Analysis of Stakeholder Reactions Toward the Use of Biofortified Foods in School Feeding Programs: An Application of the Protection Motivation Theory to Iodine Enriched Legumes in Uganda

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ABSTRACT

Objective: This study aims at evaluating reactions of parents and school authorities towards the use of iodine biofortified foods in school feeding programs as an alternative means to improve school performance and reduce Iodine Deficiency Disorders (IDDs).

Methods: A cross-sectional survey design based on Protection Motivation Theory was used to interview parents (n=360) of primary school children and school authorities (n=40). Data was analyzed through Robust (Cluster) regression analysis and Ordered Probit regression analysis techniques.

Results: The results show that knowledge about iodine and iodized salt was high, as compared to poor knowledge about IDDs and biofortification. Gender was a significant predictor of coping appraisal for school authorities while age, education, occupation, income, household size and knowledge were significant determinants of threat, coping appraisal and/or protection motivation intention among parents. In the overall model, self-efficacy (parents) and response cost (school authorities) influenced the intention to adopt iodine biofortified foods. Regarding willingness-to-pay, various factors among which gender, age, education, knowledge, perceived vulnerability, response efficacy, self-efficacy and protection motivation play a role when it would be offered at a discount. When looking at premiums, only school/household size, age and response efficacy were significant.

Conclusion: School feeding programs that incorporate iodine biofortification should strive to increase not only consumer knowledge about iodine but also its association to apparent deficiency disorders, boost self-efficacy and ensure that the costs incurred are not perceived as barriers of adoption. As expected, consumers are more responsive to discount prices of biofortified foods than to premium prices.

Key words: Biofortified foods, iodine deficiency, school feeding programs, stakeholder perceptions, Uganda

INTRODUCTION

Iodine deficiency, a well-known cause of preventable mental retardation, is still a major public health problem worldwide, with an estimated 240.9 million school aged children having low iodine intake levels, of which 24% are from Sub-Saharan Africa (Andersson et al., 2012). In Uganda, many of these children live around mountainous rural areas with iodine depleted soils or further in-land without access to fish, sea food or iodized salt (Bimenya et al., 2002). Given the profound effect of iodine deficiency on school performance (Pineda-Lucatero et al., 2008; Qian et al., 2005; Zimmermann et al., 2006) and the lack of iodine rich foods in current East-African School Feeding Programs (Murphy et al., 2007), there is a clear need for novel or improved ways to improve their cognitive performance through enhancing iodine intake levels. While Universal Salt Iodization has been successfully used to fight Iodine Deficiency Disorders (IDDs) in many countries, one third of the world population have no access to iodized salt and IDDs are still endemic in many parts of the developing countries (Zimmermann and Andersson, 2012). Given its low cost and targeted approach, i.e. towards key beneficiaries like the rural poor, biofortification of staple crops with iodine and/or other micronutrients has been proposed as a valuable way to fill this gap (De Steur et al., 2012a; Meenakshi et al., 2010; Bouis et al., 2011; Lyons et al., 2004). Increasing the iodine content of staple foods can be achieved through conventional plant breeding, provided that there is genetic multiplicity, or by applying nutrient rich fertilizers to soils (Zhu et al., 2007; Perez-Massot et al., 2013). When this is not possible, genetic engineering is a viable alternative to increase iodine concentrations in staple foods (Farre et al., 2011; Yuan et al., 2011).

With more conventional biofortified crops expected to hit the market, consumers are likely to have varying decisions concerning its acceptance and adoption. Such food choice decisions may differ based on, for example, their level of health consciousness, ability to overcome health eating barriers, nutrition knowledge, previous experience with similar foods, attitudes towards food (technologies), perceived adverse health effects, religious and cultural beliefs and inappropriate marketing strategies (Mai and Hoffmann, 2012; Verbeke et al., 2009; Pounis et al., 2011; Verbeke, 2010). Adoption of iodine biofortification as a novel strategy to prevent IDDs is most likely to involve a cognitive process leading to a motivated decision made by consumers. Social Cognition Models such as; Health Belief Model (HBM), Protection Motivation Theory (PMT), Theory of Planned Behavior (TPB), Social Cognitive Theory (SCT) and Trans-theoretical Model of Change (TTM) are often used to explain the motivational factors of people to perform or not perform health oriented behaviors (Baban and Craciun, 2007). Except for PMT, these models only focus on threats. It explicitly looks into coping factors which are also crucial persuasive communication elements for the success of health interventions (Milne et al., 2000). Despite the fact that a few studies used PMT to analyze consumer motivation to dietary change, e.g. towards functional foods (Cox and Bastiaans, 2007; Henson et al., 2008), none have been carried out using PMT in the context of nutritious foods in poor developing countries. The present study therefore employed a similar theoretical PMT model to predict the preferences of parents and school authorities towards future use of iodine biofortified foods in School Feeding Programs in Uganda.

