Partial Proportional Odds Analysis of Consumers' Packaged Food Safety Precautionary Actions in Nsuta-Mampong, Ghana

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Abstract

Food safety issues have received increased and sustained public attention and education in recent years in Ghana. With knowledge and information flow on food safety, it is expected that consumers' behaviour, attitudes and actions at point of purchases will match their levels of concern about food safety. The paper investigates and explains consumers' precautionary safety checks they undertake during purchases. Partial proportional odds model was applied in the framework of vector generalized additive models to explain how often consumers conduct precautionary checks during purchases of packaged goods. A randomly selected sample of 261 respondents from Nsuta-Mampong administrative area of Ghana was used for the study. About 32% and 27% of respondents indicated that they "always/very often" and "sometimes" conduct precautionary checks during purchases respectively. 41% "do not" engage in any precautionary food safety checks. Education, age, number of children in household, marital status, awareness and professional knowledge on food safety issues, occupation and concerns on unwholesomeness of food explained consumer's actions.

Key words: Food safety actions, Nsuta-Mampong-Ghana, packaged food, partial proportional odds.

1.0 Introduction

Consumers' perceptions, attitudes and habits toward food safety are formed by knowledge on nutrition and levels of food safety threats and risks known. The later sets of factors are driven by the efficiency of the socio-political structures, market institutions, consumer exposure to information sources and personal efforts in acquiring such knowledge. For instance, perceived product quality after an adverse event has occurred is affected and as a result plays an important role in consumers' consumption decisions (Suzuki et al., 2019; Swartz & Strand, 1981). Buyers in general, from limited and aggregated market information standpoint, see quality food in terms of a set of characteristics that differentiates individual units of a product based fundamentally on sensory parameters and relative prices. Other important attributes of quality food that draw on technological, physical, chemical, microbiological and nutritional parameters can only be handled by experts outside the market place (Abunyuwah and Awuah, 2014). Consumers at the time of purchases take these sets of attributes as given, assuming that the structure and the efficiency of the food market provide adequate control mechanisms to ensure that minimum standards required are adhered to by food producers, processors and distributors.

Food safety concerns have received sustained and increased attention from both developed and developing economies as well as in the academic frontier. Food-borne illnesses like others lead to reduced labour productivity, early death, increased health bills and disability thereby lowering incomes and reducing accessibility to food. Estimates from World Health Organisation (WHO) (2007), indicate that both the industrialized and developing countries suffer from food-borne diseases each year.

One core responsibility of national governments is to ensure food security and in effect food safety by strengthening food control systems and educating consumers on food safety issues and associated health implications. Unfortunately, the food safety systems in most African countries, including Ghana are generally weak, fragmented and poorly coordinated to effectively confront the enormous food safety challenges that exist in the region (FAO, 2005). Notwithstanding safety laws and institutions that exist in Ghana to control the supply chain of food and drugs in the country, the huge task involved and the complexity of the food distribution system have led stakeholders and the Ghanaian Food and Drugs Authority (FDA) in particular to call on consumers to show maximum concern and act accordingly about quality standards of packaged food items and drugs they

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patronise. Increased reported cases of unwholesome and uncertified tin and other packaged products at the markets and border points of entry within the past decade have led to renewed and sustained public education on food safety awareness in the country. It is therefore expected that consumers' behaviour and actions at the time of purchases will match their levels of food safety concerns formed from the knowledge and information acquired. Empirical evidence on consumer actions and rigorous assessments that explain consumer actions during purchases are limited if not unavailable in the country. Research works on food safety in Ghana have concentrated on hygiene practices and safety actions among food vendors and catering services (see Ababio et al., 2012; Ackah et al., 2011; Addo et al., 2007; Donkor et al., 2009; Feglo and Sakyi, 2012; Tomlins et al., 2002). Abunyuwah and Awuah (2014) estimated and explained the concerns about unwholesomeness of package goods people buy in binary logit framework from consumer perspective. Again, most studies which assess food safety attitudes or practices and or utilise ordinal data often resort to simple correlation, binary or multinomial regression model analysis (Ababio & Adi, 2012; Aktas et al., 2009; Cunha et al. (2017); Dagne et al., 2019; Nayga, 1996) making interpretation general and defect of ordinal quality of the response variable (Abunyuwah, 2020). The current study sets to investigate and explain consumers' actions in market places with respect to safety checks they undertake during purchases as a measure to avoid buying unwholesome package products. Specifically, how often consumers conduct precautionary actions during purchases of packaged products is estimated and explained in partial proportional odds analysis within the framework of vector generalised linear/additive models (VGLM/VGAM) of Yee (2019; 2008) and Yee and Hastie (2003).

