological challenges, strengths and limitations

4.4.1 Study population

The strengths of this pilot research lie firstly in having successfully interviewed women in this difficult-to-reach community that appears to be underprioritized by the government. This allowed the assessment of nutritional variables such as household food insecurity, women's dietary diversity, as well as the description of socioeconomic variables and anthropometric measurements in this population.

The involvement of a familiar figure, the community leader, who personally invited the participants, was another important advantage of the study. This had a positive impact during the interviews, building confidence in the community who may not have been willing to participate in a study with researchers from outside their community, mostly foreigners. The same leader facilitated the work of the researchers by helping with the pre-validation of the instruments, the sampling strategy and the translation into Tz´utujil when participants were not fluent in Spanish.

On the other hand, we found some limitations in our study. The generalizability of the results was, in general, limited by the sampling strategy of the baseline study, the Lake Atitlán Respiratory Health study. In addition, the exclusive use of a sample restricted to a single indigenous community (San Pablo) and the non-inclusion of other communities with possibly different characteristics contributes to the results not being generalizable to Mayan communities in general.

The selection criterion for participating in the study, that women did not suffer from any illness requiring a special diet, as this could potentially affect the daily dietary dynamics within the family, may be considered a limitation of the study due to a lack of awareness of the possibility of diseases such as diabetes. This is because a previous study conducted in the Mayan Tz'utujil communities of San Pablo La Laguna identified an under-diagnosis of the disease. In that research, it was reported that pre-diabetes could be reaching epidemic proportions with more

than a quarter of the population (71). However, during the eligibility screening, only one woman reported having diabetes. Nonetheless, as these women would be unaware of the condition, it will not have changed the way they plan their household food supply.

Another challenge was the impossibility of determining the true response rate. We had an estimated response rate of 58% of the original baseline sample; however, we were unable to obtain precise information on the exact number of households affected by family migration and the death of some community members. Therefore, it is possible that the 58% response rate is underestimated.

4.4.2   Study tools, misclassification and information bias

The HFIAS, an internationally accepted instrument for measuring food insecurity levels, has official and validated translations available in English, French, and Spanish. However, not all women in our study spoke Spanish, as their mother tongue is Tz'utujil, potentially introducing information bias despite the aid of an interpreter.

The data obtained with respect to the prevalence of food insecurity and the coverage of a minimum dietary diversity could raise doubts about the accuracy of the information. These results may have been influenced by several factors, including possible stigmatization and translation bias during the interviews. For instance, participants may have provided less accurate answers on the MDD-W questionnaire, particularly as it was administered after the HFIAS questionnaire, possibly due to embarrassment about admitting dietary deficiencies and irregular consumption of certain food groups. Additionally, the use of an interpreter may have randomly introduced errors in the frequency of consumption reported in the two main food instruments during the interview, given the different timeframes covered by the HFIAS (four weeks) and the MDD-W (last 24 hours).

Anthropometric measurements posed another challenging aspect of the study. This was due to the measurements being conducted under difficult conditions, as finding a flat surface in poor housing could result in less accurate measurements and misclassification biases. In addition, the measurements were taken with the participants fully clothed to avoid any discomfort caused by cultural differences. Although not ideal, it is acceptable to perform anthropometric

measurements with clothing if a population-specific fit value is available (72), so this value was obtained before the measurements.

4.4.3 Statistical analyses

The homogeneity in the study population, with all but one household having food insecurity, made statistical analyses of factors related to the level of food security impossible, therefore we could only analyze potential differences between those with mildly/moderate versus more severe food insecurity. The number of households included in the study was, however, too small to allow meaningful statistical analyses of potential differences when there was so little variability in the food insecurity outcome variable.

5   Conclusions, recommendations and further plans

Overall, this study shows that a striking majority of households (85 out of 86) consisting of indigenous Maya people from rural Guatemala face food insecurity, with severe food insecurity observed in almost two-thirds of them. Additionally, there are alarming levels of economic poverty, a very small proportion can afford the basic family food basket, and the educational level is predominantly limited to primary education. Furthermore, most of the women in charge of household food provision exhibited stunted growth, high prevalence of obesity, high WC, and WHtR above recommended levels.

This research helps us to understand the different challenges, alongside the high prevalence of food insecurity, that women in an indigenous community in Guatemala face daily. By understanding this complex reality, more informed decisions can be made to contribute to achieving global health goals as those outlined in the Sustainable Development Goal, of zero poverty, zero hunger, good health and well-being, gender equality and reduction of inequalities in Guatemala (66), a country characterized by inequalities at all levels.

Given the socioeconomic vulnerability and high levels of food insecurity experienced by this population, it would not be prudent to make nutritional recommendations on the management of general or abdominal obesity. However, more detailed research into the availability of food in the area is needed to generate detailed nutritional guidelines that take into consideration components such as food costs, portion sizes and food availability in the community.