Conceptual framework

From its advent as a fear-arousing theory (Rogers, 1975), PMT evolved into a more comprehensive persuasion model explaining how the cognitive process of threat appraisal interacts with coping appraisal to generate an intention to a health related behavioral change (Maddux and Rogers, 1983). On the basis of protection motivation, it involves a decision

making process by which an individual evaluates the gravity of, and exposure to, an imminent risk and chooses a suitable alternative to deal with the threat (Cameron, 2009; Cameron and DeJoy, 2006). Generally speaking, the PMT incorporates maladaptive as well as adaptive behavior, which, respectively, consitute threat and coping appraisal. When evaluating a threat, arousal of fear must be apparent for one to perceive danger (severity) and to consider the individual extent of the risk involved (perceived vulnerability) (Neuwirth et al., 2000). The interaction among these three components results in a so-called "threat appraisal" which decreases the probability that a maladaptive behavior occurs. Similarily, there are three coping appraisal components: the consideration of the ability of the actions to effectively eliminate the threat (response efficacy) and one's belief or confidence to successfully undertake the health preventive action (self-efficacy). Both increase the possibility that an adaptive behavior occurs. Furthermore, there is the evaluation of the costs involved in execution of the adaptive behavior (response cost) which negatively influences the latter (Henson et al., 2008; Rogers and Prentice-Dunn, 1997).
This model has a superior capacity to determine and describe health preventive behavior because it covers more components that have been underpinned by a wide array of empirical and theoretical research (Maddux and Rogers, 1983; Hodgkins and Orbell, 1998; Rogers and Prentice-Dunn, 1997). Therefore the conceptualization of this model entails someone's stimulation, maintenance and direction of an action to protect one from a threat (Ch'ng and Glendon, 2013). Although health preventive intentions are associated with actual health behavior (Milne et al., 2000), the latter also depends on intention stability over time which is in turn affected by a number of individual factors such as feelings of remorse for not performing an adaptive behavior (Cooke and Sheeran, 2004).

As was in the early years of its discovery, today PMT is still being used in health related research to predict health preventive intentions, such as genetic testing for breast cancer risk (Helmes, 2002), knowledge and risk perception of cervical cancer (Gu et al., 2012), consumption of omega-3 rich food (Cox et al., 2008), selenium enriched foods (Cox and Bastiaans, 2007), or functional foods (Henson et al., 2008), and consumer compliance with dietary guidelines (Henson et al., 2010a). Although both types of appraisal have shown a significant association with protection motivation intention, meta-analyses suggest that coping appraisal is a stronger predictor (Milne et al., 2000; Floyd et al., 2000). Thereby, self-efficacy is considered the strongest motivator of behavioral intention. A study on foods rich in phytosterols to decrease the risk of cardiovascular diseases showed that self-efficacy followed by response efficacy were more crucial predictors (Henson et al., 2010b). Cox and Bastiaans (2007), in their analysis of consumer motivation towards the use of selenium enriched foods, found that the independent variables of both appraisals explained 36% of the variation. In consumer food reseach, however, there are often variatons in the effect of PMT according to the health related product. Henson et al. (2008), for example, examined purchase intention for three products with lycopene and showed that both appraisals positively affected the likelihood of Canadian men to consume tomato juice and the snack product but not for the non-prescription pill.

Also socio-demographic characteristics may play a role. Whereas age, for example, was found to be the most important, positive factor of consumer intention to purchase lycopene containing food products (Henson et al., 2008), the effect of self-efficacy was similar between male and female consumers in Australia or China (Renner et al., 2008; Cox and Bastiaans, 2007). With respect to knowledge, only few studies found a negative effect (Henson et al., 2008). Talsma et al. (2013) showed that increasing knowledge about Vitamin A deficiency risks boosted consumer intentions to adopt biofortified cassava in Kenya. A similar positive effect was reported for cereal fortification in Botswana (Mabaya et al., 2010), highlighting the importance of knowledge when predicting preferences for nutrious foods and, thus, when developing interventions based on improving awareness (Macharia-Mutie et al., 2009; Costa-Font et al., 2008).

The aforementioned internal and external factors are incorporated in our conceptual framework to evaluate the reactions of parents and school authorities towards iodine biofortified legumes for use in school feeding programs in order to prevent IDDs and improve school performance (**Figure 1**). It hypothesizes that study participants will be first encountered with a threat of IDDs which in turn may translate into perceived fear, vulnerability and severity. Consecutively, protection motivation with regard to preference of iodine biofortified food will only be achieved when respondents believe that continued practice of maladaptive behavior is of little benefit, that iodine biofortified foods will reduce the risk and severity of IDDs in the future, but when they are also certain and confident to perform this advocated adaptive behavior while perceiving few hurdles such as time constraints and financial costs. The higher the threat and coping appraisal, the higher the protection motivation will be, as shown by a positive change in consumer preferences of iodine biofortified food in school feeding programs and by a positive willingness to pay (WTP).