2.0 Related Literature

Extensive works have been conducted on consumer behaviour and attitudes towards food safety and risk in the environmental hazards, nutrition and food sciences as well as food economics and policy literature. Major factors that have been used to explain consumer perceptions and behaviour on food safety and risk from different specifications and applications include variables that relate to demographic features such as age, sex, household size and race; to the marketing environment, including urbanization, market accessibility, knowledge and information flow factors. Socio-economic factors such as education, time constraints, employment and income have also been used (see Nayga, 1996).

In their systematic literature review of studies on the predictors of consumer food purchasing in environmentally friendly packaging, Popovic et al.(2019) summarized that major factors used in explaining consumer food purchasing behaviour are demographics, consumer attitudes, knowledge about the environmental effects of packaging, visual designs, functionality, cross-cultural differences and affordability. Brennan et al. (2007) analysed risk profile of consumers in island of Ireland and estimated association between consumers' knowledge of microbiological food safety and the microbiological food safety handling and preparation behaviours. They indicated that 'high-risk' groups were willing to engage in a range of behaviours that deviate from best practise guidelines and identified personal (overconfidence; lack of interest), environmental (technological) and lifestyle (time and energy investment) characteristics as the source cause of such deviating behaviours. A study conducted by Cunha et al. (2017) found that food handlers who had received theoretical training on food safety demonstrated higher level of knowledge than those who did not, but not on attitudes and food safety practices.

In Japan, Suzuki et al. (2019) concluded that Japanese consumers who were concerned about the effects of radioactive contamination and overall food safety matched their purchasing intent of seafood with their level of concerns. Rimal et al. (2001) analysed the relationship between seven types of food safety concerns and the corresponding change in food consumption habits of 236 households in Georgia, USA. Their results showed a gap between food safety concerns and food consumption habits. They indicated that more than 54% of their sample households were extremely concerned about pesticide residues, but only 35% actually took extreme precaution in buying items considering this perceived threat. In a related study Jevšnik et al. (2008) undertook a quantitative survey to determine Slovenian consumers' food safety knowledge and practices during purchase, transportation and storage of food, as well as food handling practices at home. Their results highlighted gaps in food safety knowledge and some critical safety violations regarding food handling at home in particular. Sanlier (2009) compared food safety and food preparation practices of young and adult consumers in Ankara Province of Turkey.

The study concluded that food safety knowledge and food preparation practice scores differed significantly between young and adult consumers in favour of adult consumers. Aktas et al. (2009) applied simple correlation analysis to investigate the relationship between consumers' educational background and some quality and safety standards considered at the time of purchase in Konya market of Turkey. Their results revealed that consumers attention on food safety and quality standards increase as their educational levels increase.

In a cross country analysis of Turkey and Kazakhstan, Sanlier et al. (2011) found among others a positive correlation between knowledge of food safety and purchasing behaviour. While previous studies have approached the analysis of food safety awareness, concerns and precautionary actions from different conceptual, methodological and philosophical perspectives, common socio-demographical, economic and institutional factors have applied.

3.0 Study Area and Methodology

3.1 Study Area

The study was conducted in Asante Mampong and Nsuta municipal/district areas of Ghana. Nsuta and Mampong serve as administrative capitals for their respective district and municipality respectively. The study area is about 52km away from Kumasi, the capital of Ashanti region and lies in central part of Sekyere traditional area of Ashanti. The area like many in Ghana hosts a number of small and medium sized supermarkets, two major weekly markets and numerous stalls and kiosks that sell variety of packaged food items. The area also has variety of economic players in both the formal and informal sectors; rural and urban residents which provide a fair socio-economic strata-mix for the study of food safety precautionary checks taken by consumers during purchases.

