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Nutrition Knowledge, Personal Motivation, And Food Label Use Among Indian Adults With Multiple Chronic Conditions: A Moderated Mediation Model.

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Nutrition Knowledge and Diet: Exploring the Influence of Social and Informational Factors in an Indian Adult Population

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ABSTRACT

Background: There has been little research conducted within developing nations examining the link between knowledge and diet-related perceptions and behaviors. In addition, prior investigations have rarely examined interrelationships between knowledge and other nutrition-related factors. **Purpose**: This study explored the relationship between nutrition knowledge, social/informational factors, and diet-related outcomes among Indian adults with multiple chronic conditions. **Methods**: A snowball sampling technique was employed to recruit individuals. Hierarchical regression analysis was employed to examine mediating and moderating relationships. **Results**: Results from a cross-sectional survey indicated that knowledge only predicted use among those reporting greater pressure/concern from close others. Furthermore, social support and social trust were found to moderate the relationship between knowledge and diet-related perceptions and behaviors. **Discussion**: Results suggest that social factors may play a critical role in moderating the impact of nutrition knowledge on diet-related perceptions and behaviors. **Translation to Health Education Practice**: Public Health Education interventions targeting developing nations should aim to maximize consumers' nutrition knowledge while identifying valued close others who can help encourage positive health action. Furthermore, Health Educators as well as government and local communities must engage in outreach efforts to reinforce or, if necessary, change public perceptions regarding the food industry.

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Background

As obesity rates rise in developing countries, it is critical to identify factors contributing to a healthier diet. Possessing greater nutrition knowledge is likely to aid individuals in managing weight and diet concerns. Nutrition knowledge reflects one's knowledge and understanding of concepts and processes connected to health and nutrition.[1,2] This factor captures the broad information utilized when making dietary choices.[3] Given the importance of nutrition knowledge in food selection, researchers have frequently explored the relationship between knowledge and consumers use of food labels—a prominent source for nutrition information at the point of sale.[4] Food label use broadly reflects how effectively consumers attend to and comprehend nutrition information when making healthy food choices.[3] Findings consistently show that nutrition knowledge is a positive predictor of increased nutrition label use.[5-7] Drawing from cognitive science, Miller and Cassady[3] posit that nutrition knowledge contributes to more efficient attention, comprehension, and recall of food labels. The authors argue that because nutrition information may be challenging to comprehend and at times communicated ineffectively, possessing greater nutrition knowledge is a key determinant of subsequent food label use. Consequently, those with higher levels of nutrition knowledge are more likely to pay attention to key food label information while ignoring irrelevant cues and understand/recall dietary facts more effectively.

In addition to cognitive perspectives, information-seeking theory offers insight into this relationship. In particular, the comprehensive model of information seeking[8] argues that beliefs related to given health behaviors should trigger information-seeking action. Thus, nutrition knowledge may reflect dietary beliefs that drive individuals to utilize food labels as a key information resource. Overall, drawing from these prior theoretical perspectives as well as empirical research we predict the following: Nutrition knowledge will positively predict food label use.

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Subjective norms

Though previous research has both theoretically and empirically examined the direct relationship between nutrition knowledge and food label use, there is an absence of research exploring factors that may moderate this relationship. In particular, social factors, such as the opinions/perspectives of close others, may be a key motivator that helps determine whether those with higher knowledge utilize food labels. Subjective norms reflect perceptions of the influence of close others on one's decision to perform or not perform a given behavior.[9] Researchers posit that peer attitudes and behaviors can act as normative influences offering the ability to vicarious learn about specific actions.[10] Originally derived from the theory of reasoned action/theory of planned behavior (TPB),[11] subjective norms reflect one of the three concepts (attitudes and self-efficacy/perceived behavioral control constituting the other two) contributing to behavioral intentions. Prior research examining a range of different health behaviors, including healthy eating, found that compared to other TPB factors, subjective norms was a somewhat weaker predictor of outcomes.[12-14] This suggests that norms could play a more indirect or moderating role in explaining health behaviors.[15-17] For example, one study found that norms indirectly predicted healthy eating behavior through attitudes,[15] and another study found significant interactions between subjective norms and both health attitudes and self-efficacy in predicting organ donation intentions.[17] Overall, though nutrition knowledge may provide the cognitive skills necessary to convince individuals that they can effectively use food label information, encouragement from others may be a key motivator to reassure consumers that the information will be valuable/useful. Notably, this argument is consistent with a social cognitive perspective that stresses the interrelationships between knowledge and vicarious processes in determining behavior change.[18] Drawing from prior research, we predict the following: Subjective norms will moderate the relationship between nutrition knowledge and food label use, such that at higher levels of subjective norms nutrition knowledge will be a more powerful predictor of use than at lower levels of subjective norms.

Nutrition knowledge and diet-related perceptions and behaviors

As a central component of health literacy,[19] nutrition knowledge may serve a critical role in promoting broader positive health outcomes. Prior research shows that though information/knowledge is a fairly consistent positive predictor of healthy eating.[20-22] the extent of the impact that knowledge has on healthy food consumption may be relatively weak.[19] This suggests that it is necessary to explore additional factors that may explain when and how nutrition knowledge exerts its strongest impact on diet-related attitudes and behaviors. The following sections address potential mediating and moderating factors in the relationship between nutrition knowledge and positive dietary outcomes.

