Economics Bulletin

Volume 44, Issue 3

Impacts of pre-existing medical conditions on WTP for fortified rice in India

Jacob Manlove
Arkansas State University

Adithya Gummadi
Arkansas State University

Abstract

The use of food fortification to combat nutrient deficiencies has garnered popularity as it has proven to be a cost-effective strategy to combat and prevent many diseases and illnesses associated with nutrient deficiencies. This research aimed to examine the willingness to pay (WTP) of Indian consumers for fortified food products predicated on the addition of the nutrients Iron, Zinc, Folic Acid, Vitamin A, and Vitamin B. Additionally, the impact of pre-existing medical conditions on overall willingness to pay are evaluated. This study finds that Indian consumers are willing to pay more for fortified products. A pre-existing medical condition's impact was positively significant for those diagnosed with heart disease, diabetes and infertility. Based on the results and findings, this study proposes to further strengthen the understanding of food fortification and consumer's understanding of its health implications.

Citation: Jacob Manlove and Adithya Gummadi, (2024) "Impacts of pre-existing medical conditions on WTP for fortified rice in India", *Economics Bulletin*, Volume 44, Issue 3, pages 804-812
Contact: Jacob Manlove - jmanlove@astate.edu, Adithya Gummadi - adithyas.gummadi@smail.astate.edu.
Submitted: July 29, 2023. **Published:** September 30, 2024.

Impacts of Pre-existing Medical Conditions on Willingness to Pay for Fortified Rice in India

Abstract
The use of food fortification to combat nutrient deficiencies has garnered popularity as it has proven to be a cost-effective strategy to combat and prevent many diseases and illnesses associated with nutrient deficiencies. This research aimed to examine the willingness to pay (WTP) of Indian consumer's for fortified food products predicated on the addition of the nutrients Iron, Zinc, Folic Acid, Vitamin A, and Vitamin B. Additionally, the impact of pre-existing medical conditions on overall willingness to pay are evaluated. This study finds that Indian consumers are willing to pay more for fortified products. A pre-existing medical condition's impact was positively significant for those diagnosed with heart disease, diabetes and infertility. Based on the results and findings, this study proposers to further strengthen the understanding of food fortification and consumers understanding of its health implications.
Keywords: fortified food products, India, willingness-to-pay, WTP

1. Introduction

Food Fortification is defined as the addition of additional nutrients that are normally not available in the product. This process is one of the safest and most cost-effective strategies to improve diet and helps to prevent and control micronutrient deficiency. Fortified rice has been initiated as a mitigation strategy by High income countries (HIC) and is being developed in Low- Middle- Income economic countries (LMIC) such as India. The majority of countries are treating hidden hunger as a serious issue. To eradicate Hidden hunger, fortification is a viable solution. Vitamin A deficiency, iodine deficiency, anemia, and iron deficiency among women and children, declines in goiter and neural tube defects (NTDs) among children; and improved serum folate among women of reproductive age all mitigated by fortified food.

India is a fast-growing nation. This growth rate is expanding the gap between the rich and poor in India. Contrasts in health outcomes across socioeconomic classes are mostly due to income disparity (Dixit, et al., 2021). By assisting the poor with medical costs, governments are bridging the growing wealth gap.

Despite gains in admittance to health care, disparities continue in India, which are linked to socioeconomic class, position, and gender, and are worsened by high costs. Health-care spending exacerbates poverty, with an estimated 40 million individuals in poverty as a result

of such spending each year. In terms of health, India is currently in change - financially, demographically, and epidemiologically (Narain, 2016). While the recent decade has seen exceptional economic growth, notably in terms of GDP development rate, this success has been accompanied by widening economic inequities. There is compelling research that indicates economic inequality or gaps across socioeconomic classes is linked to poor health outcomes. The growing disparity between the affluent and poor has negative health and societal implications (Balarajan et al., 2011). While the government is applying financial enclosure and social safety efforts to limit income disparities, the health sector must also safeguard that health inequalities across and amongst social and financial courses are addressed appropriately.

This research aims to examine the willingness to pay (WTP) of Indian consumer's for fortified food products predicated on the addition of the nutrients Iron, Zinc, Folic Acid, Vitamin A, and Vitamin B.

2. Methods

This research was completed using a WTP model based on the results of a nationwide survey of consumers in India. In addition to the WTP experiment, demographic and health status information was collected to further explain potential differences in WTP predicated on the existence of pre-existing health conditions (diabetes, cancer, heart disease, obesity, cataracts, hair loss, and infertility).