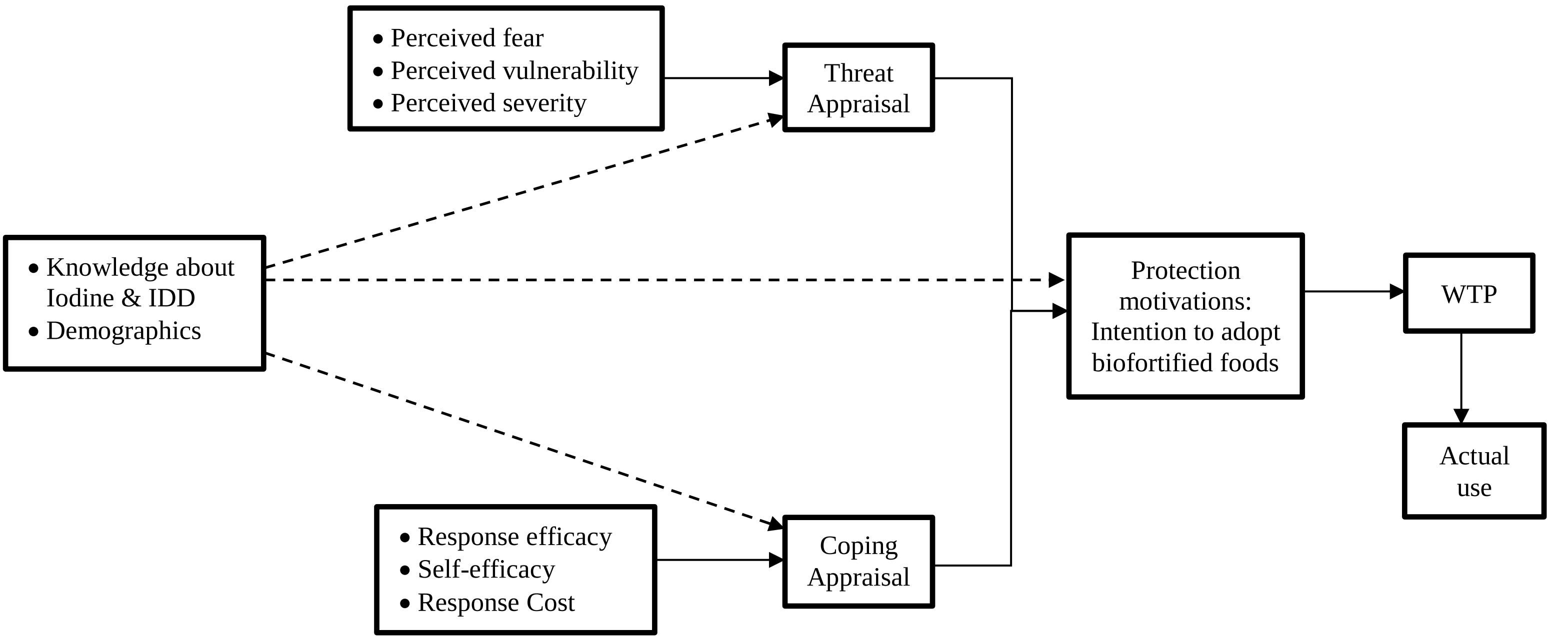


Figure 1. Conceptual Framework to determine the intention to adopt iodine biofortified legumes, based on Protection Motivation Theory
Source: Own compilation, based on Munro et al., 2007

METHODS

Design and participants

A cross-sectional design study was conducted in Kisoro District, Uganda, by which 40 authorities from 40 schools (clusters) were selected. Using cluster sampling characterized by a random walk technique, 360 parents (households) of primary school children were recruited. This allowed the use of two more or less similar pre-tested, structured questionnaires, each containing four sections: socio-demographic profile, knowledge about iodine, an information cue preceding the PMT components, the PMT components and a cheap talk script followed by the WTP questions.

Survey

Regarding knowledge, five questions on micronutrients, iodine, iodine deficiency disorders and possible interventions (salt iodization and biofortification) were measured in terms of familiarity (5-points scale, ranging from 1 "not at all familiar" to 5 "extremely familiar"). Two additional questions (1 "not at all aware" – 5 "extremely aware") were included to assess their knowledge about the relationship between iodine intake and mental development or school performance. Finally, respondents were asked about the link between living in mountainous and land locked areas and the risk of IDDs and whether they are convinced that their children's diet provided enough iodine (1 "yes" to 3 "Don't Know"). After reliability analysis, the aforementioned questions were incorporated into one overall knowledge construct for school authorities (Cronbach's $\alpha = 0.78$) and parents (Cronbach's $\alpha = 0.84$).

PMT constructs were assessed using a five-point scale. Perceived severity was assessed with three items including: "IDDs frightens you as a very serious health problem", "You know children who have suffered from IDDs" and "It is possible that children and/or school perform poorly because of iodine deficiency". Also for perceived vulnerability three scaled items were used: "Do you feel children are vulnerable to suffer from IDD if they do not eat iodine rich foods", "Children are likely to perform poorly at school due to iodine deficiency" and "In your opinion protecting children from the risk of IDDs by opting for foods rich in iodine is important" Perceived fear had two components; "Thoughts about IDDs affect your mood and school performance of children affect your mood". Except for Response cost ("I doubt the cost effectiveness of biofortified foods") coping appraisal components are assessed by two items: Response efficacy: "consuming iodine rich foods will reduce the risk of IDDs" and "Iodine biofortified legumes will help improve school performance of children"; and Self-efficacy: "It is possible for your children to eat iodine biofortified legumes at school" and "I would agree to include iodine biofortified legumes in school meals"; These components were measured on a 5-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5). Behavioral intention was determined by four 5-point Likert scale items ("extremely unlikely" 1 to "extremely likely" 5) "How likely are you to accept iodine biofortified legumes as a source of iodine for your children?", "How likely is it that you will include iodine biofortified legumes in the household/school menu for the children?", "Are you likely to buy iodine biofortified legumes for the household/school?", and "I will consider advocating for inclusion of iodine biofortified legumes in school meals". For the school authorities' questionnaire, Cronbach's alpha for the composite threat appraisal (8 items), coping appraisal (5 items) and protection motivation (4 items) was, respectively, 0.71, 0.74 and 0.68. In the parents' survey, Cronbach's alpha were 0.78 for threat appraisal (8 items), 0.62 for coping appraisal (5 items) and 0.69 for protection motivation (4 items).