3.2 Sampling and Description of Variables

A total of 270 (261 valid responses) respondents were randomly sampled from the study area. Applying stratified sampling procedure, the sample was made up of 65% and 35% respondents from the urban enclave and rural settlements respectively. Respondents were randomly selected from each stratum to obtain a total of 270 (261 valid responses) respondents in all. The quota for each stratum was determined by the sector's level of importance in terms of access to packaged products and size. The data was collected using a well-designed open and closed ended questionnaire administered through personal interviews. Data was collected on socio-economic characteristics and respondents' concerns about food safety; respondents' previous experiences and knowledge of food safety and health related issues of unwholesome food in the country. Table 1 gives a summary of major variables captured and used in the study.

Table 1. Description of Variables

Variables	Description	Measurement
Checks	How often food safety precautionary checks are conducted	Very often=3; Sometimes=2; No checks
Residence	Place of residence	Dummy: Urban=1; Rural=0
Age	Age of respondents in years	Years
Income	Monthly income earnings of respondents	Ghana cedi
Education	Years of Education	Years
Children	Number of children under 16 years in the household	Head counts
Marry	Married or partnered	Dummy: Married/Partnered=1; otherwise=0
Sex	Sex of respondents	Dummy: Male = 1, Female = 0
Aware	Received food safety information	Dummy: Yes = 1, No = 0
ConPkgF	Whether concerned about unwholesomeness of package food	Dummy: Concerned = 1, Otherwise = 0
ConunPkgF	Whether concerned about unwholesomeness of unpackaged food	Dummy: Concerned = 1, Otherwise = 0
ExProb	Experienced unwholesome food related illness or problem	Dummy: Yes=1; No =0
OccFmal	Formal/informal sector employee	Dummy: Formal sector=1; Informal sector = 0
OccHealth	Health related profession or worker	Dummy: Yes=1; No=0

Source: Field Survey, 2018

3.3 Theoretical Framework and Model Specification

To explain an individual's food safety precautionary actions taken during time of food purchases, socio-demographic features of consumers, consumers' previous experiences with and knowledge of food-borne illnesses, information received on warnings of food safety risks from health officers or those accessed through the media were considered.

Based on the general modelling framework of consumer preference and choice models, the level of precautionary food safety actions (stated in "how often") taken during purchases are stated as decision makers' choices between alternatives courses over which actions are made (Train, 2009). Consequently three levels of precautionary actions taken during purchases of packaged food items were defined. Namely, consumers who *always / very often* (VPC); *sometimes* (SPC)*; and *do not* (NPC) inspect and check for FDA certification stamp, expiry date, untempered seals and checks on product origin/labels. In this respect the dependent variable is defined as an ordinal variable with three categories. To explain ordinal categorical dependent variable such as one defined in this study, an ordered logistic/probit regression model ensues, given that fundamental assumption, the proportional odds or the parallelism assumption, under such models hold (Green, 2003; Long & Freese, 2014; Williams, 2006; 2016). This assumption is however more often violated, in which case the model becomes inappropriate (Brant, 1990; Bratsberg, 1995; Williams, 2006). Where the proportional odds assumption is violated the ordered generalised framework models are used.

In this study we utilised the vector generalized linear/additive models (VGLM/VGAM) framework, following Yee (2008; 2019). Thus given our categorical response variable Y of three-dimensional vector, the distribution of these Y outcomes are modelled conditional on given selected X explanatory variables in the form of (1)

$$f(\mathbf{y}|\mathbf{x};B) = h(\mathbf{y}, \eta_1, \dots \eta_M) \qquad (1)$$

Where $h(.)$ is defined for some known function; $\mathbf{B} = (\beta_1 \beta_2 \dots \beta_M)$ is a $p \times M$ matrix of unknown regression coefficients and η_j is the jth linear predictor specified as:

$$\eta_j = \eta_j(\mathbf{x}) = \beta_j^{\mathsf{T}} \mathbf{x} = \sum_{k=1}^{p} \beta_{(j)k} x_k; \qquad j = 1,\dots M \qquad (2)$$

In this case $\mathbf{x} = (x_1, \dots x_p)^{\mathsf{T}}$ with $x_1 = 1$ for specifications that include intercept. Equation (2) implies that all the parameters may be potentially modelled as functions of $\mathbf{x}$. As noted in Yee (2019), the VGLMs are like GLMs but allow for multiple linear predictors, and they encompass models outside the small confines of the exponential family. Extending the VGLMs of (2) in VGAMs and to accommodate the parallelism assumption equations (3) and (4) ensue. In (4) the idea of `constraints-on-the functions' are flexibly imposed which is very important, especially in the analysis of categorical data.