2.1. Survey Design

Data for this analysis was collected from a nation-wide survey of Indian consumers. Participants were recruited through the use of in country agents and were limited to those consumers 18 years or older. Upon consenting to participate in the survey, participants were prompted to answer a series of questions pertaining to their demographics and whether or not they or anyone in their immediate family has a diagnosis for a list of common medical conditions. Participants were then presented with a discrete choice experiment in which they were asked to choose between two options of fortified rice with varying levels of nutrient and micro-nutrient makeups or to choose neither. The two packages were presented side-by-side (Figure 1) and varied in the composition of the six attributes: price, zinc, iron, folic acid,

vitamin A, and vitamin B (Table 1). The levels of the attributes were to represent the range of 'typical' fortified rice products available in India.

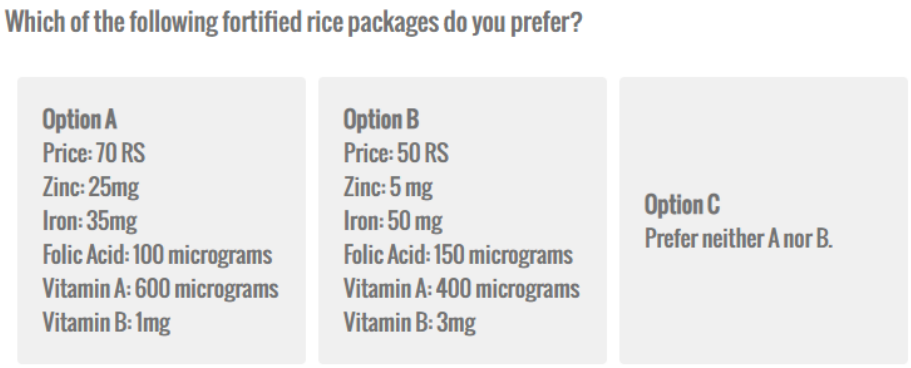

Figure 1. Example Package Profile Set

Attribute	Level
Price	30Rs, 50 Rs, 70Rs
Zinc	5mg, 15mg, 25mg
Iron	20mg, 35mg, 50mg
Folic Acid	50 micrograms, 100 micrograms, 150 micrograms
Vitamin A	400 micrograms, 600 micrograms, 800 micrograms
Vitamin B	1mg, 2mg, 3mg

Table 1. Full Attribute Table for Rice Packages

The survey design set was established from a selected set of packages from the full-factorial design (Kuhfeld, Tobias, & Garratt, 1994). The full-factorial results in 729 unique packages, to increase survey response a fifteen-choice set was presented to participants (Savage & Waldman, 2008). The choice was chosen to optimize the D-efficiency of the design (Lusk & Norwood, 2005).

2.2.WTP Methods

The WTP for fortified rice products is formulated using a random utility model. The participant responses of the survey were analyzed using a conditional logit model in which each consumer's WTP is (McFadden, 1973):

(1) $$WTP_j = \boldsymbol{\theta X_j} + \varepsilon_j$$

where $\boldsymbol{\theta}$ and $\boldsymbol{X_j}$ are the vectors of covariates and parameters affecting WTP, and ε_j is an unobserved idiosyncratic component. Thus, a consumer is willing to pay for a rice package if the derived benefit of the package is the greater than price of that alternative. The respondent's choices were analyzed using the conditional logit model with the following representing the systematic components of utility for each choice set:

(2)

$$V_1 = asc + \beta_{Price} \times Price_1 + \beta_{Zinc} \times Zinc_1 + \beta_{Iron} \times Iron_1 + \beta_{Folic\ Acid} \times Folic\ Acid_1 + \beta_{Vitamin\ A} \times Vitiman\ A_1 + \beta_{Vitamin\ B} \times Vitamin\ B_1$$

$$V_2 = asc + \beta_{Price} \times Price_2 + \beta_{Zinc} \times Zinc_2 + \beta_{Iron} \times Iron_2 + \beta_{Folic\ Acid} \times Folic\ Acid_2 + \beta_{Vitamin\ A} \times Vitiman\ A_2 + \beta_{Vitamin\ B} \times Vitamin\ B_2$$

$$V_3 = 0$$

where asc is the alternative specific constant used to capture the non-specified variation in choices and β_{Price}, β_{Zinc}, β_{Iron}, $\beta_{Folic\ Acid}$, $\beta_{Vitamin\ A}$, and $\beta_{Vitamin\ B}$ are coefficients to be estimated, $Price_i$ is the price of each alternative, $Zinc_i$, $Iron_i$, $Folic\ Acid_i$, $Vitiman\ A_i$, and $Vitamin\ B_i$ correspond to the level of nutrients and micronutrients within each choice set.