Despite the difficulty of returning this information to the population, this research aims to provide its findings to the community and local authorities using existing funds allocated for poverty reduction through CEGSS. This aims to foster greater awareness among the population and increased involvement from authorities. It is planned to disseminate the information through a podcast episode, which will be distributed through the WhatsApp mobile application. With the episode, the community will be able to learn about aspects of the current nutritional status of the community and at the same time generate greater commitment from local authorities. The podcast will be narrated as a conversation in Tz'utujil between two people and will use descriptive narration to engage listeners and present technical information in a more accessible and engaging way.

An additional recommendation for future research is to study how mental health can be affected in a constant state of "Frequency of anxiety and uncertainty about the household food supply". This needs to be addressed especially among women, as they could suffer greater emotional burden due to the pressure they experience as food providers and due to gender stereotypes that have been passed down from generation to generation.

6   References

1.   Bank TW. The World Bank in Guatemala 2022 [Available from: https://www.worldbank.org/en/country/guatemala/overview.

2.   The State of Food Security and Nutrition in the World 2022. Italy: Committee on World Food Security; 2022 2022-07-06.

3.   Webb MF, Chary AN, De Vries TT, Davis S, Dykstra M, Flood D, et al. Exploring mechanisms of food insecurity in indigenous agricultural communities in Guatemala: a mixed methods study. BMC Nutrition. 2016;2(1):55.

4.   Mazariegos M, Kroker-Lobos MF, Ramírez-Zea M. Socio-economic and ethnic disparities of malnutrition in all its forms in Guatemala. Public Health Nutr. 2020;23(S1):s68-s76.

5.   EC-FAO. An Introduction to the Basic Concepts of Food Security. 2008. Contract No.: 15 March.

6.   O'Hara S, Toussaint EC. Food access in crisis: Food security and COVID-19. Ecological Economics. 2021;180:106859.

7.   Aulestia-Guerrero EM, Capa-Mora ED. Una mirada hacia la inseguridad alimentaria sudamericana. Ciência & Saúde Coletiva. 2020;25(7):2507-17.

8.   Ben Hassen T, El Bilali H. Impacts of the Russia-Ukraine War on Global Food Security: Towards More Sustainable and Resilient Food Systems? Foods. 2022;11(15).

9.   Schiff M, Valdes A. Poverty, food intake, and malnutrition: implications for food security in developing countries. Am J Agric Econ. 1990;72(5):1318-22.

10.   Chilton M, Chyatte M, Breaux J. The negative effects of poverty & food insecurity on child development. Indian J Med Res. 2007;126(4):262-72.

11.   Hatcher AM, Page S, Aletta van Eck L, Pearson I, Fielding-Miller R, Mazars C, et al. Systematic review of food insecurity and violence against women and girls: Mixed methods findings from low- and middle-income settings. PLOS Glob Public Health. 2022;2(9):e0000479.

12.   Baghri Lankaran K, Ghahramani S. Social studies in health: A must for today. Med J Islam Repub Iran. 2018;32:106.

13.   Galler JR, Bringas-Vega ML, Tang Q, Rabinowitz AG, Musa KI, Chai WJ, et al. Neurodevelopmental effects of childhood malnutrition: A neuroimaging perspective. NeuroImage. 2021;231:117828.

14.   León J. Capital humano y pobreza regional en Perú. Región y Sociedad. 2019.

15.   Sausenthaler S, Kompauer I, Mielck A, Borte M, Herbarth O, Schaaf B, et al. Impact of parental education and income inequality on children's food intake. Public Health Nutr. 2007;10(1):24-33.

16.   Alao R, Nur H, Fivian E, Shankar B, Kadiyala S, Harris-Fry H. Economic inequality in malnutrition: a global systematic review and meta-analysis. BMJ Global Health. 2021;6(12):e006906.

17.   Cerón A, Ruano AL, Sánchez S, Chew AS, Díaz D, Hernández A, et al. Abuse and discrimination towards indigenous people in public health care facilities: experiences from rural Guatemala. International Journal for Equity in Health. 2016;15(1):77.

18.   Hernández A, Ruano AL, Marchal B, San Sebastián M, Flores W. Engaging with complexity to improve the health of indigenous people: a call for the use of systems thinking to tackle health inequity. Int J Equity Health. 2017;16(1):26.

19.   Mozaffari H, Hosseini Z, Lafrenière J, Conklin AI. The role of dietary diversity in preventing metabolic-related outcomes: Findings from a systematic review. Obes Rev. 2021;22(6):e13174.

20.   Jouanne M, Oddoux S, Noël A, Voisin-Chiret AS. Nutrient Requirements during Pregnancy and Lactation. Nutrients. 2021;13(2):692.