Mediating role of food label use

Previous research indicates that food label use positively predicts healthy dietary outcomes.[7,23,24] Drawing from the nutrition knowledge–food label use relationship described above, it is possible that food label use acts as an intervening mechanism between knowledge and positive diet-related perceptions and behaviors. Miller and Cassady[3] proposed a model whereby nutrition knowledge indirectly influences dietary intake through more effective use of food labels (greater attention, comprehension, and subsequent food selection). To the authors' knowledge, only one study examined this relationship.[25] The findings from that investigation were relatively unclear—nutrition knowledge was found to be a significant predictor of healthy eating behavior independently and when controlling for food label use, whereas food label use was not independently associated with healthy eating behavior. Consequently, it remains unclear whether food label use may intervene in the relationship between nutrition knowledge and positive dietary outcomes. This leads to the following questions:

> Does food label use mediate the relationship between nutrition knowledge and healthy eating behavior?
>
> Does food label use mediate the relationship between nutrition knowledge and perceived obesity risk?

Moderating role of social support

Greater perceived assistance/guidance from others may factor strongly in one's diet-related attitudes and behaviors. In particular, social support reflects how people perceive and assess emotional guidance, information, and broader assistance (via words and actions) provided by close others.[26,27] Social support highlights an interpersonal exchange[28] whereby individuals provide assistance to those managing situational difficulties and uncertainties.[29] Social support is often a central factor in healthy lifestyle decisions. Close family and friends may act as central informational resources for those lacking in health knowledge.[30] Importantly, social support has been linked to both healthy eating behavior[31-33] and lower body mass

index scores.[34] Consequently, Indian adults receiving greater social support will benefit by receiving timely diet and nutrition information, as well as emotional guidance to maintain positive self-esteem and self-confidence. Furthermore, social support may aid in reaffirming existing nutrition knowledge and help motivate individuals possessing this knowledge to engage in healthy lifestyle decisions. This leads to the following predictions:

> Social support will moderate the relationship between nutrition knowledge and healthy eating behavior, such that at higher levels of social support nutrition knowledge will be a more powerful predictor of healthy eating behavior than at lower levels of social support.

> Social support will moderate the relationship between nutrition knowledge and perceived obesity risk, such that at higher levels of social support nutrition knowledge will be a more powerful predictor of perceived obesity risk than at lower levels of social support.

Moderating role of social trust

Researchers posit that trust may reduce complexity when making decisions perceived as risky and/or uncertain.[35] Consequently, the broader trust that consumers have in those institutions responsible for creating various food products may ultimately contribute to product selection and use. Within an Indian population, as the diversity of food items become more widely accessible and consumed,[36] one critical issue to assess is the impact of food industry trust on healthy food decisions. Prior research examining new food consumption patterns (such as functional foods) indicates that trust is a consistent predictor of consumption.[37,38] Though individuals may possess high levels of nutrition knowledge, as food choices in specific areas/countries (such as India) expand, one's trust in those producing these products may play a key role in broader dietary behavior. Similar to how social support may reaffirm existing nutrition knowledge, perceptions of trust may also be a critical motivating force that serves to moderate the association between knowledge and dietary attitudes and behaviors. However, given that trust is typically examined within the context of unique foods or food technologies,[39,40] it is somewhat unclear whether this concept will have a similar impact within the context of broader dietary health concerns. This leads to the following questions:

> Does food industry trust moderate the relationship between nutrition knowledge and healthy eating behavior?

> Does food industry trust moderate the relationship between nutrition knowledge and perceived obesity risk?

The importance of healthy eating in India

India already constitutes roughly 17% of the world population[41] and by 2030 is predicted to be the most populous country in the world.[42] This will likely place significant pressure on public health organizations to promote preventative behaviors as a means to minimize strain on health care resources. Encouraging a healthy lifestyle that includes healthy eating will be central to these initiatives. Though developing countries such as India have traditionally faced issues related to undernutrition, recent data indicate that obesity and obesity-related health problems are posing significant public health challenges.[43] One study conducted in southern India indicated that over 40% of people living in urban areas and 20% of individuals in rural areas were obese.[44] Though obesity rates were substantially lower in rural areas, the findings also indicated that the percentage of the rural population reported as obese increased dramatically from 2% in 1989 to 20% in 2006.[44] Other studies conducted across different regions of India document similarly high prevalence of obesity.[45-47] To the authors' knowledge, only one study examined the association between nutrition knowledge and preventative dietary behavior among participants living in a developing country.[48] Given the alarming rise in obesity rates in developing countries such as India, coupled with the central role nutrition knowledge plays in healthy eating, it is critical to explore how the interrelationships between knowledge and social/informational factors contribute to Indian adults' dietary attitudes and behaviors.

Purpose

The current investigation examined the interrelationships between nutrition knowledge and social/informational factors in predicting Indian adults' diet-related perceptions and behaviors. First, this study investigated the relationship between nutrition knowledge and food label use—an activity perceived as a precursor to healthy eating behavior.[3] Within this analysis, we explored the importance of vicarious learning via subjective norms[18] in determining when nutrition knowledge exerts its greatest impact on food label use.

Next, we examined how nutrition knowledge ultimately predicts diet-related perceptions and behaviors. Drawing from the link between nutrition knowledge and food label use, food label use is explored as an intervening factor in the relationship between knowledge and diet-related perceptions and behaviors. In addition, we assessed whether social support and social trust impact how nutrition knowledge predicts dietary

outcomes. As described above, social support can predict healthy eating behavior and may also determine the extent to which other factors influence healthy dietary actions.[31] Similarly, research suggests that greater consumer distrust may contribute to individuals failing to follow nutrition advice and lead to risky dietary decisions.[49] Consequently, social support and social trust may prove critical in determining the extent that knowledge contributes to positive diet-related outcomes.