$$\eta_j(\mathbf{x}) = \beta_{(j)1} + \sum_{k=2}^{p} f_{(j)k} x_k; \qquad j = 1,\dots M \qquad (3)$$

$$\eta(\mathbf{x}) = \beta_1 + \sum_{k=2}^{p} f_k(x_k) = \mathbf{H}_1 \beta_1^* + \sum_{k=2}^{p} \mathbf{H}_k f_k^*(x_k); \qquad (4)$$

Where $\mathbf{H}_1, \mathbf{H}_2, \dots \mathbf{H}_p$ are known full-column rank constraint matrices, f_k^* is a vector containing a possibly reduced set of component functions and β_1^* is a vector of unknown intercepts. Where no constraints are imposed at all, $\mathbf{H}_1 = \mathbf{H}_2 = \dots = \mathbf{H}_p = \mathbf{I}_M$ and $\beta_1^* = \beta_1$. The $\mathbf{X}$ matrix in this framework ($\mathbf{X}_{VLM}$) is thus constructed from $\mathbf{X}$ and $\mathbf{H}_k$ using Kronecker product operations (see Yee, 2008; 2019 for examples).

The flexibility of the VGLM/VGAM framework above allows many functional links to be defined, given the nature of the data. In our analysis, where the dependent variable was ordinal, the ordered logit/probit framework was required.

In the generalized ordered logit specification (5) for example, similar to (2) and (3) above (see Williams, 2006; Yee, 2019), the regression coefficients, β_j, are estimated for each η_j category, while they appear equal for all η_j under the parallelism or proportional odds assumption which underlie the ordered models.

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i \beta_j)}{1 + \left[\exp(\alpha_j + X_i \beta_j)\right]} \qquad j = 1,2,\dots,J-1. \qquad (5)$$

Under circumstances where the proportional odds assumption is violated for some regressors, the partial ordered logit/probit models apply (Peterson and Harrell 1990) which VGAM fits via constraint matrices specification as presented in equation (4).

In the partial proportional odds (PPO) model the number of betas falls in between that of the generalized ordered and the ordered models as only betas for variables that violate the proportional odds assumption are estimated for each of the M response categories. Model (4) was implemented via the cumulative link function, under VGLM/VGAM R package (Yee, 2008; 2019) after the Brant test of parallelism assumption failed for some variables (see Table 2).

4.0 Results And Discussions

4.1 Descriptive Statistics

The average age of the consumers interviewed was 31.2 years, ranging from 20 to 55. Respondents on average earn GH¢ 1028 per month with standard deviation of 521.6 over a minimum and maximum income levels of GH¢ 280 and 2700 respectively. The average number of children under 16 years per household is 1.9. Fifty two percent of the respondents were males while the females represented 48 percent. Majority of the respondents, representing 65 percent, were city dwellers while 35 percent of the consumers interviewed came from the surrounding villages of the Municipal/District seats, Mampong/Nsuta. The major packaged items patronised by respondents were rice (packaged in bags), tomato puree, cooking oil, canned fish, spaghetti, biscuits and canned/bottled drinks; and specialised food supplements.

The results of the survey indicated that in the study area many food consumers were more concerned with unpackaged food items they buy than the packaged products, as 61.3 and 79.13 percentages of consumers indicated concern about the safety of packaged and unpackaged food items they buy respectively. These results are consistent with Abunyuwah and Awuah (2014). In terms of job profiles, only 10.7% of the respondents were health workers or had professional background in health or allied health fields. About 55% of the respondents were employed in the formal sector. This contradicts previous studies as the study area like many districts in Ghana and other developing countries are dominated by the informal sector. Surprisingly, about 48% of the respondents indicated that they have not received food safety information or been following any food safety awareness campaign over the past year. On average respondents had spent 13.8 years in formal education with standard deviation of 3.9 years, and minimum and maximum years of 0 and 20. Fairly substantial number (50.9%) of respondents had experienced food safety related problem before. Fifty one percent of respondents were married or lived together with partners. On how often respondents conduct precautionary checks, about 32% and 27% of respondents indicated that they "always/very often" and "sometimes" conduct precautionary checks during purchases respectively, while 41% "do not" engage in any precautionary food safety checks.

