

Food Safety Practices of Household Food Preparers in Akwa Ibom State, Nigeria.

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ABSTRACT

Generally, study analysed the food safety practices of household food preparers in Akwa Ibom state. A multi-stage sampling procedure was used to collect cross-sectional data from 457 respondents. Specifically, study determined the prevalence, margin and intensity of and factors influencing food safety practices of household food preparers. Given two critical indices 0.62 and 0.42, the study showed that the prevalence of best food safety practices is 49.45% and 97.8% respectively. Results of the disaggregated mean prevalence show that households that carry out less than best food safety practices do so sometimes and not often respectively while those who carry out best practices, do so most times. The mean margins, based on the two respective critical indices 0.62 and 0.42, suggest that, minimally, policy could seek to raise the value of the food safety and dietary practices index of households with less than best practices by 0.08 and 0.04 respectively. The values of the intensity (of the mean margin) 0.009, 0.002 and 0.004, 0.0003, in pairs each representative of the two critical indices-0.62 and 0.42, show that the deviation is more severe when the mean is adopted as critical index both when only deviating and all households are considered. Results of the fractional probit regression indicated that education, household income and confidence in safety labels are statistically significant in explaining the probability of households carrying out food safety practices. The gap between households who carry out less than best and best food safety practices should be bridged.

Keywords: Food Safety, Prevalence, Margin and Intensity.

INTRODUCTION

With considerable regional differences in the global burden of food borne diseases, Africa stands out, as having the highest burden per population of food borne diseases [22]. In Nigeria, despite the efforts of Government through its National Agency for Food and Drug Administration and Control (NAFDAC), to improve the safety of food supply, food safety still remains a major issue. Empirical literature has revealed that the increase in food borne illnesses could be linked to inappropriate

food safety practices in homes, as the home surroundings can encourage the perpetuation of a gamut of food borne pathogens [21]. Evidently, in the study area, as the case in developing economies' households, knowledge level and adoption of globally acceptable food safety practices are questionably low. In the case where the foods items are traded under unregulated and hygienically poor market situations, the foods bought and prepared at homes are highly susceptible to food contamination, thus impeding the overall safety of the consuming households. The situation is even worse in the poor and vulnerable households that have little or no access to basic food storage household assets.

The food preparer plays a cardinal role in the realization of near total compliance to food safety practices throughout the whole process in the food chain, especially the food preparation and storage [12, 14]. Hence, it is critical for the food preparers to fully practice the best acceptable food safety measures, which according to [13]; include proper hand washing, maintain good personal hygiene, wearing clean work attire, adherence to food-hygiene practices at work and carry out regular training to ensure that the food they handle and prepare is safe. Literature, particularly specific to the Nigerian setting are reviewed in the following paragraphs to provide context and background for the study.

The aim of a study by [9] was to identify the food safety practices of residents of a rural community in Southwest, Nigeria. Based on a cross-sectional design, five clusters were selected by simple random sampling from the sampling frame. Households were drawn from all the clusters to obtain a sample size of 216 households. Data were collected using a semi-structured questionnaire. The authors reported that majority of the respondents were female (62.2%), Christians (78.1%), married (53.1%). Further reports showed that residents of the community showed good food safety practices with 80.6% reported to always washing their hands before cooking, 90.3% always clean their cooking utensils before and after use, 83.7% always clean their cooking environment, and nearly all (96.9%) reported washing their hands after using the toilet.

Similarly, [5] analysed the food safety knowledge and practices among farming households in Irepodun Local Government Area (LGA) of Kwara State, Nigeria. Due to its large population of farmers, Irepodun LGA was purposively selected. Using a two-stage sampling technique one hundred and four (104) respondents were randomly selected from five villages. Primary data was obtained via an interview schedule. The findings showed that the mean income was 156375.50 NGN (441.74 USD) per annum, majority of the farming households have low knowledge towards food safety practices. Constraints to food safety practices include: lack of knowledge, inadequate training and awareness and inadequate finance. Outcome of PPMC analysis showed that income and educational level was significantly related to the food safety practices among farmers across the selected farming households.

[3] carried out a descriptive, cross sectional study among food vendors in primary schools in Jos North Local Government Area to determine the knowledge and practice of food safety and hygiene. The authors reported that, the mean age of the food handlers in the study was 25.8 ± 5.3 years with the mean years of work experience as 7.8 ± 1.3 years. Statistically significant relationship was additionally reported between age ($P < 0.001$) and practice of food safety and hygiene.

[2] examined the knowledge of food-borne illnesses and food safety practices of local food handlers in Ijebu-Ode Local Government Area of Ogun State. A sample of four hundred and seventy three local food handlers (snacks and cooked food handlers) were drawn for the study. Interviewer's administered questionnaire was used to obtain data on knowledge and practice and a score index was then computed. The authors report that majority (66.4%) of the respondents were female and 17.0% food handlers had no formal education. Majority (84.5%) of the respondents earned below N30000. Additionally, 31.5% respondents had poor food safety practices. Educational qualification of respondents had a significant relationship with their food safety practices ($P=0.0011$).

[4] assessed food hygiene knowledge and practices among food handlers in University of Nigeria, Nsukka Campus. Two specific objectives undergirded the study. The study implemented a descriptive, cross-sectional survey research design. The population for the study was 165 food handlers. There was no sampling done. A researchers'- designed food hygiene knowledge and practices questionnaire was the instrument for data collection. Results revealed that all the respondents (100%) who have no formal education were knowledgeable about food hygiene; 90.8% of those who have primary education, 92.3% of those who have secondary education and 92.3 of those who have no tertiary education had good knowledge of food hygiene. The authors also reported that there was no significant difference in the food hygiene practices of food handlers based on level of education ($P = >.05$).