A payment card technique was used to assess WTP for biofortified legumes. Given time constraints and the focus on the PMT constructs, we decided to incorporate a closed-ended format. Therefore, participants were provided with a hypothetical market scenario and a cheap talk script. Respondents were given the normal market price of legumes and, based on a range of amounts (in Ugandan Shillings), were confronted with two sets of questions, to indicate the maximum amount they would be prepared to pay more (first set) or less (second set) for biofortified legumes. Each set consisted of a WTP question directed towards its inclusion in home meals (parents) or school feeding programs (schools) and a question reflecting their WTP for its inclusion in school meals

Statistical analysis

Regarding the sample descriptives, Chi-square (Pearson's or Fisher's Exact test) and Mann-Whitney U tests were used for comparison of means. Factor analysis was applied to obtain factor scores for both the knowledge and PMT composite variables that build upon reliability analysis using Cronbach's alpha (Rowe, 2006). A Robust method for multiple linear regression was performed to find out which independent variable(s) affect or are associated with each of the dependent variables. Determinants of the ordinal WTP construct was analyzed using Ordered probit regression analysis (maximum likelihood estimation) (Blaine et al., 2005). All the statistical analyses were performed using StataIC v.12 and the level of statistical significance used was $p<0.05$.

RESULTS AND DISCUSSION

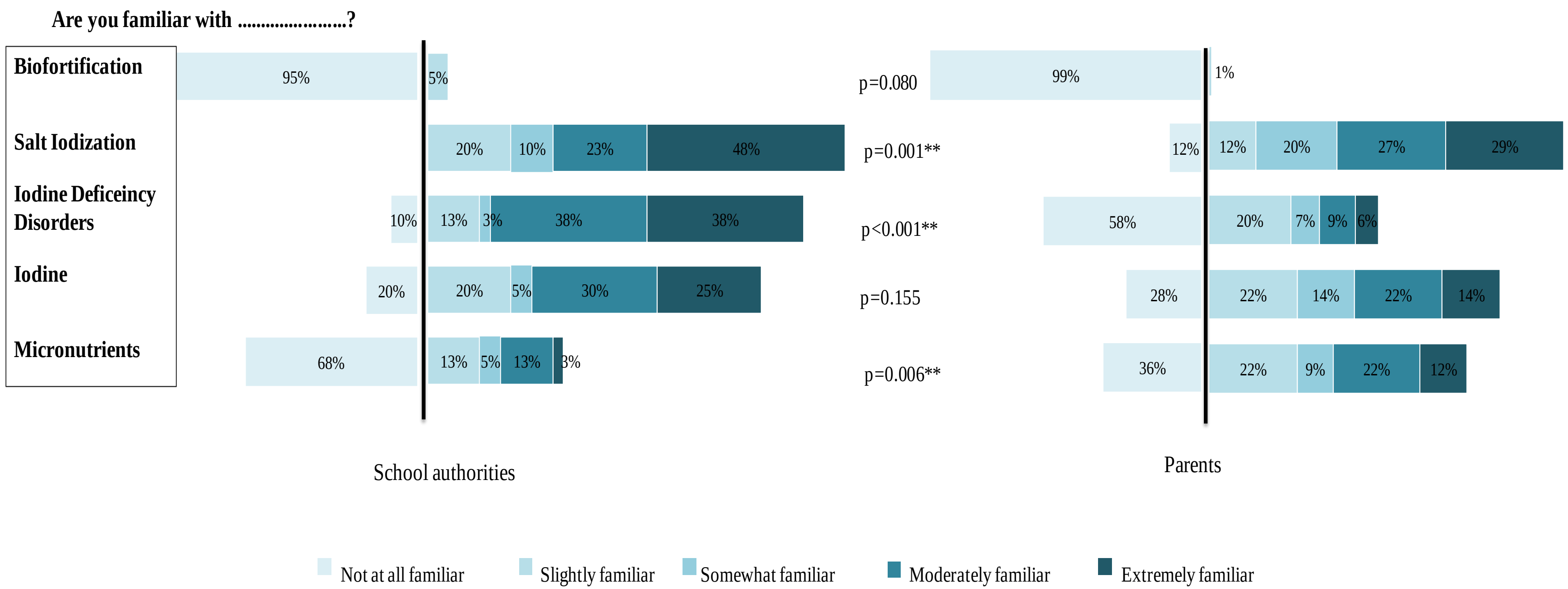
Table 1 provides an overview of the key characteristics of both samples. Male respondents are more present both in the schools authorities (75%) and parents sample (52.8%), but significanty more in the former ($p=0.007$). The mean age of school authorities (37 years) and parents (35 years) are similar ($p>0.05$). School authorities (100%), however, were twice as likely ($p<0.001$) to have at least a secondary education than parents (48.1%). Whereas all school authorities were either employed by the government or privately, only 20.8% of parents had this kind of employment. A good number (52.8%) of parents were self-employed, 3.1% were casual laborers and 23.3% were totally unemployed. The results also demonstrate that the average parental income amounted 174400 Uganda Shillings (70 USD). While the majority of school authorities rated the academic performance as good (62.5%), close to half of the parents rated it as poor (41.9%) and only 20.8% perceived it as good, a significant difference between both samples. The proportions of academic satisfaction between school authorities and parents differed significantly with, respectively, 7.5 % vs 31.0% (very to extremely satisfied), 55% vs 8.9% (moderately satisfied), 37% vs 51.1% (slightly to not satisfied). Even though the majority of schools (60%) currently ran a school feeding program, still 40% do not. A substantial proportion (95.8%) of these programs were supported by parents, while the government provided limited help to a selected few (4.2%). Most schools (87.5%) receive foods from their own farms while the market and donation only provided limited supplies, respectively 8.3% and 4.2 %. Over half of the parents (59.7%) obtained food from their own farms, 37.2% relied on markets and 3.1% on donations. Iodized salt was used by 95% of the schools, as compared to 67.5% of all parents. At home, about one out of 7 parents only buys traditional salt (14.7%). The mean consumption of iodized salt by children at school (reported by school heads) and at home (reported by parents) was similar, with about 6 days.