This investigation assesses these relationships within a population of Indian adults with multiple chronic conditions. Multiple chronic conditions reflect simultaneous health conditions that necessitate ongoing medical assistance and pose daily physical challenges.[50] As the number of chronic conditions increases, individuals' risk of dying and poorer day-to-day functioning rise.[50] Those faced with multiple health concerns must be particularly engaged in food selection and subsequent dietary intake. Furthermore, as noted above, there is limited research examining the association between nutrition knowledge and dietary attitudes and behaviors within developing countries. Consequently, as obesity rates rise across India and other developing nations, it is critical to explore the impact of various informational and social influences on preventative health behaviors.

Methods

Researchers collected data from the Madhya Pradesh viz. Sagar and Damoh districts of central India during summer and fall 2017. To recruit participants, a snowball sampling technique was employed. Within this approach, individuals initially selected for the sample are used as informants to find other individuals having necessary characteristics making them eligible for the sample.[51] First, subjects in a specific area were approached through referral of health providers. Subsequent participants from these areas were obtained through referrals from previous participants. In total, 166 individuals were recruited for the study. All participants noted having at least two chronic health conditions. All participants were surveyed at their residences in a homely environment in their local language and dialect (ie, Hindi and Bundeli), with ease for respondent given priority. Prior to the survey, participants' dyad status of chronic diseases was confirmed through documents of treatment. Subsequently, the participants completed a self-administered questionnaire that elicited information on demographic, psychographic, and other health-related information.

A total of 86.7% of the sample was from the Sagar district and 13.3% sample reported being from the Damoh district. In addition, 60.2% of participants identified as belonging to scheduled castes, 30.7% reported belonging to general castes, and 9% reported belonging to other backward caste. The average age of respondents was 51 years, with roughly 75% (74.7%) female and 25% (25.3%) male. Blood pressure/hypertension issues was the most frequently reported chronic condition, with roughly 88% (88.1%) of participants acknowledging this condition. This was followed by arthritis (53.0%), diabetes (25.3%), and obesity (12.7%).

Central study variables

Nutrition knowledge

To assess nutritional knowledge, we employed Brucks et al's[52] 3-item scale. Similar measures have been used in prior studies.[53-55] We used this subjective measure of nutritional knowledge given that many respondents may possess lower levels of knowledge and confidence in food nutrition issues and find it difficult to comprehend food and nutrition information.[55,56] Sample items included, "Please rate your knowledge of nutritional information compared to the average consumer" and "I feel confident about my ability to comprehend nutrition information on product labels." Participants responded to the first two items on a 7-point scale (1 = *extremely low*, 7 = *extremely high*) and the last question on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). Items were summed together then averaged to create the final scale (M = 2.48, SD = 1.68. The reliability for this scale was adequate (α = .85).

Food label use

Food label use was measured through 5 items on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A similar measure was used in previous studies.[54,57,58] Sample items include, "How often do you use labels when you buy a product for the first time?" and "How often you use labels in making decisions between two or more food products?" Items were summed and averaged to create the food label use measure (M = 1.60, SD = 1.24). The reliability for this scale was strong (α = .99).

Subjective norms

Subjective norms concerning food label use was measured via 4 items adapted from previous healthy eating research.[14,59] Sample items included, "Most people who are important to me think I should use food labels when shopping food" and "People who influence me encourage me to use food label." The 4 items were

summed and averaged to create the subjective norms measure (M = 1.50, SD = 0.77). The reliability for this scale was acceptable (α = .89).

Social support

To measure social support, Reider's[60] 13-item Weight Management Support Inventory was used. This measure included the following response options: 1 = *never*, 2 = *one or two times a month*, 3 = *one time per week*, 4 = *several times per week*, and 5 = *daily*. Example items included, "Others tell me about the foods that I could try that are low in fat and calories." The average of these 13 items together formed the Social Support Scale. On average, participants reported receiving social support below the scale midpoint, (M = 1.95, SD = 0.64) or slightly less than one or two times a month. The reliability for this scale was strong (α = .88).

Food industry trust

Food industry trust was assessed through 5 items drawn from previous investigations.[39,61] Participants were asked to report their level of social trust in various institutions involved in the food industry. The institutions included food companies, scientists and researchers at universities, pharmaceutical companies, agricultural companies, and the government. Items were measured on a 1 (*no trust at all*) to 7 (*very high trust*) scale. The initial reliability analysis revealed somewhat inadequate consistency across items (α = .67). This analysis also indicated that scale consistency would improve substantially by removing the trust in government item. Consequently, that item was dropped from the scale. The resulting 4 items were summed together and then averaged to create the Food Industry Trust Scale (M = 5.43, SD = 0.96). The reliability for this scale was acceptable (α = .76).

Healthy eating behavior

To assess participants' healthy eating behavior, a 5-item measure modified from previous investigations was used.[62,63] Items were measured from 1 (*strongly disagree*) to 7 (*strongly agree*). Example items include, "I make conscious efforts to eat foods that are nutritious" and "I make conscious efforts to eat foods that keep me healthy." The 5 items were summed and averaged to create the Healthy Eating Behavior Scale (M = 3.20, SD = 1.72). The reliability for this scale was acceptable (α = .96).