A descriptive cross-sectional study was conducted by [10] among food vendors and food handlers in Obafemi University Ile-Ife, South Western Nigeria. The sample of vendors drawn for the study were 238. Data was collected using a 3- sectioned structured questionnaire. The results indicated that more than half of the respondents were female (58%). It further showed that 48.7% of the respondents had completed training in food safety, out of which (49.6%) had completed university education or currently enrolled in the university. Additionally, results showed that 115 (78.2%) of respondents had satisfactory safety hygiene practices and 28 (19.0%) had unsafe hygiene practices. The main aim of a study conducted by [6] was to determine the effect of training on knowledge and practice of food hygiene and safety among food handlers in restaurants in Abakaliki, Nigeria. A quasi-experimental design was adopted for the study. A total of 170 food handlers selected for the study. Results revealed that, post-intervention, the fraction of food handlers in the intervention group who had very good practice of food hygiene and safety also increased significantly by 28.4% ($p<0.01$).

A study was carried out to examine the knowledge, attitude and hygienic practices of food vendors in Owerri town of Imo State, Nigeria. Using a cross-sectional, descriptive design and a proportionate convenience sampling technique, 200 food vendors from the three Local Government Areas (LGAs) in Owerri town were selected. Data were obtained using a pretested semi-structured interviewer administered questionnaire. The authors, [11] reported that majority of the respondents had a good level of knowledge (81%) and positive attitude (71%) about food hygiene, only 37% of the respondents had a good level of hygienic practice. It was further indicated that 32% and 46% of the respondents received training on food hygiene and environmental health worker inspection respectively. It was, additionally, shown that, there were statistically significant relationships between knowledge ($p = 0.001$), attitude ($p = 0.000$), formal training on food hygiene ($p = 0.000$) and the level of food hygienic practices.

An analysis of the food hygiene practices of food handlers within food establishments in the Federal Capital Territory was done. The study design was cross-sectional, descriptive. Adopting multistage sampling technique, [8] drew a sample size of 168 food handlers of various types. Data was obtained using structured interviewer-administered questionnaires and observation checklist. Results indicated that 42.3% of the subjects are males, whereas 57.7% are females. Majority (72.7%), had secondary education and above, while (27.3%) had primary education and below. Furthermore, 89.3% of them wash their hands after the use of toilets, whereas only 44 (26.7%) change their hand gloves at work. 53 (31.5%) are isolated from workplace when ill. Additionally, 103 (61.3%) use ideal waste disposal methods at workplace ($P < 0.01$).

It is observable, based on the above empirical literature review around the subject of food safety, specifically food safety practices in Nigeria, generally focus on the level of performance of food safety practices and the scope of the study includes determining factors that influence the performance of food safety practices. Other studies, specifically by: [15, 7 and 19] buttress this fact. An incisive look into the issue of food safety with specific regards to practices should, however, include, but not be restricted to, analyzing the level of adherence to and factors affecting food safety practices in a given study area. Hence this study, in addition to the aforementioned, develops special statistical estimators to measure the disaggregated mean prevalence, margin and intensity of food safety practices of household food preparers. Noticeably also, from the review of empirical literature there is a dearth of studies on food safety practices, with the proposed addition, in South East Nigeria. It is against this background that this study is carried out in Akwa Ibom state Nigeria. As a precursor to determining the prevalence, margin and intensity of food safety practices in the study area, the study develops a food safety practices index, *fspi*. Additionally, the study specifies a fractional probit regression to determine factors significant in explaining the probability of a household carrying out food safety practices.

MATERIALS AND METHODS

Study Area

The study was conducted in Akwa Ibom State. The State is located in the South-South geopolitical and South East ecological zones of Nigeria. It is one of the Niger Delta States. The State lies between 4°33" and 5°33" North latitudes, and 7°35" and 8°25" East longitudes. The estimated total area is put at 7,245,935km², and has a shoreline of 129km on the Atlantic Ocean to the South. It shares borders with Cross River State to the East, Abia State to the North, and Rivers State to the West. The 2006 provisional census puts the population at 3,920,208, out of which 2,044,510 are males while 1,875,698 are females.

The major ethnic groupings in the state are Ibibio, Annang and Oron. Ibibio is the main language. The above population lives within the tropical rainforest zone with two major seasons: rainy season (May to October) and a dry season (November to April). Annual rainfall ranges between 2400mm along the coast and 2000mm. In 1997, the State was divided into six (6) agricultural zones namely- Abak, Etinan, Eket, Uyo, Oron and Ikot Ekpene.

Data Collection

Data for the study was cross-sectional. This primary data was obtained using a structured questionnaire that was administered to households. Furthermore, a multistage sampling procedure was applied in this study. In the first stage, three agricultural zones were randomly selected out of

the six agricultural zones, namely: Uyo, Eket and Ikot Ekpene. Next, three local governments each were purposively to give urban, semi-urban and rural representation to the study. Thirdly, six communities were randomly selected from each of the selected Local governments. In the last stage 10 households were randomly selected, giving a total of 540 households (180 from each selected zone). However, 457 questionnaires were duly and properly completed and hence the analysis was based on this number. Data was collected in 2018.

Analytical Framework

Food Safety Practices Index

First step involves the computation of, the food safety practice index *fspi*. In this case, twenty two (22) food safety practice items, gleaned from a wide range of literature (See Appendix 1), are assigned values based on how often [never = 0, not often=1, sometimes = 2, most times = 3, always = 4] households food preparers was reported to carry them out. Following, these values are summed up for each respondent. Next the outcome, on respondent basis, is divided by a total of 88 (which is the highest figure obtainable if the respondent carries out all practices always). The quotient, so obtained, is the food safety practices index (*fspi*) for each household food preparer.

Critical Scores

Household food preparers are dichotomized into respondents that carry out less than best and best practices. This is done based on two threshold indices namely: the mean food safety practices index and two-thirds of the mean food safety practices index. In this context, household food preparers with food safety practice index equal to and above the critical indices are termed as carrying out best food safety practices. On the other hand, respondents with values below the critical indices are termed to be carrying out less than best food safety practices.

Prevalence

To estimate food safety practice prevalence, three measures of prevalence are developed namely: percentage prevalence, disaggregated mean prevalence and weighted mean prevalence are developed.