Table 1. Characteristics of school authorities and parents in Kisoro, Uganda

Characteristic	Respondents		*p-value*
	School authorities (n=40)	**Parents (n=360)**	
Gender			
Male	30 (75%)	190 (52.8%)	0.007**
Female	10 (25%)	170 (47.2%)	
Age (mean ±SD)	36.9 ±10.35	34.9 ±8.48	0.347
Education level			
No formal education	0(0%)	73 (20.3%)	
Primary education	0(0%)	114 (31.7%)	
Secondary education	(0)	83 (23.1%)	<0.001**
Tertiary	40(100%)	82 (22.8%)	
University	0(0%)	8 (2.2%)	
Occupation			
Unemployed	0 (0%)	84 (23.3%)	
Casual worker	0 (0%)	11 (3.1%)	<0.001**
Self-employed	0 (0%)	190 (52.8%)	
Government/private worker	40 (100%)	75 (20.8%)	
Income (mean ±SD)	-	174400 ±148850	
Size (mean ±SD)	644.43 ±323.29	2.37 ±0.998	
Academic performance			
Poor	0 (0%)	151 (41.9%)	
Fair	7 (17.5%)	52 (14.4%)	
Good	25 (62.5%)	75 (20.8%)	<0.001**
Very good	6 (15%)	41 (11.4%)	
Excellent	2 (5%)	41 (11.4%)	
Academic performance satisfaction			
Not at all satisfied	6 (15%)	123 (34.2%)	
Slightly satisfied	9 (22%)	61 (16.9%)	<0.001**
Moderately satisfied	22 (55%)	32 (8.9%)	
Very satisfied	3 (7.5%)	109 (30.3%)	
Extremely satisfied	0 (0%)	35 (9.7%)	
School feeding program			
Yes	24 (60%)	-	
No	16 (40%)	-	
Support source (n=24)†			
Parents	23 (95.8%)	-	
Government	1 (4.2%)	-	
Source of food			
Own farm	2 (8.3%)	215 (59.7%)	
Market	21 (87.5%)	134 (37.2%)	<0.001**
Donation	1 (4.2%)	11 (3.1%)	
Type of salt used			
Traditional	2 (5%)	53 (14.7%)	
Industrial iodized	38 (95%)	243 (67.5%)	<0.001**
Both	0 (0%)	64 (17.8%)	
Frequency of iodized salt intake	5.79 ±1.64	5.66 ±2.22	0.494

Proportions and means were compared using Chi-square tests and Mann-Whitney U test, respectively.
Means and standard deviations are in brackets, unless indicated.
†Applicable number of respondents for that particular question.
** Significant at p<0.05.

Figure 2 shows the responses to the questions assessing stakeholders' knowledge on a scale of 1 (not at all familiar) – 5 (Extremely familiar). Knowledge on salt iodization and iodine is high in both groups, most likely due to the regular use of iodized salt. This is a positive finding, that, if consumers are aware of the importance of iodine, may lead to satisfactory intake levels of iodized salt, as shown in previous studies (Buxton and Baguune, 2012; Mohapatra et al., 2001). Unfortunately, study participants are not that familiar with IDDs, especially in the group of parents, calling for communication efforts when marketing iodized salt. Although parents could not identify a single deficiency disorder related to iodine, it does not mean that parents are unaware of the existence of goiter or poor school performance of their children, but they can not associate iodine to these disorders. This has also been shown in other studies where people do not know the causes of IDDs and, in extreme cases, sometimes associate it to traditional practices especially witchcraft (Mallik et al., 1998; Jooste et al., 2005). Even though parents got more aquinted with micronutrients, familiarity with vitamins and minerals is relatively low in both samples. Despite the fact that 3 out of 5 schools have a school food program, nearly 70% is not familiar with micronutrients. As expected, only few people have heard of biofortification. It is not a surprise that knowledge about biofortification is very low in the study area. Although biofortified orange sweet potatoes were introduced in the same area in 2007, few people participated in this intervention (Hotz et al., 2012). It is clear that additional efforts are needed to increase awareness. There were statistically significant differences between respondent’s familiarity with regard to micronutrients ($p=0.006$), IDDs ($p<0.001$) and salt iodization ($p=0.001$).



** Significant at p<0.05.

Figure 2. Familiarity with iodine, its deficiency and interventions, per subsample

Results in **Table 2** indicate that both parents and school authorities have a high average threat appraisal, mainly due to the high scores on perceived fear and perceived vulnerability. Only the latter was statistically different (p=0.05) between the two groups, a finding that might relate to school authorities' more negative perception of academic performance. The general coping appraisal score among school authorities (4.36) was significantly lower than that of parents (4.50). Within the group of coping appraisal items, self-efficacy obtained the only significant difference between the school authorities and parents, of which the latter were even more optimistic than the former . This concurs with a study that showed that parents of children with healthy food choices believe they have more control over them, while viewing unhealthy preferences as short-term, modifiable options (Russell and Worsley, 2013). All coping appraisal items obtain a high score, except for the relatively low response costs. Finally, the scores reveal a clear intention for protection motivation in both stakeholder groups, but particularly in the group of parents. Despite the fact that school feeding schemes require additional (external) support and efforts (Bundy et al., 2011), the significantly lower protection motivation is still relatively high.