Perceived risk

Perceived obesity risk was measured by 4 items modified from scales used by Cox et al[64] and Plotnikoff and Higginbotham.[65] The items assessed one's perceived personal risk of becoming obese as well as a comparative risk assessment with those in one's age group. Example items included, "Compared to the average person in my age group, my risk of becoming obese is" (1 = *extremely low* to 7 = *extremely high*) and "Because of my diet, I am worried about becoming obese in the future" (1 = *strongly disagree* to 7 = *strongly agree*). The average of these items together formed a Perceived Vulnerability Scale (M = 2.32, SD = 1.44). The reliability for this scale was strong (α = .91).

Control measures

A variety of demographic items were assessed as control measures. This included gender, age, weight, and education (measured from 1 = *no formal schooling* to 5 = *college/university*). In addition, given that a portion of this investigation involved the relationship between food label use and subjective norms—a concept drawn from TPB—two other concepts from this model were included as control measures. This included attitudes toward food labeling and food label self-efficacy. To measure participants' attitudes toward food label use, we adapted 3 items from Marietta et al.[66] Example items included, "The information on food label are accurate" and "The information on food label are truthful." Participants responded to the questions on a 7-point scale (1 = *extremely low* to 7 = *extremely high*). All items were summed together and averaged to create this measure (M = 3.93, SD = 1.61). Alpha reliability for this scale was strong (α = .96). Food label use self-efficacy was measured through 4 items adapted from previous research[67,68] on a 7-point scale (1 = *strongly disagree* to 7 = *strongly agree*). Sample items included, "I can use food labels in choice of food products one has never bought before" and "I can use food labels in decision between two or more food products." The average of these 4 items was taken to create the Food Label Self-efficacy Scale (M = 1.89, SD = 1.29). The scale exhibited strong reliability (α = .93).

Planned analyses

To formally explore the proposed relationships, hierarchical regression analysis was performed. These tests allow the researcher to examine the incremental variance explained by a set of predictor variables after accounting for the variance explained by other measures (ie, demographics, self-efficacy). All control measures were included in the first block followed by central study variables in block 2. All central study variables were mean-centered for subsequent interaction tests. Finally, the interaction terms were included

in block 3 of the hierarchical regression models. To decompose significant interactions, separate regressions were run at one standard deviation above and below the mean of the respective moderator variable of interest.[69]

Results

Preliminary analyses

Preliminary correlation tests were run to explore associations between the central study variables. With the exception of subjective norms and social support, significant associations were found between nutrition knowledge and all study variables (see Table 1).

Nutrition knowledge and food label use

The first set of predictions examined the relationship between nutrition knowledge and food label use. This included direct effects and the moderating impact of subjective norms. Preliminary correlation analyses indicated a significant positive relationship between nutrition knowledge and use ($r = 0.59$, $P < .01$; see Table 1). To formally explore this relationship, hierarchical regression analysis was performed. Food label self-efficacy, attitudes toward food labels, and demographic variables (age, gender, education, weight) were included as control measures in block 1. Block 2 included nutrition knowledge and subjective norms. Finally, the two interaction terms involving knowledge and subjective norms were added to block 3 of the hierarchical regression models. Results from the hierarchical regression analysis indicated that block 1 measures (ie, demographics, self-efficacy) explained significant variance in food label use, $R^2 = 0.76$, $F(6, 159) = 81.76$, $P < .01$. The inclusion of nutrition knowledge and subjective norms in block 2 led to significant incremental variance, $\Delta R^2 = .03$, $\Delta F(2, 157) = 11.46$, $P < .01$ (see Table 2). Examination of the individual beta coefficients showed that nutrition knowledge remained a significant, positive predictor of food label use ($\beta = 0.21$, $P < .01$). Of note, results from this block indicated that subjective norms were *negatively* associated with use ($\beta = -0.10$, $P < .05$), which contrasts with the significant, *positive* relationship found in preliminary correlation tests ($r = 0.30$, $P < .01$). It was revealed that this relationship was likely confounded by the strong relationship that subjective norms had with self-efficacy ($r = 0.45$, $P < .01$), one of the significant control measures in the regression model. Consequently, the researchers caution against drawing conclusions regarding any direct relationship between norms and food label use.

Block 3 of the regression analysis indicated a significant positive interaction found between nutrition knowledge and subjective norms, $\beta = 0.16$, $P < .05$; $\Delta R^2 = 0.02$, $\Delta F(1, 156) = 17.42$, $P < .01$.[a] Results showed that at high levels of subjective norms, nutrition knowledge was a significant, positive predictor of food label use ($\beta = 0.33$, $P < .01$), whereas at low levels of

Table 2. Main and moderator effects of nutrition knowledge and subjective norms as predictors of food label use.[a]

	β	SE	*t*
Model 1—Control measures			
Gender (male)	0.05	0.13	1.09
Age	0.01	<0.01	0.29
Education	0.10*	0.04	2.06
Weight	0.01	0.01	0.15
FLU efficacy	0.82**	0.04	18.13
FLU attitudes	0.02	0.04	0.37
	$R^2 = 0.75$		
	$F(6, 159) = 81.76$**		
Model 2—Predictors			
Nutrition knowledge	0.21**	0.04	4.15
FLU subjective norms	−0.10*	0.07	2.17
	$\Delta R^2 = 0.03$		
	$\Delta F(2, 157) = 11.46$**		
Model 3—Interaction terms			
Knowledge × Norms	0.16**	0.03	4.17
	$\Delta R^2 = 0.02$		
	$\Delta F(1, 156) = 17.42$**		

[a]FLU = food label use. Results reflect findings of hierarchical regression analysis. Regression coefficients are standardized.
*$P \leq .05$. **$P \leq .01$.