1. Percentage Prevalence

This is simply a percentage of households who fall below (less than best) and above/equal to (best) the critical indices. This measure uses an indicator function that takes on a value of 1 for than best (and best) households, alternatively and expresses it as a proportion of the total number of households (N). The values obtained are subsequently multiplied by a hundred (100) and reported as percentages. This means that the number of households with values below (<) and above/equal (≥) to the mean food safety practices index are counted, hence the indicator, 1. This is captured in equations 1 and 2. Similarly, the number of households with values below (<) and above/equal (≥) to two-thirds of the mean food safety practices index are counted, hence the indicator, 1. This is as indicated in equations 3 and 4. This is given as indicated in equations 1, 2, 3 and 4:

Using mean as critical index:

$$fspi_{pp} = \sum_{i=1}^N 1(fspi < \overline{fspi}) \frac{1}{N} \dots \dots \dots 1$$

$$fspi_{pp} = \sum_{i=1}^N 1(fspi \geq \overline{fspi}) \frac{1}{N} \dots \dots \dots 2$$

Using 2/3 mean as critical index:

$$fspi_{pp} = \sum_{i=1}^N 1(fspi < \frac{2}{3} \overline{fspi}) \frac{1}{N} \dots \dots \dots 3$$

$$fspi_{pp} = \sum_{i=1}^N 1(fspi \geq \frac{2}{3} \overline{fspi}) \frac{1}{N} \dots \dots \dots 4$$

Where N = total number of household food preparers

$$fspi_{pp} = \text{percentage prevalence}$$

$$\overline{fspi} = \text{mean } fspi$$

$$\frac{2}{3} \overline{fspi} = \text{Two-thirds mean } fspi$$

2. Disaggregated mean Prevalence

This is the second measure of prevalence is essentially a mean computed based on actual values of *fspi*. The word 'disaggregated' here implies that the population is dichotomized ('disaggregated') into those that carry out less than best and best practices before the means are computed. This measure is calculated for households with values below and above/equal to the mean. This is done as expressed in equations 5 and 6. It is similarly calculated for households with values below and above/equal to the mean. This is done as expressed in equations 7 and 8.

$$fspi_{pa} = \sum_{i=1}^N (fspi < \overline{fspi}) \frac{1}{n} \dots \dots \dots 5$$

n = number of household food preparers with $fspi < \overline{fspi}$.

$$fspi_{pa} = \sum_{i=1}^N (fspi \geq \overline{fspi}) \frac{1}{n} \dots \dots \dots 6$$

n = number of household food preparers with $fspi \geq \overline{fspi}$

Using 2/3 mean as critical index:

$$fspi_{pa} = \sum_{i=1}^N (fspi < \frac{2}{3} \overline{fspi}) \frac{1}{n} \dots \dots \dots 7$$

n = number of household food preparers with $fspi < \frac{2}{3} \overline{fspi}$

$$fspi_{pa} = \sum_{i=1}^N (fspi \geq \frac{2}{3} \overline{fspi}) \frac{1}{n} \dots \dots \dots 8$$

n = number of household food preparers with $fspi \geq 2/3 \overline{fspi}$.

$fspi_{pa}$ = disaggregated mean prevalence

3. Weighted Mean Prevalence

The weights used are the sum of the $fspi$ of households that have less than best (and best) food safety practices expressed as a proportion of the total $fspi$ for all households in the study area. This is computed as expressed in equations 9 and 10, where the mean is used as critical index to split households into less than best and best practices households. It is also calculated using two thirds of the mean as critical score in equations 11 and 12.

$$\frac{fspi_{wpa}}{< \overline{fspi}} = \overline{fspi} \times \frac{\sum fspi < \overline{fspi}}{\sum fspi} \dots \dots \dots 9$$

$$\frac{fspi_{wpa}}{\geq \overline{fspi}} = \overline{fspi} \times \frac{\sum fspi \geq \overline{fspi}}{\sum fspi} \dots \dots \dots 10$$

$$\frac{fspi_{wpa}}{< 2/3 \overline{fspi}} = \overline{fspi} \times \frac{\sum fspi < 2/3 \overline{fspi}}{\sum fspi} \dots \dots \dots 11$$

$$\frac{fspi_{wpa}}{\geq 2/3 \overline{fspi}} = \overline{fspi} \times \frac{\sum fspi \geq 2/3 \overline{fspi}}{\sum fspi} \dots \dots \dots 12$$

Where,

$fspi_{wpa}$ = weighted mean prevalence

Food Safety Practice Margin

This is a measure computable only for households who have less than best practices. This implies that the margin is obtained for households with values below the mean and two thirds of the mean, respectively. It is basically a deviation from the threshold score by households with less than best food safety practices in the study area. Essentially, in this vein, it measures the gap between respondents who carry out less than best food safety practices and the one who carry out best practices. By implication it is the value by which the $fspi$ of household food preparers should be raised to ensure that all of them carry out best food safety practices. The margin is computed based on the number of uninformed households (n) and all households (N) in the study area.

The rationale for this is that, firstly, the number of households with less than best practices and all the households provide the basis for conclusion in terms of targeted interventions (ones geared towards households with less than best practices). Secondly, computation based on all the households establishes the premise for interventions that are untargeted ones (ones spread across all households). It is worthy of note that this measure, however, assumes that households that perform best practices have $fspi$ values exactly equal to the critical scores. Two measures of the margin are computed in this study, namely the mean margin and mean proportionate margin.

1. Mean Margin

This measure captures the difference in index values between household food preparers that carry out less than best and best food safety practices. It is obtained as seen in equations 13 and 14, where the mean is adopted as critical index. It is similarly calculated as given in equations 15 and 16, given that two thirds of the mean is critical index.