Table 2. Protection Motivation constructs and the intention to adopt biofortified legumes among school authorities and parents in Kisoro, Uganda

PMT constructs & intention	School authorities (n=40)	Parents (n=360)	
	Mean ±SD	Mean ±SD	*p-value*
Threat appraisal	4.37 ±0.46	4.35 ±0.46	0.610
Perceived severity	4.12 ±0.68	4.08 ±0.62	0.574
Perceived vulnerability	4.53 ±0.46	4.37 ±0.57	0.050**
Perceived fear	4.63 ±0.49	4.74 ±0.54	0.075
Coping appraisal	4.36 ±0.44	4.50 ±0.47	0.025**
Response efficacy	4.31 ±0.55	4.30 ±0.54	0.863
Self-efficacy	4.40 ±0.47	4.70 ±0.55	<0.001**
Response cost[a]	2.48 ±1.26	2.18 ±0.92	0.246
Protection motivation	4.24 ±0.48	4.41 ±0.49	0.005**

Means were compared using Mann-Whitney U test.
** Significant at p<0.05.

The results of the multiple regression analysis for the PMT dependent variables (threat appraisal, coping appraisal and protection motivation) are presented in **Table 3**. While no external factor was found to be significant among school authorities in relation to threat appraisal, occupation, household size, age and income significantly affect threat appraisal among parents (10.4% of the explained variance). The effect of age and occupation were negative while income and household size had a positive influence on threat appraisal.

Among school authorities, gender had a positive significant effect, explaining 8.7% of the total variance in coping appraisal. The higher level of coping appraisal in male school heads contradicts previous studies about health eating behaviors who reported, respectively no (Renner et al., 2008; Cox and Bastiaans, 2007) or an opposite effect of gender (Lowenstein et al., 2013). For parents, occupation, education and age negatively affected coping appraisal. Knowledge about iodine and IDDs as well as household size were positive predictors of coping appraisal, together accounting for 13.3 % of the explained variance of the coping appraisal models.

With regard to protection motivation to adopt biofortified foods, no predictor produced significant results for school authorities. For parents, occupation and knowledge were significant predictors (9% explained variance).

When looking at the three models at household level (parents), occupation negatively affects all main PMT components, while age and household size has a, respectively, negative and positive influence on both types of appraisal. This contradicts evidence on individual PMT components that found a positive relationship between perceived severity of health problems and age and occupation status (Avila-Burgos et al., 2005). In our study, however, older and employed parents have limited experience with iodine deficiency and do not perceive it to be a serious problem that requires prompt attention. Knowledge is an important predictor of both coping appraisal and protection motivation. This is not in line with previous studies that have reported lower protection motivation with increasing knowledge about particular healthy foods in question (Henson et al., 2010b; Verbeke, 2005). The high level of knowledge about iodine in our sample, together with the limited availability of coping strategies may be responsible for this opposite finding. A comparable study about biofortified pro-vitamin A cassava in Kenya found out that the high awareness by children caretakers about vitamin A and its deficiencies significantly increased their intention to use biofortified cassava (Talsma et al., 2013). Therefore, promotion of iodine biofortified foods should be accompanied with an awareness campaign. Furthermore, income and education relatively significantly determined, respectively, the threat and coping appraisal models.

Contrary to what previous studies have shown, i.e. education enhances knowledge acquisition (Molster et al., 2009; Bornkessel et al., 2014), the present study suggests that educated parents have a lower coping appraisal. Given that increased knowledge enhances coping appraisal, from a marketing point of view, improving iodine deficiency related knowledge seems to be more effective in increasing coping appraisal than having a high education level. This positive knowledge effect may be, in turn, related to parents' previous experiences of using iodized salt. Still, it is important to note that knowledge is most likely a prerequisite but not the only condition to ensure a sustainable behavioral change in favor of iodine rich foods.

Table 3. Multiple linear regression (Robust) of external predictors of threat appraisal, coping appraisal and intention to adopt iodine biofortified legumes among school authorities and parents in Kisoro, Uganda

Predictors	**School authorities**						**Parents**[c]					
	Threat appraisal $R^2 = 0.140$		**Coping appraisal $R^2 = 0.087$**		**Protection motivation $R^2 = 0.132$**		**Threat appraisal $R^2 = 0.104$**		**Coping appraisal $R^2 = 0.133$**		**Protection motivation $R^2 = 0.090$**	
	β	***p*-value**	**β**	***p*-value**	**β**	***p*-value**	**β**	***p*-value**	**β**	***p*-value**	**β**	***p*-value**
Gender	0.131	0.660	0.491	**0.045****	0.268	0.431	-0.073	0.493	-0.004	0.961	0.026	0.762
Age	-0.006	0.637	0.008	0.674	-0.016	0.148	-0.016	**0.047****	-0.023	**0.006****	-0.004	0.574
Education							-0.127	0.315	-0.291	**0.019****	-0.254	0.126
Occupation							-0.628	**0.001****	-0.611	**0.002****	-0.571	**0.006****
Income							0.004	**0.002****	0.003	0.072	0.001	0.204
School/household size	0.001	0.128	0.0001	0.903	0.0003	0.460	0.084	**0.028****	0.098	**0.005****	-0.007	0.865
Knowledge of Iodine & IDDs	0.277	0.063	0.086	0.607	0.255	0.107	0.096	0.148	0.193	**0.016****	0.160	**0.017****
Academic performance satisfaction	-0.040	0.766	-0.007	0.966	0.086	0.569	0.001	0.987	-0.012	0.808	0.062	0.225