Table 1. Intercorrelations between central predictor and outcome variables.[a]

Variable	Nutrition knowledge	Food label use	Subjective norms	Social support	Food industry trust	Healthy eating behavior	Perceived obesity risk
1. Nutrition knowledge		0.59**	0.12	−0.12	0.37**	0.73**	−0.20*
2. Food label use			0.30**	−0.04	0.22**	0.43**	−0.08
3. Subjective norms				0.28**	<0.01	0.03	0.10
4. Social support					−0.19*	−0.18*	0.63**
5. Food industry trust						0.23**	−0.03
6. Healthy eating behavior							−0.09
7. Perceived obesity risk							

[a]The numbers reflect Pearson's *r* coefficients.
*$P < .05$. **$P < .01$.

subjective norms nutrition knowledge was only marginally associated with use (β = 0.09, P = .09). Figure 1 displays this interaction.

Nutrition knowledge and diet-related perceptions and behaviors

Additional analyses examined the nature of the relationship between nutrition knowledge and diet-related perceptions and behaviors. To explore these relationships, hierarchical regression analysis was again employed. Demographic variables (age, gender, education, weight) were included as control measures in block 1. Results from two hierarchical regression tests showed that control measures explained significant variance in both healthy eating behavior, R^2 = 0.23, F(4, 160) = 12.01, P < .01 (see Table 3), and perceived obesity risk, R^2 = 0.28, F(4, 161) = 15.46, P < .01 (see Table 4). Block 2 included nutrition knowledge, food label use, social support, and social trust. Block 3 included four interaction variables: Nutrition knowledge × Social support, Nutrition knowledge × Social trust, Food label use × Social support, and Food label use × Social trust. The findings for block 2 and block 3 are described below.

Mediating role of food label use

The following analyses examined whether food label use mediated the relationship between nutrition knowledge and dietary outcomes. The first mediation test examined healthy eating behavior as the outcome measure. Preliminary correlation analyses indicated that both nutrition knowledge (r = 0.73, P < .01) and food label use (r = 0.43, P < .01) were positively associated with healthy eating behavior. Follow-up hierarchical regression analysis showed that though nutrition knowledge remained a significant predictor of healthy eating behavior (β = 0.72, P < .01; see Table 3), food label use was no longer associated with this outcome (β = −0.02, P > .05). This indicates that food label use did not mediate the relationship between nutrition knowledge and healthy eating behavior. The second test examined perceived obesity risk as the outcome measure. Preliminary correlation tests showed that though nutrition knowledge was negatively associated with perceived obesity risk (r = −0.20, P < .05), food label use was not associated with this outcome. Overall, the findings indicate that food label use did not mediate the relationship between nutrition knowledge and perceived obesity risk. Furthermore, follow-up regression

Table 3. Main and moderator effects of nutrition knowledge and informational/social factors as predictors of healthy eating behavior.[a]

	β	SE	t
Model 1—Control measures			
Gender (male)	0.01	0.31	−0.09
Age	0.19*	0.01	2.58
Education	0.48**	0.08	6.33
Weight	0.02	0.64	0.28
	R^2 = 0.23		
	F(4, 160) = 12.01**		
Model 2—Predictors			
Nutrition knowledge	0.72**	0.08	9.40
Food label use	−0.02	0.09	−0.24
Social support	−0.05	0.16	−0.84
Food industry trust	−0.07	0.10	−1.21
	ΔR^2 = 0.34		
	ΔF(4, 156) = 30.62**		
Model 3—Interaction terms			
Knowledge × Support	−0.19**	0.09	−3.03
Knowledge × Trust	0.16**	0.06	2.60
	ΔR^2 = 0.05		
	ΔF(2, 154) = 9.26**		

[a]Results reflect findings of hierarchical regression analysis. Regression coefficients are standardized.
*P ≤ .05. **P ≤ .01.

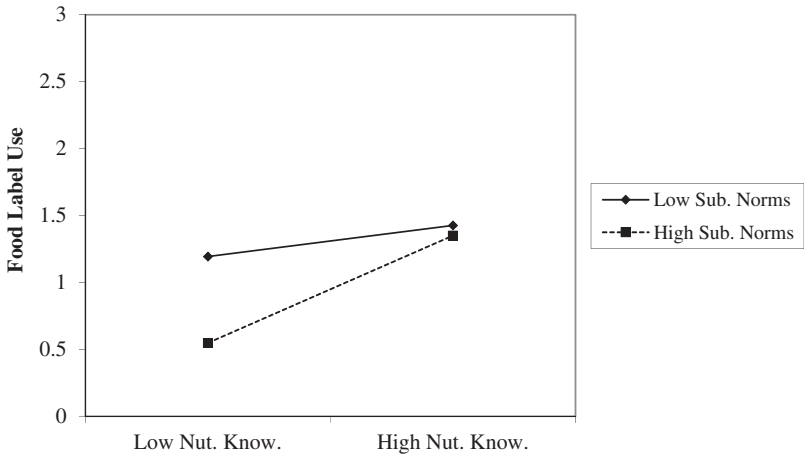

Figure 1. Moderator effect #1: How nutrition knowledge predicts food label use as a function of subjective norms, indicated by linear regression analysis.