21.   FAO. Minimum dietary diversity for women. Rome, Italy: FAO; 2021. #176 p. p.

22.   Fedacko J, Takahashi T, Singh RB, Pella D, Chibisov S, Hristova K, et al. Chapter 6 - Globalization of Diets and Risk of Noncommunicable Diseases. In: Singh RB, Watson RR, Takahashi T, editors. The Role of Functional Food Security in Global Health: Academic Press; 2019. p. 87-107.

23.   Vadiveloo M, Dixon LB, Parekh N. Associations between dietary variety and measures of body adiposity: a systematic review of epidemiological studies. Br J Nutr. 2013;109(9):1557-72.

24.   Boutari C, Mantzoros CS. A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. Metabolism. 2022;133:155217.

25.   Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019;92:6-10.

26.   Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. BMC Public Health. 2009;9:88.

27.   WHO. Global Status report on noncommunicable diseases 2014. 2014.

28.   Jiwani SS, Carrillo-Larco RM, Hernández-Vásquez A, Barrientos-Gutiérrez T, Basto-Abreu A, Gutierrez L, et al. The shift of obesity burden by socioeconomic status between 1998 and 2017 in Latin America and the Caribbean: a cross-sectional series study. Lancet Glob Health. 2019;7(12):e1644-e54.

29.   WHO. Waist circumference and waist-hip ratio: report of a WHO expert consultation: WHO; 2011.

30.   Sommer I, Teufer B, Szelag M, Nussbaumer-Streit B, Titscher V, Klerings I, et al. The performance of anthropometric tools to determine obesity: a systematic review and meta-analysis. Sci Rep. 2020;10(1):12699.

31.   Mechanick J, Hurley D, Garvey W. Adiposity-Based Chronic Disease as a new Diagnostic Term: The American Association of Clinical Endocrinologists and American College of Endocrinology Position Statement. Endocrine Practice. 2016;23.

32.   Heianza Y, Qi L. Chapter 14 - Genetics of Central Obesity and Body Fat. In: Watson RR, editor. Nutrition in the Prevention and Treatment of Abdominal Obesity (Second Edition): Academic Press; 2019. p. 153-74.

33.   Carmienke S, Freitag MH, Pischon T, Schlattmann P, Fankhaenel T, Goebel H, et al. General and abdominal obesity parameters and their combination in relation to mortality: a systematic review and meta-regression analysis. Eur J Clin Nutr. 2013;67(6):573-85.

34.   Ortega PEN, Meneses ME, Delgado-Enciso I, Irecta-Nájera CA, Castro-Quezada I, Solís-Hernández R, et al. Association of rs9939609-FTO with metabolic syndrome components among women from Mayan communities of Chiapas, Mexico. Journal of Physiological Anthropology. 2021;40(1):11.

35.   Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev. 2012;13(3):275-86.

36.   NICE. Obesity: identification, assessment and management. National Institute for Health and Care Excellence; 2022.

37.   Gatica-Domínguez G, Victora C, Barros AJD. Ethnic inequalities and trends in stunting prevalence among Guatemalan children: an analysis using national health surveys 1995-2014. Int J Equity Health. 2019;18(1):110.

38.   INE. República de Guatemala: Encuesta Nacional de Condiciones de Vida 2014. Instituto Nacional de Estadística; 2015.

39.   INE. Canasta Básica Alimentaria (CBA) Canasta Ampliada (CA) Enero 2023. Instituto Nacional de Estadística; 2023.

40.   CEPAL. La desigualdad social en Guatemala. Evolución y respuesta institucional. 2022.

41.   INE. Compendio estadístico de pueblos. 2021.

42.   Cerón A, Ruano AL, Sánchez S, Chew AS, Díaz D, Hernández A, et al. Abuse and discrimination towards indigenous people in public health care facilities: experiences from rural Guatemala. Int J Equity Health. 2016;15:77.

43.   Stavenhagen R. Las identidades indígenas en América Latina. IIDH. 2010;52:171-89.

44.   López J. Asthma, respiratory symptoms and lung function across age groups in an indigenous Mayan population in Guatemala, and relation to work in the traditional textile industry: a cross-sectional pilot study: University of Bergen; 2022.

45.   Menchú M, Méndez H, Dary O. Estudio Complementario al Análisis Secundario de los Datos de la Encuesta Nacional de Condiciones de Vida de Guatemala: Referencia para diseñar intervenciones específicas de micronutriente. Institute of Nutrition of Central America and Panama 2013.

46.   Sartorius K, Sartorius B, Madiba TE, Stefan C. Does high-carbohydrate intake lead to increased risk of obesity? A systematic review and meta-analysis. BMJ Open. 2018;8(2):e018449.

47.   Soto-Méndez MJ, Campos R, Hernández L, Orozco M, Vossenaar M, Solomons NW. Food variety, dietary diversity, and food characteristics among convenience samples of Guatemalan women. Salud Publica Mex. 2011;53(4):288-98.

48.   Mayén AL, Stringhini S, Ford ND, Martorell R, Stein AD, Paccaud F, et al. Socioeconomic predictors of dietary patterns among Guatemalan adults. Int J Public Health. 2016;61(9):1069-77.