4.2 Partial Proportional Odds Analysis.

Analysing or explaining ordinal dependent variable in a multivariate framework requires that ordinal regression model is applied. However the popular ordered logit/probit models work under the assumption of parallelism or proportional odds. This assumption is however more often violated, in which case the model becomes inappropriate (Brant, 1990; Bratsberg, 1995; Williams, 2006). A violation of the proportional odds assumption by some of the regressors calls for the adoption of the partial proportional odds model (PPO) in modelling ordinal data (see Harrell, 2001; Williams, 2006). In this respect a Brant test was conducted via **brant** package in R, to ascertain whether the proportional odds assumption was tenable for all, some or none of the explanatory variables. Results of the Brand test for the proportional odds assumption are presented in Table 2.

Table 2: Brant test for proportional odds assumption

Variable	Chi-sq	df	probability
Omnibus (model)	69.65	13	0.00
Residence	0.46	1	0.50
Sex	0.26	1	0.61
Age	0.01	1	0.93
Marry	0.65	1	0.42
Childn	0.48	1	0.49
Income	0.23	1	0.63
Aware	2.13	1	0.14
Education	2.66	1	0.10
ConPkgF	27.54	1	0.00
ConunPkgF	1.41	1	0.24
ExpProb	0.66	1	0.42
OccFmal	14.31	1	0.00
OccHealth	0.67	1	0.41

The results of the Brant test in table 2 indicate that the parallel lines assumption was violated in the model. Thus the model as a whole failed at higher significance level (p-value 0.000), of course, as a result of the non-parallelism of ConPkgF (concern of unwholesomeness of package goods) and OccFmal (occupation in formal or informal sector) variables. In applying partial proportional odds model (PPO) in this study, **the goodness of fit was evaluated in comparison with the ordered logit model (Ologit) and generalised ordered logit model (Gologit) specifications using the** *Akai*ke's Information Criterion (AIC) and the likelihood ratio test, given the structure of equations (3) and (4) as nested. As presented in table 3, for the Ologit, Gologit and the PPO models AIC values of 464.7256, 440.479 and 435.6502 were obtained respectively. The LR chi-square value of 33.075 (0.000) is highly significant when the PPO is compared with the Ologit, but appeared insignificant with LR chi-square value of 17.121 (0.103) when compared with the Gologit model. These support the choice for the partial proportional odds (PPO) model since it had the smallest AIC value; and significantly improves on the Ologit model with two additional parameters while no significant improvement could be achieved when the unconstrained Gologit model was estimated.

Table 3: Akaike's information criterion and likelihood ratio tests

Model	Observations	Df-AIC	LR	AIC	LR chi-sqr
Ologit	261	15	2	464.726	33.075(0.000)
Gologit	261	28	11	440.479	17.171(0.103)
PPO	261	17	-	435.650	-

Source: Author's estimation

Results of the PPO model are presented in Table 4, where column one contains variables used to explain the variations in degree of precautionary actions taken during purchases. The estimated coefficients with their standard errors, z-scores and p-values are presented in columns two, three, four and five respectively. The last column of table 4 displays the odds ratio, which is used to interpret the intensity of effects of the explanatory variables on the degree of safety checks.

The results are interpreted in a two dimensional rank-order categories for the three level safety actions defined for the dependent variable; namely, 'conduct precautionary checks always/very often (VPC)', 'sometimes conduct precautionary checks (SPC)' and 'no precautionary checks conducted (NPC)'. The results presented in panel one use 'NPC' as base category and it is contrasted with the 'SPC' and 'VPC' categories. The signs of the coefficients provide an indication of how likely or otherwise a respondent will be in the SPC and VPC category.