Using the mean as critical index:

$$fspi_{mm} = \sum_{i=1}^N (\overline{fspi} - < \overline{fspi}) \frac{1}{N} \dots \dots \dots 13$$

N = total number of household food preparers.

$$fspi_{mm} = \sum_{i=1}^N (\overline{fspi} - < \overline{fspi}) \frac{1}{n} \dots \dots \dots 14$$

n = number of household food preparers with $fspi < \overline{fspi}$

Using 2/3 of the mean as critical index:

$$fspi_{mm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi}) \frac{1}{N} \dots \dots \dots 15$$

N = total number of household food preparers

$$fspi_{mm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi}) \frac{1}{n} \dots \dots \dots 16$$

n = number of household food preparers with $fspi < 2/3 \overline{fspi}$

$fspi_{mm}$ = mean margin.

2. Mean Proportionate Margin

This is the mean margin expressed as a function of (that is, divided by) the specific critical index being applied. Equations 17 and 18 show the formula, taking the mean $fspi$ as critical index. Additionally, equations 19 and 20 represent the formula when two thirds of the mean is taken as critical index.

Using the mean as critical index:

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{\overline{fspi} - < \overline{fspi}}{\overline{fspi}} \right) \frac{1}{N} \dots \dots \dots 17$$

N = total number of household food preparers

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{\overline{fspi} - < \overline{fspi}}{\overline{fspi}} \right) \frac{1}{n} \dots \dots \dots 18$$

n = number of household food preparers with $fspi < \overline{fspi}$

Using 2/3 of the mean as critical index:

$$fspi_{mpm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi}) \frac{1}{N} \dots \dots \dots 19$$

N = total number of household food preparers

$$fspi_{mpm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi}) \frac{1}{n} \dots \dots \dots 20$$

n = number of household food preparers with $fspi < 2/3 \overline{fspi}$

$fspi_{mpm}$ = mean proportionate margin.

Intensity

This measure is the margin squared. It measures the severity of the gap between household food preparers who carry out less than best and best food safety practices. It is calculated based on the mean margin and mean proportionate margin.

1. Intensity of the mean margin (imm)

This is given as shown in equations 21, 22, 23 and 24. Equations 21 and 22 adopt the mean as critical index while 23 and 24 assume two thirds of the mean as threshold index.

Using the mean as critical index:

$$fspi_{imm} = \sum_{i=1}^N (\overline{fspi} - < \overline{fspi}) \frac{1}{N}^2 \dots \dots \dots 21$$

N = total number of household food preparers

$$ddi_{imm} = \sum_{i=1}^N (\overline{fspi} - < \overline{fspi}) \frac{1}{n}^2 \dots \dots \dots 22$$

n = number of household food preparers with $fspi < \overline{fspi}$

Using 2/3 of the mean as critical index:

$$fspi_{imm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi})^2 \frac{1}{N} \dots \dots \dots 23$$

N = total number of household food preparers.

$$fspi_{imm} = \sum_{i=1}^N (2/3 \overline{fspi} - < 2/3 \overline{fspi})^2 \frac{1}{n} \dots \dots \dots 24$$

n = number of household food preparers with $fspi < 2/3 \overline{fspi}$

$fspi_{imm}$ = intensity of the mean margin

2. Intensity of the Mean Proportionate Margin (imp_m)

is the mean proportionate margin squared. Equations 25 and 26 adopt the mean as critical index. Similarly, equations 27 and 28 assume two thirds of the mean as critical index.

Using the mean as critical index:

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{\overline{fspi} - fspi}{\overline{fspi}} \right)^2 \frac{1}{N} \dots \dots \dots 25$$

N = total number of household food preparers.

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{\overline{fspi} - fspi}{\overline{fspi}} \right)^2 \frac{1}{n} \dots \dots \dots 26$$

n = number of household food preparers with $fspi < \overline{fspi}$

Using 2/3 of the mean as critical index:

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{\frac{2}{3}\overline{fspi} - fspi}{\frac{2}{3}\overline{fspi}} \right)^2 \frac{1}{N} \dots \dots \dots 27$$

N = total number of household food preparers.

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{\frac{2}{3}\overline{fspi} - fspi}{\frac{2}{3}\overline{fspi}} \right)^2 \frac{1}{n} \dots \dots \dots 28$$

n = number of household food preparers with $fspi < \frac{2}{3}\overline{fspi}$

$fspi_{imp}$ = intensity of the mean proportionate margin

Estimation Procedure

Estimating Prevalence, Margin and Intensity

1. Percentage Prevalence

This is given by substituting for the values of the mean in equation 1 and 2, and similarly substituting for the values of two thirds of the mean in equation 3 and 4. The respective outcomes are as shown in equations 29, 30, 31 and 32.

Given the mean, 0.62, as critical index:

$$fspi_{pp} = \sum_{i=1}^N 1(fspi < 0.62) \frac{1}{N} \dots \dots \dots 29$$

$$fspi_{pp} = \sum_{i=1}^N 1(fspi \geq 0.62) \frac{1}{N} \dots \dots \dots 30$$

Using two-thirds (2/3) of the mean, 0.42, as critical index:

$$fspi_{pp} = \sum_{i=1}^N 1(fspi < 0.42) \frac{1}{N} \dots \dots \dots 31$$

$$fspi_{pp} = \sum_{i=1}^N 1(fspi \geq 0.42) 1/N \dots \dots \dots 32$$

N = total number of household food preparers (= 457)

2. Disaggregated Mean Prevalence

This is given as expressed in equations 33, 34, 35 and 36. Equation 33 and 34 are obtained by substituting for the value of the mean in equation 5 and 6. Additionally equation 35 and 36 are derived by substituting for the value of two thirds of the mean in equation 7 and 8.