49.   Lemke S, Delormier T. Indigenous Peoples' food systems, nutrition, and gender: Conceptual and methodological considerations. Matern Child Nutr. 2017;13 Suppl 3(Suppl 3).

50.   Steinbrook E, Flood D, Barnoya J, Montano CM, Miller AC, Rohloff P. Prevalence of Hypertension, Diabetes, and Other Cardiovascular Disease Risk Factors in Two Indigenous Municipalities in Rural Guatemala: A Population-Representative Survey. Glob Heart. 2022;17(1):82.

51.   Instituto Nacional de Estadística Guatemala. Departamento Sololá, municipio San Pablo La Laguna. Estimaciones y proyecciones de la población total según sexo y edad. Período 2015 - 2030. 2015.

52.   Instituto Nacional de Estadística Guatemala. Resultados del Censo 2018 2018 [Available from: https://www.censopoblacion.gt/mapas.

53.   Coates J SA, Bilinsky P. . Household Food Insecurity Access Scale (HFIAS) for measurement of household food access: indicator guide. Washington, D.C: Food and Nutrition Technical Assistance Project, Academy for Educational Development. 2007.

54.   Knueppel D, Demment M, Kaiser L. Validation of the Household Food Insecurity Access Scale in rural Tanzania. Public Health Nutr. 2010;13(3):360-7.

55.   Dutta S, Borgohain N. Reliability and Validity of Household Food Insecurity Access Scale in Assam, India. Int j interdiscip res innov. 2018;6(3).

56.   Instituto Nacional de Estadistica Guatemala. Canasta Básica Alimentaria (CBA) Canasta Ampliada (CA). 2023.

57.   Instituto Nacional de Estadistica Guatemala. República de Guatemala: Encuesta Nacional de Condiciones de Vida 2014. 2015.

58.   Carpi C. Description of dietary patterns and food diversity in a selected sample of Maya women: a pilot field study in the Lake Atlitlán area, Guatemala. Bergen: University of Bergen; 2023.

59.   Seimon RV, Wild-Taylor AL, Gibson AA, Harper C, McClintock S, Fernando HA, et al. Less Waste on Waist Measurements: Determination of Optimal Waist Circumference Measurement Site to Predict Visceral Adipose Tissue in Postmenopausal Women with Obesity. Nutrients. 2018;10(2).

60.   Thiese MS, Ronna B, Ott U. P value interpretations and considerations. J Thorac Dis. 2016;8(9):E928-e31.

61.   Pourmotabbed A, Moradi S, Babaei A, Ghavami A, Mohammadi H, Jalili C, et al. Food insecurity and mental health: a systematic review and meta-analysis. Public Health Nutrition. 2020;23(10):1778-90.

62.   Travieso E. Lake Atitlán, Guatemala: "The Possibility of a Shared World". Alternautas. 2022;3(2).

63.   Ruano AL, Rodríguez D, Rossi PG, Maceira D. Understanding inequities in health and health systems in Latin America and the Caribbean: a thematic series. Int J Equity Health. 2021;20(1):94.

64.   Inter-American Commission on Human Rights (IACHR). Indigenous Women. Washington, D.C.: IACHR; 2017.

65.   Sinclair K, Thompson-Colón T, Bastidas-Granja AM, Del Castillo Matamoros SE, Olaya E, Melgar-Quiñonez H. Women's autonomy and food security: Connecting the dots from the perspective of Indigenous women in rural Colombia. SSM - Qualitative Research in Health. 2022;2:100078.

66.   Moradi S, Mirzababaei A, Dadfarma A, Rezaei S, Mohammadi H, Jannat B, et al. Food insecurity and adult weight abnormality risk: a systematic review and meta-analysis. European Journal of Nutrition. 2019;58(1):45-61.

67.   Carvajal-Aldaz D, Cucalon G, Ordonez C. Food insecurity as a risk factor for obesity: A review. Front Nutr. 2022;9:1012734.

68.   Potochnick S, Perreira KM, Bravin JI, Castañeda SF, Daviglus ML, Gallo LC, et al. Food Insecurity Among Hispanic/Latino Youth: Who Is at Risk and What Are the Health Correlates? J Adolesc Health. 2019;64(5):631-9.

69.   Yoo EG. Waist-to-height ratio as a screening tool for obesity and cardiometabolic risk. Korean J Pediatr. 2016;59(11):425-31.

70.   Testa A, Jackson DB. Food Insecurity, Food Deserts, and Waist-to-Height Ratio: Variation by Sex and Race/Ethnicity. J Community Health. 2019;44(3):444-50.

71.   Bream KDW, Breyre A, Garcia K, Calgua E, Chuc JM, Taylor L. Diabetes prevalence in rural Indigenous Guatemala: A geographic-randomized cross-sectional analysis of risk. PLoS One. 2018;13(8):e0200434.