Table 4: Partial Proportional Odds Model Results

Variables	Coefficients	Std. Error	z value	Pr(>|z|)	Odds Ratio
NPC vs SPC & VPC					
(Intercept):1	-5.8201640	1.1812066	4.927	0.0000081 ***	
Residence	-0.0766049	0.3014728	0.254	0.7994170	0.9262557
Sex	-0.2254639	0.2815146	0.801	0.4231920	0.7981458
Age	0.0491405	0.0214962	2.286	0.0222540 **	1.0503679
Marry	0.8347959	0.3910168	2.135	0.0327660 **	2.3043437
Childn	-0.5068188	0.1517543	3.340	0.0008390 ***	0.6024089
Income	0.0003846	0.0003094	1.243	0.2137870	1.0003847
Aware	0.7777834	0.3019671	2.576	0.0100030 **	2.1766421
Education	0.2833032	0.0713011	3.973	0.0000709 ***	1.3275076
ConPkgF:1	1.7688007	0.3530519	5.010	0.0000054 ***	5.8638168
ConunPkgF	-1.0440683	0.3872819	2.696	0.0070200 ***	0.3520197
ExpProb	1.0216798	0.2817571	3.626	0.0002880 ***	2.7778570
OccFmal:1	-0.2634807	0.4063211	0.648	0.5166910	0.7683724
OccHealth	1.0969972	0.4679995	2.344	0.0190770 **	2.9951585
NPC & SPC vs VPC					
(Intercept):2	-6.0357037	1.1891647	5.076	0.0000034 ***	
ConPkgF:2	0.4645623	0.3486986	1.332	0.1827700	1.5913175
OccFmal:2	-1.2626209	0.4100300	3.079	0.0020750 ***	0.2829116

Significant at *10%, **5% and ***1% levels.

In the same direction, the results in block two contrasted the 'NPC' and 'SPC' groups with the 'VPC' group. In table 3, a total of 15 parameters (excluding the constants) were estimated after constraining those variables that did not violate the proportional odds assumption. Only ConPkgF and OccFmal did appear in the second panel and had their coefficients varying across the **J**–1 equations while the rest have same coefficients across the two category blocks in accordance with specification (4) and the concept of partial proportional odds (PPO) model (Brant, 1990; Bratsberg, 1995). The results of the PPO are interpreted by considering the current category and the least coded categories as the base groups, when viewed as binary logit. This means that the mth panel results are equivalent to the results of a binary logistic model where categories 1 to m are coded as zero or base outcome and m+1 to J are often coded as 1. By this coding, a positive coefficients or odds ratios that exceed 1 provide an indication that higher values of an explanatory variable increase the probability that a respondent is more likely to belong to the higher ranked category, thus 'always/very often' conduct precautionary checks during purchases (VPC). Contrary, negative coefficients or odds ratios that fall below 1 imply that higher values of the explanatory variable increase the odds of being in the current or lower ranked categories (Williams 2006), in our representation, towards NPC category.

As indicated by number of asterisks, eight of the 11 variables that passed the proportional odds assumption appeared significant while three, Residence, Sex and Income were insignificant in explaining how often consumers perform precautionary safety checks during purchases. The above findings though contradicts Nagar 1996, who found that residence, sex and income were significant in explaining how likely packaged information will be utilized during purchases in his study of determinants of consumers' use of nutritional information on food packages in USA, a critical look in terms of their directions of influence indicates same as the results of this study. For the negative, negative and positive signs of the coefficients for residence, sex and income respectively, implies that urban residents and males are less likely, while higher income earners are more likely, to 'always/very often (VPC)' conduct precautionary checks during purchases. The results contradict the findings of Abunyuwah and Awuah (2014) for sex and residence, but agree with theirs for income in terms of direction of effects.

For the variables that did not violate the parallelism assumption and appeared significant, Age, Marry, Aware, Education, ExpProb, and OccHealth had positive coefficients while Child and ConunPkgF negatively related to the likelihood of been 'always/very often' in conducting precautionary checks during purchases (towards VPC category). The effects of these variables are equal across the M-1 response categories, and in effect were not reported in panel 2 (NPC&SPC vs VPC) of table 3. For instance the aged are more likely (1.0504 times) to be in SPC or VPC than to be in NPC. This same probability holds for being more likely to be in VPC than to be in NPC or SPC. Thus, as one increases in age, the more likely he/she is to undertake precautionary checks during purchases. This finding, as expected, supports the results of Nagar (1996) and Sanlier (2009).

Similarly, respondents with higher educational attainments; who are health professionals or workers; and those who had accessed food safety awareness information or campaigns are more likely (1.328; 2.177; and 2.995 times respectively) to undertake precautionary checks always/very often (VPC) than to take 'no precautionary action (NPC) or sometimes (SPC)' during purchases. While studies by (Brennan et al., 2007; Cunha et al., 2014; Jevšnik et al., 2008) in general do not support these findings, Abunyuwah and Awuah, 2014; Nagar 1996; Aktas et al., 2009; Sanlier et al., 2011, as theory posits (see Popovic et al., 2019), arrived at similar findings. Again, in table 3, respondents who are married or partnered; and those who have encountered problems with buying unwholesome food items are less likely to ignore precautionary checks during purchases.

From panel one, the Child and ConunPkgF variables have negative coefficients, meaning that households with higher number of children under sixteen and those who expressed concerns about unwholesomeness of unpackaged foods respectively, are less likely to 'always/very often' perform precautionary checks during purchases. While the results for the later variable seems plausible, the former is inconsistent and contrasts with many previous studies (Baker, 2003; Dosman et al., 2001; Lin, 1995). In Brennan et al. (2007) however, similar results were observed where some 'high-risk' groups were willing to engage in a range of behaviours that deviate from best practise guidelines and identified overconfidence, lack of interest, technological and time and energy investment as the source cause of such deviating behaviours.

In the second panel, as stated earlier, only estimates for variables that failed to pass the parallelism assumption, namely; ConPkgF and OccFmal, were presented. Both variables maintained their respective positive and negative signs across the two categories. The negative sign for OccFmal indicates that respondents working in the formal sector of the economy are less likely to conduct precautionary checks during purchases in general. The insight from PPO perspective is that these respondents will be less likely to fall under NPC compared to SPC and VPC as implied by the insignificant coefficient in panel 1. The highly significant (p-value=0.002) effect in panel 2, means that they are more likely to fall under NPC or SPC than VPC.

The PPO framework does explain the complexities carried by the OccFmal variable. Thus while in general formal sector employees (OccFmal) are more likely to tend towards 'SPC', they operate at the intermediary given results presented in tables 3. As indicated by Nayga (1996), these customers may be constrained by time and lifestyle (Brennan et al., 2007). The positive coefficient for ConPkgF on the other hand means that respondents who are concerned with unwholesomeness of packaged foods are more likely, as expected, to undertake precautionary checks during purchases. Similar findings were found in Nayga (1996) and Suzuki et al. (2019) where health and safety concerns were matched with actions. In panel 2, the results appear insignificant, thus switched in intensity but maintained direction of influence. The indication is that respondents who are concerned with unwholesomeness of packaged foods tend to be more, vigorously (5.88 times), likely to 'sometimes' (SPC) or 'always/very often' (VPC) undertake precautionary checks than taking no precautionary checks (NPC). However, they would be relatively less (1.5 times) more likely to 'always/very often' undertake precautionary checks than being of 'no' (NPC) or 'sometimes' (SPC) category. Comparing the coefficients of the PPO with the Ologit, the ordered model's beta coefficient (1.197) for ConPkgF underestimates the impact of it (1.789) on moving people away from the lowest category while also overstating ConPkgF's impact (0.465) in moving people towards the highest category (VPC). Similarly, the Ologit estimate of (-0.768) for OccFmal underestimates its impact of moving people from the highest category (-1.263) and overestimates (-0.264) its effect placing consumers under the lowest category (NPC) from SPC or VPC.

Findings of the study are very important for the Ghanaian Food and Drugs Authority given the nature of food safety control system and educational campaign challenges of the Ghanaian food markets. The results imply that knowledge of and in effect accessibility to food safety information significantly affect precautionary actions taken during purchases. The results from table 3 above also show that some socio-economic factors namely, income, place of residence and sex which are often found to be associated with consumers' food safety concerns and related perception of food and environmental risks and precautionary actions, were not found to be significant in explaining variations in food safety precautionary actions taken during purchases.

5. Conclusion

Ensuring food safety requires efficient socio-political structures and market institutions with high consumer awareness and action. However, in Ghana like many developing economies, limited logistical base and weaker institutional structures have placed consumers at strategic position in the food safety campaign. When consumers are well informed, concerned about wholesomeness of food they buy and take actions appropriately, importers and food distributors/sellers become obliged to strictly adhere to food safety standards.

Following sustained national call for increased concerns and vigilance from consumers on unwholesome food items available in the markets and of packaged food products in particular, the study aimed at providing insights into the factors that influence consumers' food safety precautionary actions during purchases. The results from the study, based on partial proportional odds analysis, indicate that consumers' levels of food safety precautionary actions are consistently linked with their' levels of exposure to and health experiences with food safety risks; where, educational levels, marital status, presence of children in the household and information accessibility played major role. Food safety awareness campaigns should be intensified and localized.

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