Using the mean, 0.62, as critical index:

$$fspi_{pa} = \sum_{i=1}^N fspi < 0.62) 1/n \dots \dots \dots 33$$

n = number of household food preparers with $fspi < 0.62$

$$fspi_{pa} = \sum_{i=1}^N (fspi \geq 0.62) 1/n \dots \dots \dots 34$$

n = number of household food preparers with $fspi \geq 0.62$

Given two-thirds ($2/3$) of the mean, 0.42, as critical index:

$$fspi_{pa} = \sum_{i=1}^N fspi < 0.42) 1/n \dots \dots \dots 35$$

n = number of household food preparers with $fspi < 0.42$

$$fspi_{pa} = \sum_{i=1}^N (fspi \geq 0.42) 1/n \dots \dots \dots 36$$

n = number of household food preparers with $fspi \geq 0.42$

3. Weighted Mean Prevalence

This is presented in equations 37, 38, 39 and 40. These equations are derived by substituting for the respective values of the mean and two thirds of the mean in equations 9, 10, 11 and 12 respectively. Given the mean, 0.62, as critical index:

$$fspi_{wpa} = \overline{fspi} \times \frac{\sum fspi < 0.62}{\sum fspi} \dots \dots \dots 37$$

$$fspi_{wpa} = \overline{fspi} \times \frac{\sum fspi \geq 0.62}{\sum fspi} \dots \dots \dots 38$$

Using two-thirds (2/3) of the mean, 0.42, as critical index:

$$fspi_{wpa} = \overline{fspi} \times \frac{\sum fspi < 0.42}{\sum fspi} \dots\dots\dots 39$$

$$fspi_{\geq 0.42} = \overline{fspi} \times \frac{\sum fspi \geq 0.42}{\sum fspi} \dots\dots\dots 40$$

Mean Margin

This is indicated by equations 41, 42, 43 and 44. These equations are derived by substituting for the values of the mean and two thirds of the mean in equations 13, 14, 15 and 16 respectively.

Using the mean, 0.62, as critical index

$$fspi_{mm} = \sum_{i=1}^N (0.62 - < 0.62) \frac{1}{N} \dots\dots\dots 41$$

N = total number of household food preparers (= 457)

$$fspi_{mm} = \sum_{i=1}^N (0.62 - < 0.62) \frac{1}{n} \dots\dots\dots 42$$

n = number of household food preparers with $fspi < 0.62$

Given two-thirds (2/3) of the mean. 0.42, as critical index:

$$fspi_{mm} = \sum_{i=1}^N (0.42 - < 0.42) \frac{1}{N} \dots\dots\dots 43$$

N = total number of household food preparers (= 457)

$$fspi_{mm} = \sum_{i=1}^N (0.42 - < 0.42) \frac{1}{n} \dots\dots\dots 44$$

n = number of household food preparers with $fspi < 0.42$

Mean Proportionate Margin

This is as presented in equations 45, 46. 47 and 48. These equations are obtained by substituting for the values of the mean and two thirds of the mean in equations 17, 18, 19 and 20 respectively.

Using them mean, 0.62, as critical index:

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{0.62 - < 0.62}{0.62} \right) \frac{1}{N} \dots\dots\dots 45$$

n = number of household food preparers with $fspi < 0.62$

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{0.62 - < 0.62}{0.62} \right) \frac{1}{n} \dots \dots \dots 46$$

Using two-thirds (2/3) of the mean, 0.42, as critical index,

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{0.42 - < 0.42}{0.42} \right) \frac{1}{N} \dots \dots \dots 47$$

n = number of household food preparers with $fspi < 0.62$

$$fspi_{mpm} = \sum_{i=1}^N \left(\frac{0.42 - < 0.42}{0.42} \right) \frac{1}{n} \dots \dots \dots 48$$

N = total number of household food preparers (= 457)

Intensity

Intensity of the mean margin

This is expressed in equations 49, 50, 51 and 52. These equations are derived by substituting for the respective values of the mean and two thirds of the mean in equations 21, 22, 23 and 24 respectively.

Using then mean, 0.62 as critical index:

$$fspi_{imm} = \sum_{i=1}^N (0.62 - < 0.62) \left(\frac{1}{N} \right)^2 \dots \dots \dots 49$$

$$fspi_{imm} = \sum_{i=1}^N (0.62 - < 0.62) \left(\frac{1}{n} \right)^2 \dots \dots \dots 50$$

n = number of households with $fspi < 0.62$

N = total number of households (= 457)

Given two- thirds (2/3) of the mean, 0.42 as critical index:

$$fspi_{imm} = \sum_{i=1}^N (0.42 - < 0.42) \left(\frac{1}{N} \right)^2 \dots \dots \dots 51$$

$$fspi_{imm} = \sum_{i=1}^N (0.42 - < 0.42) \left(\frac{1}{n} \right)^2 \dots \dots \dots 52$$

n = number of households with $fspi < 0.42$

N = total number of households (= 457)

Intensity of the mean proportionate margin

This is obtained as seen in equations 53, 54, 55 and 56. These equations are derived from equations 25, 26, 27 and 28 respectively.

Given the mean, 0.62, as critical index:

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{0.62 - < 0.62}{0.62} \right)^2 \frac{1}{N} \dots \dots \dots 53$$

n = number of households with $fspi < 0.62$

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{0.62 - < 0.62}{0.62} \right)^2 \frac{1}{n} \dots \dots \dots 54$$

N = total number of households (= 457)

Taking two-thirds (2/3) of the mean, 0.42, as critical index:

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{0.42 - < 0.42}{0.42} \right)^2 \frac{1}{N} \dots \dots \dots 55$$

n = number of households with $fspi < 0.42$

$$fspi_{imp} = \sum_{i=1}^N \left(\frac{0.42 - < 0.42}{0.42} \right)^2 \frac{1}{n} \dots \dots \dots 56$$

N = total number of households (= 457)

Estimating Factors affecting Food Safety Practices

The probability of a household carrying out food safety practices is influenced basically by socio-economic characteristics and other factors seen in empirical literature. Probit models, as contrasted with linear probability models, have conditional probabilities that are nonlinearly related to the independent variable(s). Furthermore, probit functions have the characteristic of approaching 0 and 1 asymptotically; hence the predicted probabilities are always sensible. In addition, the probit model is based on the standard normal cumulative density function (CDF). This is defined basically as in equation 57:

$$F(Z) = \int_{-\infty}^Z 2\pi^{1/2} e^{-z^2/2} dz \dots \dots \dots 57$$

Where Z is a standard normal variable and e is the base of the natural log. In a probit model since the standard normal CDF replaces the linear function, what is estimated is in equation 58.

$$E(Y|x_i) = \Pr(Y = 1|x_i) = F(\beta_0 + \beta_i X_i) = \int_{-\alpha}^{\beta_0 + \beta_i X_i} (2\pi)^{1/2} e^{-\frac{\beta_0 + \beta_i X_i}{2}} d(\beta_0 + \beta_i X_i) \dots \dots \dots 58$$

The β terms are not estimated using Ordinary Least Squares regression but a technique known as maximum likelihood estimation. This estimation finds values for the parameters (β s) that maximize the probability of observing the Y values in the sample with the given X values.