72.   Wijnhoven TMA, van Raaij JMA, Spinelli A, Yngve A, Lissner L, Spiroski I, et al. WHO European Childhood Obesity Surveillance Initiative: Impact of Type of Clothing Worn during Anthropometric Measurements and Timing of the Survey on Weight and Body Mass Index Outcome Measures in 6–9-Year-Old Children. Epidemiology Research International. 2016;2016:5130317.

7 Appendix

Appendix 1: Household Food Insecurity Access Scale (HFIAS) Measurement Tool

Coates J SA, Bilinsky P. . Household Food Insecurity Access Scale (HFIAS) for measurement of household food access: indicator guide. Washington, D.C: Food and Nutrition Technical Assistance Project, Academy for Educational Development. 2007.

No	Question	Response Options	CODE
1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	….|__|
1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|__|
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	….|__|
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four	….|__|

		weeks)	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	….|__|
3.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|__|
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0 = No (skip to Q5) 1 = Yes	….|__|
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|__|

No	Question	Response Options	CODE
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	….|__|
5.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|__|
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	….|__|
6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|__|
7.	In the past four weeks, was there ever no food to eat of any kind in your	0 = No (skip to Q8) 1 = Yes	….|__|

	household because of lack of resources to get food?		
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	....|__|
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	....|__|
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	....|__|
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes	....|__|

No	Question	Response Options	CODE
9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	....|__|

Appendix 2: MDD-W tool list-based method pictures

Carpi C. Description of dietary patterns and food diversity in a selected sample of Maya women: a pilot field study in the Lake Atlitlán area, Guatemala. Bergen: University of Bergen; 2023.

3. ¿Papas, plátanos, raíz de güisquil o yuca?

Papas

Plátanos

Yuca

4. ¿Frijoles?

Frijoles

Habas

Mínima Diversidad Alimentaria por la Mujeres
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

Mínima Diversidad Alimentaria por la Mujeres
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

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5. ¿Pepitas, manías, ajonjolí, o semillas de marañón?

Pepitas

Maníes

Ajonjolí

6. ¿Leche, leche en polvo o quesos?

Leche

Leche en polvo

Quesos

Mínima Diversidad Alimentaria por la Mujeres:
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

Mínima Diversidad Alimentaria por la Mujeres:
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

53

7. ¿Carne de res o cerdo?

Carne de res

Ejemplos cocinados

En sopa

Churrascos

Cerdo

Ejemplos cocinados

Adobada

Chuleta

Ahumada, asado, frito

8. ¿Pollo?

Pollo

Ejemplos cocinados

Caldo de pollo

Pollo loroco

A la plancha

Asado

9. ¿Jamón, salchichas, o chorizo?

Chorizo

10. ¿Pescado o marisco?

Pescado

Ejemplos cocinados

Pescado frito

Mariscos

Ejemplos cocinados

Ceviche

Caldo de mariscos

11. ¿Huevos?

Huevos

12. ¿Montes, hierba mora (guilete), lechuga, acelga o ejotes?

Hierba morra

Lechuga

Acelga

Ejotes

Mínima Diversidad Alimentaria por la Mujeres.
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

Mínima Diversidad Alimentaria por la Mujeres.
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

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13. ¿Tomates, cebollas, guïsquil, pepino, repollo, chiles (chiltepe) o , elote?

Tomate

Repollo

Cebolla

Chiles

Guisquil

Elote

Pepino

14. ¿Mangos, papayas, o melón?

Mango

Papaya

Melón

15. ¿Manzanas, bananos, piña, cítricos (naranja, limón), uvas, aguacate o fresas ?

Manzanas

Bananos

Piña

Cítricos

Uvas

Aguacate

Fresas

Mínima Diversidad Alimentaria por la Mujeres.
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

16. ¿Aceite vegetal, mantequilla, margarina, manteca de cerdo o crema?

Aceite vegetal

Mantequilla

Mirasol

Margarina

Mínima Diversidad Alimentaria por la Mujeres.
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

58

17. ¿Chips, chicharines, plátanos fritos, golosina y otros snacks saladas?

Chucherias

Chicharines

Plátaninas

18. ¿Tortilla frita, rellenitos, papas fritas, o doblada de frijoles?

Rellenitos

Papas fritas

Doblada de frijoles

20. ¿Sopas chinas?

Sopas chinas

19. ¿Tamales, pache, chuchitos o pollo frito?

Tamales

Pache

Chuchitos

Pollo frito

Mínima Diversidad Alimentaria por la Mujeres:
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

Mínima Diversidad Alimentaria por la Mujeres:
Apoyo ilustrado por el cuestionario basado en la lista definida de alimentos

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21. ¿Pan dulce, pastel, galletas, cereal de desayuno, chocolate o azúcar?

Pan dulce

Cereal de desayuno

Pastel

Chocolate

Galletas

Azúcar

22. ¿Frescos, gaseosa, jugo de frutas, bebidas de chocolate, u atol?