Table 4. Main and moderator effects of nutrition knowledge and informational/social factors as predictors of perceived obesity risk.[a]

	β	SE	*t*
Model 1—Control measures			
Gender (male)	0.02	0.25	0.31
Age	−0.17*	0.01	−2.49
Education	−0.19**	0.07	−2.63
Weight	0.49**	0.01	7.01
	R^2 = 0.28		
	$F(4, 161)$ = 15.46**		
Model 2—Predictors			
Nutrition knowledge	−0.24**	0.07	−3.10
Food label use	<0.01	0.08	0.02
Social support	0.54**	0.14	8.91
Food industry trust	0.11	0.09	1.91
	ΔR^2 = 0.27		
	$\Delta F(4, 157)$ = 22.99**		
Model 3—Interaction terms			
Knowledge × Support	−0.21**	0.08	−3.25
Knowledge × Trust	−0.07	0.05	−1.02
	ΔR^2 = 0.03		
	$\Delta F(2, 155)$ = 5.47**		

[a]Results reflect findings of hierarchical regression analysis. Regression coefficients are standardized.
*$P \leq .05$. **$P \leq .01$.

analyses showed that nutrition knowledge remained a significant negative predictor of perceived obesity risk (β = −0.24, $P < .01$; see block 2, Table 4).

Moderating relationships

The following analyses examined social support and food industry trust as moderating variables. The first of these moderation analyses involved the impact of social support and food industry trust on the relationship between nutrition knowledge and healthy eating behavior. Results from block 2 of this analysis revealed that neither social support nor food industry trust were significantly associated with healthy eating behavior (see Table 3). Block 3 of this hierarchical regression analysis indicates that significant interactions emerged between nutrition knowledge and social support (β = −0.19, $P < .05$; see Table 3) as well as between nutrition knowledge and food industry trust (β = 0.16, $P = .01$; see Table 3). Subsequent tests to decompose interactions showed that at high levels of social support, nutrition knowledge was actually a *weaker* predictor of healthy eating behavior (β = 0.45, $P < .01$; see Figure 2) than at lower levels of social support (β = 0.78, $P < .01$; see Figure 2). Conversely, after decomposing the interaction between nutrition knowledge and food industry trust, results indicated that at high levels of trust, nutrition knowledge was a more powerful predictor of healthy eating behavior (β = 0.75, $P < .01$; see Figure 3) than at low levels of trust (β = 0.48, $P < .01$).

The second test examined the same interactions as predictors of perceived obesity risk. Preliminary findings from block 2 indicate that, in addition to nutrition knowledge, social support was significantly associated with perceived obesity risk (β = 0.54, $P < .01$). Block 3 of this hierarchical regression analysis indicates that a significant interaction only emerged between nutrition knowledge and social support (β = −0.21, $P < .01$; see block 3, Table 4). Follow-up tests indicated that at high levels of support, nutrition knowledge was a significant, negative predictor of perceived obesity risk (β = −0.48, $P < .01$, see Figure 4), whereas at low levels of support, nutrition knowledge was not significant associated with risk (β = −0.11, $P > .05$).

Exploratory analyses

Unexpectedly, food label use was not independently associated with diet-related perceptions and behaviors. Given that numerous interactions emerged between nutrition knowledge and social factors, identical

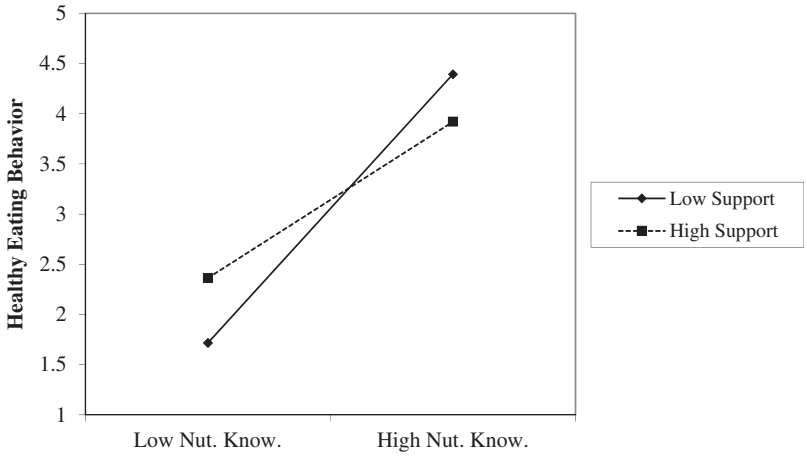

Figure 2. Moderating effect #2: How nutrition knowledge predicts healthy eating behavior as a function of social support, indicated by linear regression analysis.