Sometimes it is more meaningful for a researcher to express the dependent variable as a fraction, percentage or proportion. Within such a context, as is provided in this study, fractional probit

regressions, a variant of the traditional probit regression can be used. The main difference is that in this context the dependent variable is $0 \leq Y \leq 1$, as seen in equation 59.

$$E(Y|x_i) = \Pr(0 \leq Y \leq 1) = F(\beta_0 + \beta_i X_i) = \int_{-\alpha}^{\beta_0 + \beta_i X_i} (2\pi)^{1/2} e^{-\frac{\beta_0 + \beta_i X_i}{2}} d(\beta_0 + \beta_i X_i) \dots \dots \dots 59$$

The coefficients obtained by estimating a probit model provide the change in the Z (standard normal) value for a unit change in the dependent variables. However to have results akin to that which is obtainable using Ordinary Least Squares regression, that is, to obtain the impact of the independent variables on the probability of observing the outcome, marginal effects are further estimated. The food safety practice of households is expressed as a proportion of a maximum possible value and is, hence, a value that lies between 0 and 1. The factors affecting the probability of a household carrying out food safety practices are the explanatory variables for the fractional probit model. These variables are given in Table 1.

Table 1. Lists, Codes and Description of Variables used in Fractional Probit Regressions

Variables	Codes	Description
Age[X ₁]	Years	Continuous
Education[X ₂]	Years	Continuous
Household Size[X ₃]	Figures	Continuous
Monthly income of household head[X ₄]	Amount [Naira]	Continuous
Children below 5 years[X ₅]	Figures	Continuous
Adults above 65 years[X ₆]	Figures	Continuous
Confidence in Safety labels	Yes=1, No=0	Dummy

RESULTS

Summary Statistics of Continuous variables

Table 2. Summary Statistics of the Continuous variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Age(years)	41	11	18	78
Monthly income(figures in Naira)	94793.03	71297.76	10000	850000
Education(years)	13	4	0	23
Household Size(figures)	5	1	1	9
Children below five (5) years(figures)	1	1	0	6
Adults above 65 years(figures)	1	1	0	5

Source: Field Survey, 2018 *Note: 363.86 naira is equivalent to \$1.00

Table 2 shows that the minimum and maximum ages of household food preparers are 18 and 78 years respectively. This table further reveals that the mean number of years spent acquiring formal education is 13, which would imply that on the average the population have a little more than secondary school education- perhaps an OND (Ordinary National Diploma) or an NCE(National certificate of Education). The minimum number of children below five years and adults above 65years is nil, as additionally seen in Table 2. On the average, however, each household has at least one member in this categories. This provides relevance for the study, as children below five years and adults above 65 years are more vulnerable to the consequences of less than best food safety

practices. The minimum monthly income is about \$27 and the maximum, \$2336 with an average of \$260.

Descriptive Statistics of Dummy Variables

Table 3. Descriptive Statistics of the Dummy Variables

Marital Status	Frequencies	Percentages
Single	40	8.75
Married	417	91.25
Total	457	100
Employment Status		
Unemployed	12	2.63
Employed	445	97.37
Total	457	100
Gender		
Male	1	0.22
Female	456	99.78
Total	457	100
Confidence in Safety Labels		
Confident	336	73.52
Not Confident	121	26.48
Total	457	100

Source: Field Survey, 2018.

Table 3 indicates that over 90% of household food preparers are female (99.78%), employed (97.37%) and married (91.25%). These figures imply that these variables are completely determined and hence provides an explanation for their absence in the fractional probit regression.

Prevalence

Table 4. Food Safety Practices of Households: Prevalence

	Prevalence					
	Percentage prevalence		Disaggregated Mean prevalence		Weighted mean prevalence/percentage contribution	
Critical Index	LTB	B	LTB	B	LTB	B
0.62	50.55	49.45	0.54	0.71	0.27(44)	0.35(56)
0.42	2.2	97.8	0.31	0.63	0.01(1.07)	0.61(98.93)

Source: Field Survey, 2018 *LTB (less than best; <critical index), B (best; ≥ critical index)

Percentage Prevalence

Table 4 shows that 50.55% and 49.45% of households in Akwa Ibom State were found to operate less than best and best food safety practices using the mean *fspi*, 0.62, as critical index, above and equal to which households are considered to operate best food safety practices index. Additionally, 2.2% and 97.8% of household food preparers in Akwa Ibom State operate less than best and best food safety practices using 2/3 of the mean food safety practices index, 0.42, as threshold index.

Disaggregated mean Prevalence

The figures, 0.54 and 0.71 respectively are the mean food safety practices indices given that the population was split into households operating less than best and best food safety practices when the mean *fspi*, 0.62, is adopted as threshold index. The value, 0.54, implies that household food preparers who carry out less than best food safety practices perform food safety practices sometimes, on the average. The figure, 0.71, suggests that the category of household food preparers termed to carry out best practices operate given food safety practice items most times. This pair of figures additionally highlight that the real difference between households who carry out best food safety practices and those who do not is 0.17. Furthermore, from Table 4, the values 0.31 and 0.63 respectively are equal to the mean of households operating less than best and best food safety practices in that order when 2/3 of the mean food safety practices index, 0.42, is used as threshold index. The value, 0.31 indicates that, given two thirds of the mean *fspi* as critical index, household food preparers described as carrying out less than best food safety practices perform presented food safety practice items not often. Additionally, the figure 0.63 shows that household food preparers who do operate best food safety practices carry out food safety practice items presented most times. This pair of figures, 0.31 and 0.63, uncover the real gap between households who carry out and who do not operate best food safety practices and that difference, in this instance, is 0.32.