Frescos

Gaseosa

Atol

Jugo de fruta

23. ¿Té/infusión o café endulzado?

Té o café endulzado

24. ¿Incaparina?

Incaparina

Appendix 3: Ethical approval from the Regional Committees for Medical and Health Research Ethics

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord	Monika Rydland-Nymo	77620756	10.01.2023	203917

Cecilie Svanes

Prosjektsøknad: Lake Atitlan Lungehelseundersøkelse
Søknadsnummer: 203917
Forskningsansvarlig institusjon: Universitetet i Bergen

Prosjektsøknad: Endring godkjennes

Søkers beskrivelse

Studien skal kartlegge forekomst av astma og allergiske sykdommer i en befolkning i Lake Atitlan området i Guatemala, og sammenheng mellom luftveishelse/allergier og a) eksponeringer i den tradisjonelle tekstilindustrien i området, b) eksponering for desinfeksjonsmidler og rengjøringsmidler knyttet til Covid-19 pandemien, og c) foreldres yrkeseksponeringer i tekstilindustrien og andre yrker (pesticider er svært utbredt i jordbruket i området). Studien har som sekundærformål å etablere en dataressurs/biobank som kan benyttes til forskning også på andre relevante helseutfall, slik som diabetes og overvekt som er svært hyppig i denne befolkningen. Studien er utformet i samarbeid med lokale organisasjoner, blant annet organisasjoner av "veversker" - kvinnene i den tradisjonelle tekstilindustrien - og har også som formål å engasjere disse lokale organisasjonene i forskning som er ønsket fra deres samfunn.

Studien skal rekruttere 50 kvinner i tekstilindustrien og 150 kvinner i andre yrker, og deres husstander med foreldre, ektefeller og barn. Informasjon om generelle karakteristika, luftveissymptomer og helseutfall, og relevante eksponeringer, samles via standardiserte intervju. Kliniske målinger innbefatter spirometri, hudprikktest, antropometriske mål og blodtrykk, og det samles biomateriale (blod, urin, faeces).

Vi viser til søknad om prosjektendring vedlagt protokoll versjon 3, mottatt 10.01.2023 for ovennevnte forskningsprosjekt. Søknaden er behandlet av sekretariatet i Regional komité for medisinsk og helsefaglig forskningsetikk (REK) nord på delegert fullmakt fra komiteen, med hjemmel i forskningsetikkforskriften § 7, første ledd, tredje punktum. Søknaden er vurdert med hjemmel i helseforskningsloven § 11.

Endringene omfatter ny versjon av forskningsprotokoll og endring i prosjektmedarbeidere. Nye medarbeidere er Fernando Jerez og Rafael Duran.

Prosjektleder beskriver og begrunner endringene slik: *To nye masterkandidater skal ta sin master på prosjektet. Vi ønsker da å inkludere et større antall deltakere i delprosjektet om*

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ernæring som allerede er godkjent, og vi ønsker videre å legge til ni spørsmål om matsikkerhet under punktet "Food management" i dette delprosjektet. Oppdatert protokoll er vedlagt.

REKs vurdering

REK har ingen innvendinger mot omsøkte endringer.

Etter fullmakt er det fattet slikt

Vedtak

Med hjemmel i helseforskningsloven § 11 godkjennes prosjektendringene.

Prosjektet er godkjent frem til 30.11.2024.

Av dokumentasjonshensyn skal opplysningene oppbevares i fem år etter prosjektslutt. Enhver tilgang til prosjektdataene skal da være knyttet til behovet for etterkontroll. Prosjektdata vil således ikke være tilgjengelig for prosjektet. Prosjektleder og forskningsansvarlig institusjon er ansvarlige for at opplysningene oppbevares indirekte personidentifiserbart i denne perioden, dvs. atskilt i en nøkkel- og en datafil.

Etter denne femårsperioden skal opplysningene slettes eller anonymiseres. Komiteen gjør oppmerksom på at anonymisering er mer omfattende enn kun å slette koblingsnøkkelen, jf. Datatilsynets veileder om anonymiseringsteknikker.

Vi gjør oppmerksom på at før prosjektet igangsettes må det foreligge et behandlingsgrunnlag for behandling av personopplysninger. Dette må forankres i egen institusjon.

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 30.11.2024, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Med vennlig hilsen

May Britt Rossvoll
sekretariatsleder

Monika Rydland-Nymo
rådgiver

Kopi til:

Universitetet i Bergen
Ana Lorena Ruano

Appendix 4: Ethical Approval from the *Ministerio de Salud Pública y Asistencia Social* of Guatemala

GOBIERNO *de* GUATEMALA | MINISTERIO DE SALUD PÚBLICA Y ASISTENCIA SOCIAL

Guatemala 05 de octubre de 2022
CNES-ADQ-025-2022

Doctora
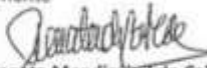Cecilie Svanes
Investigadora Principal
Estudio No. 29-2020

Respetada Dra. Svanes.