Note: except for age and income, all variables were recoded into dummy variables.
[c] Cluster option included
** Significant at $p<0.05$

Table 4 shows the effects of both external factors and PMT components on intention to adopt biofortified legumes. In both samples, the model accounted for a relatively large variation of the protection motivation (behavioral intention)(42 % to 45 %). Response cost had a significant negative effect in the sample of school authorities. The higher the perceived costs, the lower the intention to change behavior in the future by consuming biofortified legumes. This underlines that the dependence on external assistance is a barrier to adoption among schools. Jensen et al. (2013), for example, cited similar barriers associated with launching a school feeding program and considered the costs, consumers' willingness-to-pay and the requirement of external support as most important. Among parents, self-efficacy was the only significant predictor, positively affecting protection motivation intention to adopt biofortified foods. This suggests that parents' acceptance is mainly based on their confidence to undertake the proposed dietary intervention, a finding that is shared by other studies who apply a similar model of consumers' reaction to nutritious food (Cox and Bastiaans, 2007; Cox et al., 2004; Henson et al., 2008; Henson et al., 2010b).

Table 4. Multiple linear regression (robust) of external factors, PMT constructs of Threat and Coping appraisal as predictors of intention to adopt biofortified legumes as a dependent variable among school authorities and parents in Kisoro, Uganda

Predictors	**School authorities (R^2 =0.424)**		**Parents[c] (R^2 = 0.457)**	
	β	***p*-value**	**β**	***p*-value**
Gender	0.068	0.828	0.046	0.513
Age	-0.016	0.168	0.007	0.283
Education			-0.083	0.563
Occupation			-0.184	0.144
Income			-0.001	0.435
School/household size	0.0002	0.639	-0.061	0.069
Knowledge of Iodine & IDD	0.265	0.113	0.056	0.167
Academic performance satisfaction	0.116	0.462	0.063	0.181
Perceived severity	0.162	0.517	0.206	0.089
Perceived vulnerability	0.049	0.842	0.007	0.910
Perceived fear	-0.077	0.638	0.025	0.575
Response efficacy	0.137	0.532	0.141	0.120
Self-efficacy	0.172	0.416	0.475	**<0.001****
Response cost	-0.217	**0.041****	0.022	0.548

[c] Cluster option included
** Significant at p<0.05

Finally, an ordered probit regression analysis was conducted to identify significant determinants of WTP (**Table 5**). Both subsamples are on average prepared to pay a higher (37.5 – 41%) price premium for iodine biofortified legumes in school feeding programs than in school meals (19 – 20%). Conversely, when it could be offered at a discount, they require relatively similar discount prices, respectively 33 – 38% and 37 – 39% for school feeding program and school meals. Other studies in developing regions have reported values in a similar range: premium prices of 13.8% (Kimenju and De Groote, 2008) and 33.7% (De Steur et al., 2012b) versus discount prices of 37% (De Groote and Kimenju, 2008). Still, the range of WTP can be higher, up to 64% (Gonzalez et al., 2009) or as alow as 3.8% (Loureiro and Bugbee, 2005).

Regarding the inclusion of biofortified lentils in the school feeding program, the marginal effects show that school size has a negative effect on premium for biofortified foods in the school authorities' sample. On the other hand, perceived vulnerability had a positive marginal effect in case their would be a discount. For parents, no predictor was found to affect WTP for biofortified foods at a premium price; however, at a discount price, education and response efficacy had positive marginal effects on WTP. Although there is no education effect in the ‘premium’ model, its positive effect on willingness to pay a discount corresponds with a Kenyan study on fortified maize (De Groote and Kimenju, 2008).

When considering the biofortified lentils as independent school meals, age had positive and school size negative marginal effects related to premiums for biofortified foods in the school authorities sample. In the discount scenario, knowledge and response efficacy positively affected WTP whereas self-efficacy and protection motivation intention generate negative effects. Parents’ premium for school meals was in a similar way positively affected by age and response efficacy, and negatively by household size. When looking at the discount values, gender and protection motivation intention had negative marginal effects while age and response efficacy were positive determinants. The importance of female parents with regards to child feeding is supported by Gonzalez et al. (2009) who showed that women were more willing to pay higher for biofortified cassava. De Steur et al. (2012b) also illustrated a higher interest in GM biofortified rice.

Table 5. Determinants of Willingness to Pay for biofortified legumes at premium and discount among school authorities and parents in Kisoro, Uganda, by Ordered Probit regression

		School authorities				Parents			
	Level/pseudo R^2	**PR-SFP/0.182**	**PR-SM/0.216**	**DC-SFP/0.244**	**DC-SM/0.400**	**PR-SFP/0.047**	**PR-HM/0.042**	**DC-SFP/0.039**	**DC-HM/0.202**
	Mean WTP ±SD (in $)	**1.85 ±0.16**	**1.60 ±0.16**	**0.93 ±0.21**	**0.61 ±0.10**	**1.89 ±0.16**	**1.70 ±0.17**	**1.00 ±0.17**	**0.63 ±0.10**
Gender	mfx	-0.115	-0.195	-0.164	0.013	-0.054	-0.018	-0.023	-0.050
	p-value	*0.554*	*0.380*	*0.313*	*0.911*	*0.198*	*0.404*	*0.338*	***0.026*****
Age	mfx	-0.017	0.023	0.005	0.014	0.004	0.004	0.0004	0.005
	p-value	*0.074*	**0.039****	*0.499*	*0.061*	*0.216*	***0.020*****	*0.831*	***<0.001*****
Education	mfx					0.063	0.042	0.066	0.008
	p-value					*0.278*	*0.113*	***0.009*****	*0.756*
Occupation	mfx					0.086	-0.062	-0.031	-0.020
	p-value					*0.131*	*0.150*	*0.448*	*0.590*
Income	mfx					0.0004	0.0004	-0.0002	0.0001
	p-value					*0.302*	*0.061*	*0.369*	*0.471*
School/household size	mfx	-0.001	-0.001	-0.0003	-0.00003	-0.022	-0.019	-0.005	-0.012
	p-value	***0.015*****	***0.014*****	*0.246*	*0.866*	*0.131*	***0.015*****	*0.576*	*0.068*
Knowledge of Iodine &	mfx	0.136	-0.128	-0.125	0.189	-0.040	-0.018	-0.009	0.009
IDDs	*p-value*	*0.197*	*0.237*	*0.090*	***0.029*****	*0.108*	*0.167*	*0.538*	*0.439*
Academic performance	mfx	0.063	-0.135	-0.104	-0.039	-0.045	-0.011	-0.002	-0.007
satisfaction	*p-value*	*0.446*	*0.167*	*0.119*	*0.457*	*0.060*	*0.377*	*0.883*	*0.540*
Perceived severity	mfx	-0.217	-0.463	-0.278	-0.094	-0.062	-0.015	-0.024	-0.013
	p-value	*0.232*	0.060	*0.071*	*0.435*	*0.071*	*0.375*	*0.196*	*0.383*
Perceived vulnerability	mfx	0.151	0.229	0.470	0.038	0.016	-0.008	0.024	0.009
	p-value	*0.465*	0.333	***0.010*****	*0.762*	*0.619*	*0.624*	*0.204*	*0.565*
Perceived fear	mfx	0.014	-0.103	0.010	0.047	-0.048	0.008	-0.008	0.004
	p-value	*0.883*	*0.342*	*0.884*	*0.401*	*0.135*	*0.617*	*0.641*	*0.756*
Response efficacy	mfx	-0.063	-0.123	0.041	0.292	-0.005	0.055	0.057	0.083
	p-value	*0.641*	*0.405*	*0.686*	***0.017*****	*0.901*	***0.013*****	***0.014*****	***<0.001*****
Self-efficacy	mfx	0.266	0.221	-0.072	-0.228	0.036	-0.026	-0.032	-0.025
	p-value	*0.057*	*0.121*	*0.476*	***0.029*****	*0.326*	*0.165*	*0.118*	*0.122*
Response cost	mfx	-0.030	0.103	0.067	-0.053	-0.009	0.011	-0.010	-0.009
	p-value	*0.762*	*0.343*	*0.343*	*0.406*	*0.631*	*0.290*	*0.341*	*0.324*
Protection Motivation	mfx	0.006	0.093	-0.012	-0.192	-0.065	-0.008	-0.020	-0.031
Intention	*p-value*	0.960	*0.501*	*0.887*	***0.041*****	*0.054*	*0.610*	*0.256*	***0.026*****

PR, premium, DC, discount, SFP, school feeding program, SM, school meals; HM, home meals mfx, marginal effect coefficient. ** Significant at $p<0.05$. Regular prices 1.5$ (SFP/HM) -1.0$ (SM)

CONCLUSIONS

A Protection Motivation Theory based framework is used to model parents' and school authorities' reactions towards biofortified foods. By applying this framework to the case of iodine rich legumes, the effect of both external as well as internal PMT components on protection motivation intention and/or its two types of appraisal (threat and coping) is analysed. In general, both stakeholder groups are intended to adopt iodine biofortified foods. Regarding the main PMT constructs, this study lend support for the important role knowledge about the health problem plays. Once again, self-efficacy turned out to be a strong determinant of motivation intention among parents. Furthermore, response cost, a component that has been rarely included in PMT studies makes a significant contribution to the literature in terms of a clear negative effect on motivation intention among school authorities. Besides, socio-demographic variables like age and gender influence the likelihood to adopt a behavioral change towards biofortified food consumption. When looking at WTP estimates, participants were more responsive at a discount as compared to the offered premium prices, regardless of context in which biofortified foods would be used, i.e. as a part of school feeding programs or as a school meal. Average premiums for school authorities and parents amount about 39 % (school feeding program) and 20 % (school meals), whereas discount prices between 36% and 38 % were obtained . The factors that explained WTP at a discount price included gender, age, education, knowledge, perceived vulnerability, response efficacy, self-efficacy, protection motivation intention while at a premium level only school/household size, age and response efficacy have a significant influence.

In this respect, a school feeding intervention based on iodine biofortified foods should strive to increase awareness of iodine, its association to deficiency disorders and self-efficacy especially among young mothers, while at the same time ensuring that the cost to be incurred by schools are not considered as a barrier for implementation. Although several factors have shown a considerable effect on the intention to adopt biofortified foods, further supporting the use of PMT models to evaluate reactions towards nutritious foods, it is crucial to further evaluate its external validity and the appropriateness of each of its items.

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