Weighted Mean Prevalence

At threshold index 0.62, households with less than best and best food safety practices contribute 44% and 56% to the total *fspi*. In actual figures this contribution is 0.27 and 0.35 respectively, which adds up to the actual mean *fspi*, 0.62. Given the critical index 0.42, 1.07% and 98.93% of the total *fspi* value, 85.0682 is contributed by households operating less than best and best food safety practices respectively. In actual figures, 0.01 and 0.61 for households operating less than best and best food safety practices are the contributory figures to the mean *fspi*, 0.62.

Margin

Table 5: Food Safety Practices of Households: Margin

Critical Index	Mean Margin		Mean Proportionate Margin	
	Targeted(n)	Untargeted(N)	Targeted(n)	Untargeted(N)
0.62	0.08	0.04	0.13	0.06
0.42	0.11	0.003	0.27	0.006

Source: Field Survey, 2018.

Mean Margin

Given two critical indices used (0.62 and 0.42), the figures 0.08 and 0.11 depict the mean deviation, from the given critical scores, for households with scores that reveal they operate less than best food safety practices. Intuitively, it is the minimum value by which any intervention programme should aim to raise the *fspi* of households in the study area, provided that the measures are targeted only at households whose *fspi* are below the respective critical values. Explicitly, these are the figures by which the *fspi* of deviating households should be raised to ensure that household food preparers who carry out less than best food safety practices sometimes move up to being best food safety practices practitioners- carry out food safety practices most times at the minimum. The figures, 0.04 and 0.003, are obtained with respect to the two critical indices; 0.62 and 0.42 respectively. These values depict the mean deviation obtained as a function of all the households and not just households which operate less than best food safety practices. Intuitively, it is the

minimum value by which any intervention should aim to raise the *fspi* of the population without specific recourse to households operating less than best food safety practices. Elaborating, these are the specific values by which the *fspi* of all households should be raised to ensure that food safety practices are, on the average carried out most times.

Mean Proportionate Margin

With respect to the two critical indices (0.62 and 0.42), the values, 0.13 and 0.27 are the mean proportionate margin of the population (where households with *fspi* < 0.62 and 0.42, have zero *fspi* margin). It is useful to think of this measure as the minimum value (expressed as a proportion of the critical index) by which *fspi* of households have to be raised to bring them up to the critical values. Multiplying these values by the critical index (0.62 and 0.42) respectively, the precise minimum value by which an intervention should seek to raise *fspi* is obtained. This is provided that the interventions are targeted only at households with indices below the critical value. Additionally, given the critical indices 0.62 and 0.42, the values obtained are 0.06 and 0.006 respectively. These figures essentially represent the ratio of the minimum value by which *fspi* must be raised with perfect targeting (intervention aimed only at households operating less than best food safety practices) to the maximum value with no targeting (intervention aimed at whole population) which would entail aiming to raise the value of every households index with enough to ensure that they are not below the critical index.

Intensity

Table 6: Food Safety Practices of Households: Intensity

Critical Index	(of the Mean Proportionate Margin)		(of the Mean Margin)	
	Targeted(n)	Untargeted(N)	Targeted(n)	Untargeted(N)
0.62	0.02	0.01	0.009	0.004
0.42	0.0094	0.0002	0.002	0.00003

Source: Field Survey, 2018.

Intensity

These figures (0.02 and 0.0094) and (0.01, 0.02 and 0.004) reveal the intensity of the mean proportionate margin (severity) of the deviation from the critical indices 0.62 and 0.42 respectively of the households operating less than best food safety practices from the study area, when the mean margin and mean proportionate margin are determined based on the number of households operating less than best food safety practices and all the households respectively. The results show that the intensity of the margin- mean proportionate margin and mean margin are consistently higher using the mean, 0.62 as critical index. This implies that the deviation of household food preparers is more intense when the mean is adopted as critical index.

Factors influencing Food Safety Practices**Table 7: Results from Fractional Regression**

Independent Variables	P > z Value	Marginal effect
Age	0.043**	-.00070003
Education	0.000***	.0084206
Household Size	0.780	-.0008541
Household Income	0.038**	-1.36e ^{-0.7}
Children below 5 years.	0.593	.0025797
Adults above 65 years	0.129	.0096901
Confidence in Safety labels.	0.000***	.0628756(*)

Source: Field Survey, 2018

Statistics: prob>chi2= 0.0000;

number of observations=457;***p≤0.01,**p≤0.05;*p≤0.1

(*) marginal effect is the discrete change of dummy variable from 0 to 1.

Age and household income are statistically significant at 5% and negatively related to the probability of a household food preparer carrying out food safety practices. This means that younger household food preparers and households with lower income are more likely to be carrying out food safety practices. Specifically, the marginal effects imply that a 1 unit increase in age decreases negligibly (by 0.07%) the probability of carrying out food safety practices. This is plausible in that the older a household preparer gets there is a possibility though negligible of rescinding on food safety practices with the reduced pressure since children are likely to have grown and left home. The marginal effects also show that a 1 unit increase in household income decreases the probability of a household food preparer carrying out food safety practices by 1.36e⁰⁵⁰%.

Education of household food preparer and confidence in safety labels are statistically significant at 1% and positively related to the probability of household food preparers carrying put food safety practices in the study area. This shows that more educated household food prepares and those confident in safety labels are more likely to carry out food safety practices than less educated and those who are not confident in safety labels. The marginal effects reveal that a 1unit increase in the education of the household food preparer increase the probability of carrying out food safety practices by 0.8%. Furthermore, the marginal effects show that household food preparers that are confident in safety labels are 6.3% more likely to carry out food safety practices than their counterparts who are not.

DISCUSSION

Table 4 reports the three measures of prevalence namely: percentage prevalence, disaggregated mean prevalence and weighted mean prevalence. With specific reference to percentage prevalence, [11] similarly report that 37% respondents, in a study on knowledge, attitude and practice of food hygiene of food vendors in Owerri, had good food hygiene practice. His findings are disparate from the figures obtained in this study. The findings of [7] report 95% perfect food safety behavior of Dairy Plant workers in China, corroborating the figures obtained in this study, using two thirds of the mean, 0.42, as critical index. Still in a differing vein, [15] found good self-reported food safety practices (88%) of food handlers in a university in Malaysia. [19] reports 57.63% of food safety

practices of male adolescents in Iran, results which are not in tandem with figures obtained in this study. Further, on the contrary, [17] report 79% food safety practices in a study on food safety knowledge, attitude and practices of women in India. The differing outcomes could be plausible as it is impracticable to expect varied populations to present with exact figures which would suggest equal food safety behaviour across different population sets.

In a vein related to the reported figures of disaggregated mean prevalence in Table 4, [2], report that 31.5% of respondents had poor food safety practices implying that the other proportion, 68.5%, had good food safety practices in Ijebu-Ode Local Government Area of Ogun State. Similarly, [10] showed that 78.2% of respondents, in a study of food vendors and food handlers in Obafemi University Ile-Ife, South Western Nigeria, had satisfactory safety hygiene practices and 19.0% had unsafe hygiene practices. Furthermore, [11] having examined the knowledge, attitude and hygienic practices of food vendors in Owerri town of Imo State, Nigeria, assert that only 37% of the respondents had a good level of hygienic practice, suggesting that the other 63% had a poor level of hygienic practice. The disaggregated mean prevalence, which is unique to this study, measures the exact gap between those who perform less than best and best food safety practices. The studies cited here, however are bereft of this detail.

Table 5 reports the margin of food safety practices in the study area. This is presented as the mean margin and the mean proportionate margin. These measures indicate the gap between household food preparers who carry out less than best and those who perform best food safety practices. Relatedly, [2] indicate that 31.5% of respondents had poor food safety practices. Additionally, [10] showed that 19.0% of respondents had unsafe hygiene practices. In a similar vein, [11] implied that 63% of respondents had a poor level of hygienic practice. This study, however, reports the gap between households who perform less than best and those who carry out best practices. Specifically, the margin indicates this difference but assumes that best performing households all have values equal to the mean or two thirds of the mean. The disaggregated mean prevalence, earlier discussed does not make this assumption.

Table 7 shows that education and confidence in safety labels are positively related to and significant in explaining household food preparers' probability of performing best food safety practices. In corroboration, [7] find educational level significant in explaining food safety behavior of dairy plant workers in China. [16], similarly, find education level of mothers significant in explaining food safety practices score of students in China. In a related vein, to further corroborate, [19] find adolescents level of education, parents' educational level and household economic conditions significant in explaining their food safety practices. Additionally, the results in Table 7 are in consonance with [5] opine that educational level was significantly related to the food safety practices among farmers across the selected farming households in Irepodun Local Government Area (LGA) of Kwara State. The results in Table 7 are also in tandem with [3] who carried out a descriptive, cross sectional study among food vendors in primary schools in Jos North Local Government Area to determine the knowledge and practice of food safety and hygiene. Their results reveal a statistically significant relationship between age ($P < 0.001$) and practice of food safety and hygiene. [2] examined the knowledge of food-borne illnesses and food safety practices of local food handlers in Ijebu-Ode Local Government Area of Ogun State and corroborate that educational qualification of respondents significantly affected their food safety practices ($P = 0.0011$)

CONCLUSION

Using the prevalence index, the result presents the population as one where approximately half of the population operates best food safety practices. Additionally, the results further show that households who carry out food safety practices do so most times, thus further explaining how often these best food safety practices are carried out. Similar results are obtained for households that do not carry out food safety practices based on the two critical scores used. Using the mean *fspi* as critical index, in this instance, the disaggregated mean for households who do not operate less than best indicates that these household food preparers actually carry out food safety practices sometimes. Interestingly, the difference in the values of the disaggregated mean prevalence between household food preparers who carry out and who do not operate best food safety practices shows the real gap between these two categories. The gap so obtained does not assume that values equal to and above the mean *fspi* have a zero margin.

Furthermore, the mean margin obtained using the mean *fspi* as critical index and in turn, expressed as a function of the number of households that do not carry out best food safety practices, uncovers the deviation of the disaggregated mean prevalence of those that do not carry out best food safety practices from the threshold score, hence reflecting the gap between those households that carry out food safety practices and those that do not, assuming that household food preparers who operate best food safety practices have *fspi* values just equal to the threshold score being considered. This measure, thus, further describes the proportion of the population that does not carry out food safety practices. The intensity of the mean margin shows that the mean deviation for households that do not carry out food safety practices is more critical than otherwise. Measuring the percentage prevalence, disaggregated mean prevalence, mean margin and intensity of the mean margin brings the state of the food safety practices of household food preparers in the study area into a clearer, more detailed perspective and, is hence a meaningful addition to empirical literature on food safety practices and its measurement.

Younger household food preparers with lower household income are more likely to be carrying out best food safety practices. This is plausible because younger household food preparers may be having young children and hence more keen on the propriety of the diet of the children. Furthermore, the constrained household income and confident in food labels necessitate the household food preparer to be keen on food safety and related practices so as to get the best of threateningly lean resources.

Given the observable gap in adopting best food safety practices by households' food preparers, we recommend institutionalization of sustained food safety advocacy program by relevant government agencies. This could be either through information dissemination from mass media or through group educational schemes.

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