Por este medio enviamos el dictamen de aprobado del sub-estudio de diversidad alimentaria del protocolo "Estudio de Salud Pulmonar Lago Atitlán" (Lake Atitlan Lung Health Study, en inglés).

Adicionalmente, se hacen las siguientes recomendaciones para consideración de los investigadores:

1. En el consentimiento informado, sección 5. Beneficios a su participación, cambiar la frase "... y así poder dar una base para mejorar la alimentación personal..." a "... y así poder dar información que sirva de base para diseñar estrategias para mejorar la alimentación..."

2. Si en caso la diversidad nutricional no es adecuada, recomendar a las autoridades de salud local y comunitarias:
   - Evaluación por especialista (Nutricionista)
   - Tratamiento médico o nutricional completo y su seguimiento, si el caso lo amerita.
   - Capacitación sobre hábitos alimenticios saludables de forma personal y por curso de vida, con énfasis en la niñez y adolescencia.
   - Recomendar la ingesta de agua como un hábito saludable.
   - Capacitar sobre los métodos de preparación y cocción más saludable de los alimentos, con énfasis en la niñez y adolescencia.
   - Recomendar la ingesta de agua como un hábito saludable.
   - Capacitar sobre los métodos de preparación y cocción más saludable de los alimentos.
   - Capacitación sobre guías de actividad física, necesarios como un hábito esencial para la salud
   - Propiciar proyectos con autoridades y lideres locales, para la implementación de espacios adecuados al aire libre, donde se instalen equipos para ejercitarse.

Atentamente

MSc. Renata Mendizabal de Cabrera
Presidente
Comité Nacional de Ética en Salud

Dr. Jorge Cifuentes Morales
Secretario
Comité Nacional de Ética en Salud

CC Archivo
Rne/Ccn/adqg

Trabajando por la salud de Guatemala

Ministerio de Salud Pública y Asistencia social
6 Avenida 3-45 zona 11 Teléfono: 2444-7474   www.mspas.gob.gt

Appendix 5: Informed consent form

UNIVERSIDAD DE BERGEN

Consentimiento para formar parte del subestudio sobre diversidad dietética dedicado a participantes mayores de 18 años

´1. Información clave:

Título: Descripción de la diversidad dietética y seguridad alimentaria de un grupo de mujeres mayas, un sub-estudio del lago de Atitlán Estudio de Salud Pulmonar.
Investigador principal: Profesora Cecilie Svanes, Departamento de Salud Pública Global y Primaria Atención y Centro de Salud Internacional Universidad de Bergen
Co-investigadores: Profesora Asociada Ana Lorena Ruano, Departamento de Salud Pública Global y Atención Primaria, Centro de Salud Internacional, Universidad de Bergen; Mónica Mazariegos, Instituto de Nutrición de Centroamérica y Panamá; Doctorando Juan Pablo López Cervantes, Departamento de Salud Pública Global y Atención Primaria, y Centro de Salud Internacional, Universidad de Bergen; Estudiante de máster Chloë Carpi, Centro de Salud Internacional Universidad de Bergen; Estudiante de máster Rafael Durán, Centro de Salud Internacional Universidad de Bergen.

Se le invita a participar en un sub-estudio de investigación del Estudio de Salud Pulmonar del Lago Atitlán. Los siguientes documentos incluye información sobre el objetivo y el desarrollo del estudio, los riesgos y beneficios relacionados con su participación, el respeto a su confidencialidad y la protección de tus datos. Estas informaciones le ayudarán a decidir si desea participar o no en este estudio.

2. Propósito del estudio:

El objetivo de este subestudio es investigar la diversidad dietética de las mujeres mayas de Guatemala que participaron previamente en el Estudio de Salud Respiratoria del Lago de Atitlán (julio de 2021), utilizando un cuestionario que incluye una parte dedicada a la seguridad alimentaria utilizando la Escala de (HFIAS) para la Medición del Acceso a los

Alimentos, y otra parte dedicada a la diversidad alimentaria utilizando la herramienta estandarizada Minimum Dietary Diversity for Women (MDD-W).

3. Pasos del estudio:

Si da su consentimiento para participar en este estudio, se le pedirá que responda dos breves cuestionarios realizados en español o en idiomas locales (Tz´utujil y kaqchikel) cuando sea necesario. La entrevistadora será la co-investigadora Chloë Carpi y Rafael Durán estudiantes del máster de la Universidad de Bergen.

En primer lugar, se le pedirá información personal general, como edad, estado civil, nivel educativo y ocupación. educativo y profesión. Esto llevará **aproximadamente 10 minutos.**

En segundo lugar, se le harán 9 preguntas sobre seguridad alimentaria que le llevarán aproximadamente **10 minutos**. Además, se le harán 24 preguntas con respuestas sí/no sobre lo que comió las últimas 24 horas, incluyendo alimentos, bebidas y aperitivos consumidos en casa o en otro lugar. Este cuestionario durará **aproximadamente 30 minutos** y estará asistido con imágenes para facilitar la comprensión.