The choice model used also allows for the marginal willingness-to-pay (MWTP) for each of the non-price attributes (nutrients and micronutrients) to be determined. The MWTP is calculated as the ratio of the coefficient of the attribute of interest divided by the price coefficient such that:

(2) $$MWTP_j = \frac{-\beta_j}{\beta_{Price}}$$

where $MWTP_j$ is the WTP to for an additional unit increase in the attribute, β_j is the coefficient of attribute *j,* and β_{Price} is the price coefficient (Buckell, White, & Shang, 2020). To evaluate the significance of the MWTP of each attribute, the Delta method is used to calculate the estimates standard errors (Daly, Hess, & Jong, 2012). Additionally, interaction variables consisting of the variable price and one of the sets of medical conditions are used to calculate an additional WTP model to examine the effects of the medical condition on a consumer's WTP for fortified rice

3. Results

The survey received a total of 476 complete surveys, representing a statistical power of 78%, near the 80% survey standard. The summary statistics of respondents to basic demographic questions are presented in Table 1. Additionally, included is the percent of total income spent on total health related expenses in which nearly 60% of respondents report spending more 20% or more on health issues. The results of the model are shown in Table 2. The price variable is negative, as expected, and significant. Additionally, all variables of nutrient and micro-nutrient are positive and significant with the exception of Vitamin A. These results are consistent with expectations, as the greater the nutrient content of the fortified rice product, the greater the utility associated with the product.

Demographic	**% of Respondents**
Sex	
Male	54.67%
Female	45.33%
Age	
18-30	43.10%
31-40	27.30%
41-50	20.11%
51-60	8.33%
61 +	1.15%
Income	
Less than 25,000 Rs/month	34.12%
25,001 - 35,000 Rs/month	25.12%
35,001 - 45,000 Rs/month	18.96%
45,001 - 55,000 Rs/month	9.48%
More than 55,000 Rs/month	12.32%
Percent of income spent on health-related expenses.	
Less than 10%	41.90%
11-20%	21.43%
21-30%	23.33%
31-40%	10.48%
40% or more	2.86%

Table 1. Summary Statistics of Respondents n=476

Variable	Coefficient	Std Err
Price	-0.00170	0.00101*
Zinc	0.01375	0.00251***
Iron	0.00640	0.00136***
Folic Acid	0.00137	0.00043***
Vitamin A	0.00016	0.00010
Vitamin B	0.08225	0.02252***

*, **, &*** represent statistical significance at the 0.1,0.05, & 0.01 levels, respectively.

Table 2. WTP Conditional Logit Results

The results of this study provide valuable insight into the willingness of Indian consumers to pay for fortified rice products. The addition of key nutrients such as zinc, iron, folic acid, vitamin A, and vitamin B can have a positive impact on the overall health of Indian consumers, particularly those with pre-existing medical conditions such as heart disease, diabetes, and infertility. The survey results show that these consumers are willing to pay more for fortified products, indicating that there is a market for these types of products in India.

One of the key findings of this study is the impact of price on consumers' willingness to pay. The results indicate that price has a negative impact on willingness to pay, meaning that consumers are less likely to purchase fortified rice products that are priced higher than their non-fortified counterparts. This highlights the importance of keeping prices of fortified products affordable in order to increase their accessibility to consumers.

The results of the MWTP are presented in Table 3. Vitamin B has the highest MWTP with Indian consumers willing to pay on average ₹48.4245/mg, whereas Folic Acid has the lowest willingness to pay for its fortification to rice at ₹0.8070/µg.

Micro-nutrient	MWTP*
Zinc	₹8.0932/mg ($0.098/mg)
Iron	₹3.7651/mg ($0.046/mg)
Folic Acid	₹0.8070/µg ($0.0098/µg)
Vitamin A	₹0.0919/µg ($0.0011/µg)
Vitamin B	₹48.4245/mg ($0.59/µg)

*Based in conversion rate 4/4/23

Table 3. MWTP for Micro-nutrients

The results of the expanded model including sociodemographic and health variables is shown in Table 4. The survey results show that income level and health-related expenses play a role in consumers' willingness to pay for fortified rice products. Consumers with lower incomes and higher health-related expenses are less likely to be willing to pay for fortified products, indicating that affordability is a significant barrier for these consumers.

The impact of pre-existing medical conditions was greatest for those with heart disease and infertility, indicating that consumers in these grouping are willing to pay a premium for fortified rice. Additionally, the families with a child in the home are less willing to purchase fortified rice – likely associated with the increased cost of family expenses. As the age of the consumer increase, the WTP for fortified rice decreased. Being male and the sole decision maker of the household also decreases WTP.

Variable	**Coefficient**	**Std Err**
Price	-0.01492	0.00296***
Zinc	0.01393	0.00252***
Iron	0.00653	0.00137***
Folic Acid	0.00142	0.00044***
Vitamin A	0.00017	0.00010***
Vitamin B	0.08577	0.02259***
Price x Diabetes	0.00182	0.00151
Price x Cancer	0.00718	0.00516
Price x Heart Disease	0.00551	0.00201***
Price x Obesity	0.00253	0.00186
Price x Cataracts	-0.00594	0.00283**
Price x Hair loss	-0.00203	0.00186
Price x Infertility	0.00531	0.00281*
Price x Age	-0.00021	0.00007***
Price x Child	-0.00307	0.0009***
Price x Male	-0.00224	0.00138
Price x Sole	-0.00447	0.00154***

*,**,&*** represent statistical significance at the 0.1,0.05, &0.01 levels, respectively.

Table 4. Expanded WTP Conditional Logit Results

4. Discussion and Conclusion’s

This study provides important insight into the willingness to pay for fortified rice among Indian consumers and the impact of pre-existing medical conditions on WTP. The results suggest

that fortified rice could be a cost-effective solution to combat nutrient deficiencies and improve the overall health of Indian consumers, particularly those with pre-existing medical conditions. Additionally, these results will help policy makers to understand the impact of pre-existing medical conditions on willingness to pay for fortified rice and help to design policies that are more beneficial for the population in incentivizing their consumption. One of the primary findings of the study is the relationship with price and fortified food. This highlights the importance of government and private sector intervention to make fortified products more affordable for low-income consumers. This can be achieved through subsidies, price controls, or other government-led initiatives aimed at making fortified products more accessible to low-income consumers.

References

Balarajan, Y, et al. “Health Care and Equity in India.” The Lancet, vol. 377, no. 9764, 2011, pp. 505–515, https://doi.org/10.1016/s0140-6736(10)61894-6.

Buckell, John, et al. “Can Incentive-Compatibility Reduce Hypothetical Bias in Smokers’ Experimental Choice Behavior? A Randomized Discrete Choice Experiment.” Journal of Choice Modelling, vol. 37, 2020, p. 100255, https://doi.org/10.1016/j.jocm.2020.100255.

Daly, Andrew, et al. “Calculating Errors for Measures Derived from Choice Modelling Estimates.” Transportation Research Part B: Methodological, vol. 46, no. 2, 2012, pp. 333–341, https://doi.org/10.1016/j.trb.2011.10.008.

Dixit, Jyoti, et al. “Health Related Quality of Life among Rheumatic Fever and Rheumatic Heart Disease Patients in India.” PLOS ONE, vol. 16, no. 10, 2021, https://doi.org/10.1371/journal.pone.0259340.

Kuhfeld, Warren F., et al. “Efficient Experimental Design with Marketing Research Applications.” Journal of Marketing Research, vol. 31, no. 4, 1994, p. 545, https://doi.org/10.2307/3151882.

Lusk, Jayson L., and F. Bailey Norwood. “Modeling Beef Quality Heterogeneity.” Journal of Agricultural and Applied Economics, vol. 37, no. 3, 2005, pp. 603–618, https://doi.org/10.1017/s1074070800027115.

McFadden, Daniel. Conditional Logit Analysis of Qualitative Choice Behavior. Univ. of California, 1973. Narain, JaiPrakash. “Public Health Challenges in India: Seizing the Opportunities.” Indian Journal of Community Medicine, vol. 41, no. 2, 2016, p. 85, https://doi.org/10.4103/0970- 0218.177507.

Savage, Scott J., and Donald M. Waldman. “Learning and Fatigue during Choice Experiments: A Comparison of Online and Mail Survey Modes.” Journal of Applied Econometrics, vol. 23, no. 3, 2008, pp. 351–371, https://doi.org/10.1002/jae.984.