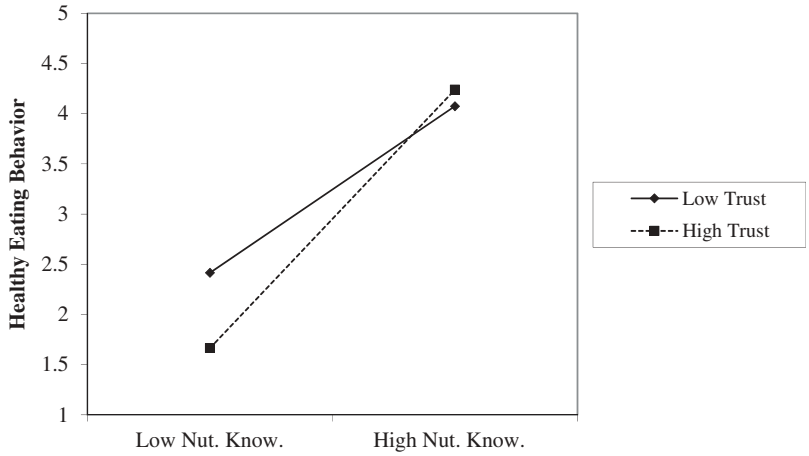

Figure 3. Moderating effect #3: How nutrition knowledge predicts healthy eating behavior as a function of food industry trust, indicated by linear regression analysis.

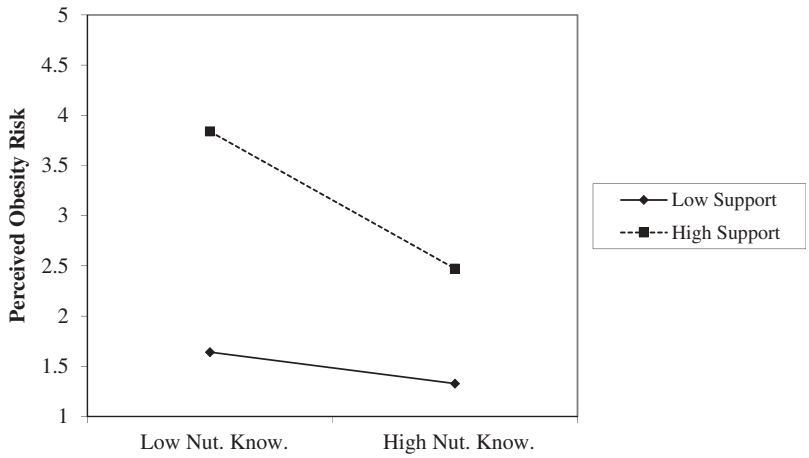

Figure 4. Moderating effect #4: How nutrition knowledge predicts perceived obesity risk as a function of social support, indicated by linear regression analysis.

investigations were performed to examine whether social support and food industry trust interacted with food label use to predict health outcomes. Results indicated that no significant interactions emerged between food label use and social support when predicting healthy eating behavior ($\beta = -0.06$, $P > .05$) or perceived obesity risk ($\beta = -0.03$, $P > .05$). Similarly, no significant interactions emerged between food label use and food industry trust in predicting either health outcome (for health eating behavior: $\beta = -0.14$, $P > .05$; for perceived obesity risk: $\beta = -0.14$, $P > .05$).

Discussion

This study addressed how social and informational factors impact the relationship between nutrition knowledge and diet-related perceptions and behaviors. These relationships were examined within a population of Indian adults with multiple chronic conditions. Prior investigations have primarily examined the link between nutrition knowledge and health outcomes within developed/Westernized nations. This investigation aimed to provide a more comprehensive understanding of the conditions upon which nutrition knowledge influences diet among a relatively understudied population with significant health needs. Overall, findings indicate that nutrition knowledge was a positive predictor of food label use—a key precursor to positive dietary outcomes. However, within this investigation, results indicated that knowledge was unrelated to food label use among participants reporting lower subjective norms. When addressing diet-related perceptions and behaviors, results showed that nutrition knowledge independently predicted higher levels of healthy eating behavior and lower levels of perceived obesity risk. In both instances, social factors

(social support and social trust) influenced the strength of these relationships. The following sections explore theoretical and practical implications for these findings, as well as highlight study limitations and areas for future research.

Theoretical implications

Nutrition knowledge and food label use

Prior researchers suggest that nutrition knowledge provides the cognitive resources to enable individuals to effectively utilize food labels.[3] Thus, individuals with greater nutrition knowledge are more likely to pay attention to and comprehend this information resource. Though the findings from this investigation provide additional support for these arguments, our results also highlight the importance of social influence. In particular, knowledge did not predict food label use among those reporting lower level of subjective norms. This suggests that a lack of certain social motivators may undermine the impact of cognitive skills on particular information-seeking behaviors. More specifically, cognitive skills alone may be insufficient to motivate individuals to utilize food labels. Prior persuasion research has stressed the importance of both motivation and ability to more critical information processing.[70,71] Drawing from this perspective, close others, whom one identifies with and may vicariously learn from,[18] may be critical to increasing the perceived relevance of food label use.

The findings also indicated that nutrition knowledge, but not food label use, predicted diet-related perceptions and behaviors. This counters the model proposed by Miller and Cassady[3] that predicted that increased food label use should partially mediate the relationship between knowledge and dietary outcomes. In contrast, the findings from this study suggest that nutrition knowledge could mediate the relationship between food label use and health outcomes. In particular, because nutrition labels are a valuable information resource, increased use may contribute to greater nutrition knowledge. In support of this assumption, Neuheuser et al[72] found that food label use was related to a variety of *beliefs* involving fat consumption, including the importance of following a low-fat diet and beliefs about the association between diet and cancer. Viewed this way, the broader relationship between nutrition knowledge and food label use may operate in a more bidirectional manner. First, pre-existing knowledge may act as a key motivating factor leading to food label use. Next, as a nutrition information resource, increased food label use may add to one's existing nutrition knowledge. Finally, greater overall knowledge resulting from food label use may influence healthier eating behavior. Overall, this bidirectional process may offer a clearer explanation how these factors operate together to predict diet-related outcomes.

The role of social factors on nutrition outcomes

When examining whether social support and social trust moderate the relationship between nutrition knowledge and diet-related perceptions and behaviors, the results are slightly unclear. First, among Indian adults placing greater trust in institutions producing food products, nutrition knowledge was a more powerful predictor of healthy eating behaviors. As adults from developing countries such as India gain access to a greater diversity of food options,[36] perceptions regarding the production/manufacturing of those products may prove critical to ultimate food choices. Though there is a lack of research examining the interrelationship between trust and knowledge, given these moderator effects, as well as the significant, positive correlation between knowledge and trust, it is evident that trust and knowledge may operate together to contribute to positive health outcomes.

A more ambiguous relationship existed between social support and nutrition knowledge. In particular, among Indian adults reporting higher levels of support, nutrition knowledge was a stronger predictor of lower perceived obesity risk but a *weaker* predictor of healthy eating behavior. Prior research has shown that support may contribute to negative health outcomes,[31,73] which suggests that nutritional guidance from others may not always be perceived as helpful. This may also provide explanation for the positive association found between support and perceived obesity risk. In particular, though close others (eg, family, friends) aim to motivate an individual to eat healthy, support from these individuals may also trigger greater perceived health risk. Although beyond the scope of the present investigation, these findings suggest that it is critical to identify whether certain components of social support are more or less effective for individuals managing weight concerns.

Limitations and areas for future research

There are several limitations of this investigation that may provide areas for future exploration. First, this study utilized a cross-sectional design. This indicates that we are unable to determine any causal relationship between nutrition knowledge and either food label use or diet-related perceptions and behaviors. As noted above, it is possible that bidirectional relationships exist between nutrition knowledge and food label use. Consequently, it is critical

for future investigators to tease apart what aspects of nutrition knowledge drive food label use and what aspects result from greater use. Second, the population examined in this project included individuals from only one developing country (India). This limits the ability to make generalizable claims to other developing nations. Future researchers should explore these relationships within nations with similar economic and public health concerns. Third, the individuals selected for this study reported having multiple chronic health conditions. It is probable that a contributing factor in many of these health concerns (eg, hypertension, diabetes) was poor diet/nutrition. Direct experiences with the consequences of poor diet may have made these individuals more health conscious. The findings from research on this population may not generalize to those not faced with multiple chronic conditions. Fourth, because individuals self-reported information, there may be issues regarding accuracy of reporting. Relatedly, the nature of various measures may include substantial subjectivity. For example, some of the healthy eating behavior measures broadly asked about one's experience with eating healthy without specifically assessing consumption of certain healthy foods (ie, fruits and vegetables). Finally, the study employed a non-probability, snowball sampling technique. Participants were not recruited at random but rather were recruited based on referrals by other participants. Therefore, it is unclear whether the population of participants with multiple chronic conditions in this study is representative of typical Indian adults dealing with numerous chronic health concerns.

Translation to Health Education Practice

Our study reaffirms the value of Health Education/nutrition education initiatives and, in particular, nutrition knowledge in contributing to food label use and a healthier diet among those faced with chronic health conditions. Furthermore, the results offer a clearer understanding of how social/informational factors contribute to diet-related perceptions and behaviors. More broadly, given the alarming rise in obesity rates within developing nations[43] such as India, researchers and the broader public health community must stress that individuals seek out the appropriate guidance of close others to (*a*) help promote greater interest and use of nutrition information resources and (*b*) motivate healthier eating behavior.

Based on these results, public Health Education interventions targeting developing nations should aim to maximize consumers' nutrition knowledge while identifying valued normative influences that can help encourage positive health action. Subjective norms may determine the strength of the relationship between nutrition knowledge and food label use, indicating that social factors can be central to motivating greater engagement in food selection. Health Educators should invest in broader coordinated efforts with individuals' close family/friends to ensure that nutrition information is reinforced and leads to positive dietary decisions. This could include group Health Education/nutrition education sessions with individuals and close others to emphasize both nutrition knowledge and the value of family and friends to encourage food label use. Subsequently, Health Education interventions should include assessments over time of how well close others offer nutrition guidance to the individual and the ultimate impact of normative factors combined with nutrition knowledge to motivate greater food label use.

The findings also suggest that diet-related social support may undermine the positive influence of nutrition knowledge on diet. Interventions that incorporate social influences (eg, family, friends) to strengthen the impact of nutrition knowledge on diet must be wary of how participants perceive/respond to guidance from close others. Regular evaluations of peer support must be integrated within these approaches.

Finally, our results highlight the importance of consumer trust in those institutions producing food products—particular among populations most at risk for diet-related health problems. Addressing this issue may require a multifaceted approach. First, at a societal level, local and national public Health Education initiatives may be needed to reinforce or, if necessary, change public perceptions regarding the food industry. Second, at the individual/intervention level, greater efforts must be made by Health Educators to address participants' skepticism toward food companies/manufacturers. Health Educators should seek to offer clearer guidance by both validating legitimate personal concerns and correcting any misjudgments held toward the food industry.

Note

a. Subsequent analyses were run to ensure that this confounding effect of efficacy on the relationship between norms and food label use did not impact the interaction results. Interaction results of regression analyses with and without efficacy in the model were consistent.

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