Por último, se tomarán medidas de su peso, estatura, circunferencia de cintura y cadera utilizando una báscula plana, un estadiómetro portátil y una cinta métrica. Esta primera parte durará **aproximadamente 5 minutos.**

En total, la entrevista y la medición no durarán más de **35 minutos.**

4. Riesgos potenciales:

Este estudio se considera una actividad de bajo riesgo para el participante, justificado por las siguientes razones:

· Los datos se recopilan a través de **un proceso no invasivo**. Dos breves cuestionarios serán se lleva a cabo, y se espera que los participantes proporcionen respuestas simples. Solo la cintura y las mediciones de la circunferencia de la cadera implicarán un contacto corporal cercano.

- · **La rutina diaria del participante no se verá afectada por el estudio**. La participación no requiere modificar los hábitos dietéticos y necesita solo una hora para completar los dos cuestionarios
- · **Respeto a la privacidad y confidencialidad del participante**. Consulte la sección 8.

5. Beneficios de su participación:

Su participación contribuirá a conocer los hábitos alimentarios y a aumentar el conocimiento sobre la nutrición de su comunidad local. Los conocimientos adquiridos se comunicarán a su comunidad, y dar una base para mejorar la alimentación personal, pero también de su familia y de la comunidad. El conocimiento adquirido también contribuirá a estudios adicionales y un mayor conocimiento de la dieta en las comunidades mayas de Guatemala.

6. La participación es voluntaria

Participar en este proyecto de investigación es **voluntario**. Usted no tiene que participar, y puede detener su participación en cualquier momento durante el transcurso del estudio. Por favor, tómese su tiempo para leer y entender este formulario, y hacer preguntas antes de decidir participar en este proyecto de investigación.

7. Participantes del estudio:

Está invitada a participar si eres una mujer maya que vive en la región de Sololá en Guatemala alrededor del lago Atitlán, con una edad entre 18 a 49 años y que habla español y/u otros idiomas locales (Tz´utujil y Kaqchikel).

Criterios de exclusión: las mujeres embarazadas y las mujeres con una condición que requiere una dieta específica están excluidas para los fines del estudio.

8. Protección de los datos y difusión:

Sus datos serán recopilados y registrados en un cuestionario por los co-investigadores Chloë Carpi y Rafael Durán de forma segura en el sitio en un lugar cerrado. Se le asignará un número único para asegure su anonimato. Luego, los datos se transferirán a una

computadora protegida con contraseña, se almacenarán en un servidor seguro de la Universidad de Bergen (SAFE), y guardado a salvo. El acceso a los datos será únicamente otorgado por el investigador principal del equipo en Noruega y Guatemala, y asignado al equipo solo miembros. Los resultados de este sub-estudio podrían publicarse en artículos o presentaciones, sin embargo, se mantendrá su anonimato y no se incluirá ningún dato que permita identificarle. El nombre y otra información que pueda identificar directamente su identidad se almacenarán de forma segura y separado del resto de los datos. Los investigadores pueden contactarlo nuevamente para otros fines como parte de este proyecto. Además, los datos pueden usarse o compartirse para futuros estudios de investigación. Sin embargo, los datos serán desidentificados, lo que significa que se eliminará las informaciones que puede identificar directamente su identidad.

9. Contacto:

Por favor, póngase en contacto con los investigadores enumerados a continuación para:
- · Obtener más información sobre el estudio
- · Hacer una pregunta sobre los procedimientos de estudio
- · Reporte cambios en su dieta habitual que puedan influir en los resultados del estudio (embarazo, enfermedad…)
- · Dejar el estudio antes de que termine
- · Expresar su preocupación por el estudio

Co-investigador: Chloë Carpi
Email: Chloe.Carpi@student.uib.no
Tel: 37935642

Co-investigador: Rafael Durán
Email: rafael.duran@student.uib.no
Tel: 37935614

Co-investigator: Juan Pablo López Cervantes
Email: Juan.Lopez@student.uib.no
Tel: +47 46245860

10. Su consentimiento:

Al firmar este documento, usted acepta participar en este estudio. Dos copias de este documento serán hacerse, uno se le dará a usted y el otro se quedará con el equipo. Si tienes alguna pregunta antes de la firma puede ponerse en contacto con los miembros del equipo mencionados en la sección 9. Participar en este estudio incluye responder a dos cuestionarios y mediciones antropométricas.

Además, al dar su consentimiento, acepta que los datos puedan ser utilizados en el futuro estudios con la aprobación de los comités de ética.

Acepto para participar en este estudio:

Nombre completo:_____

Fecha (dd/mm/aaa):_____

Firma: