Communication

Factors influencing dietary supplement consumption: A case study in Chiang Mai, Thailand

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Abstract: A consumer survey on dietary supplement consumption was carried out on 494 consumers aged 20 years and older in Chiang Mai province. The percentage of consumers who regularly consumed dietary supplements was 38.5%. Vitamins and minerals were the most consumed products, followed by functional drinks, functional foods, protein extracts, dietary fibre, cod liver oil, phytochemicals, algae products, fat absorbers, fish oils and bee products in that order. Females and participants who had recommended waistlines, had higher income, usually felt stressed or sick, and who preferred eating fruits/vegetables or routinely drank water tended to have a higher rate of consumption of dietary supplements. Participants gave priority over a product with guaranteed quality when they made decision to purchase dietary supplements, but their purchase was also influenced by the attractiveness of the product and advertisement for it.

Key words: dietary supplement, consumption of dietary supplements, consumer survey

INTRODUCTION

Good health is what many consumers desire. The cost of health care is continuing to rise and as a consequence consumers are more and more interested in their health and in seeking alternative forms of medicine [1-3]. This trend is reflected in an increase in dietary supplement and herbal product consumption [4]. International sales of dietary supplements were forecasted to reach USD 24.22 billion in 2011 and USD 29.75 billion by 2015 [5]. Dietary supplement sales in Thailand in 2011 were estimated at 27,000 million Baht with a 10-12% annual rate of growth [6]. About 80% of the products are marketed through the method of direct sale [7].

Dietary supplement consumption may be associated with demographic factors [8-9], health-related characteristics [8-10], psychological factors [11] and an incidence of disease [12]. The prevalence of dietary supplement consumption varies with any given population, the definition of supplements, the definition of what constitutes regular supplement usage [3], the time period of the survey and the changing demographics in the period [13]. Those who are female, have an education beyond high school, earn higher levels of income, are older, are self-employed, have a lower body mass index, participate in physical activities, consume greater fruits and/or vegetables, eat less fat, take less prepared foods, like to eat out, have higher stress levels, are a non-smoker, and consume moderate or no amount of alcohol tend to be faithful users of supplements [8-10] though not in all cases [3]. In addition, although supplement users tend to be more educated, no correlation is found between supplement consumption and nutritional knowledge [13].

In Thailand, dietary supplement products are controlled by the Notifications of Ministry of Public Health No. 293 [14] and No. 309 [15]. They are defined as products that are taken or consumed in addition to conventional foods, and which contain nutrients or other substances as ingredients and are in the forms of tablet, capsule, powder, flake, liquid or others, but which are not considered conventional foods, being for consumers who expect benefits of health promotion [14]. Moreover, there must be clear wording on the product label stating that 'individuals should regularly take a varied diet that includes the 5 essential nutrients in appropriate portions' and that 'there is no guarantee of the prevention or cure of diseases' [15].

Since most dietary supplement products in Thailand are marketed by direct sales, the most important factor influencing dietary supplement consumption is the direct selling strategy, especially face-to-face selling and network marketing [16]. Face-to-face selling allows the salespeople to build a relationship with the customers, earn their trust, judge their response and tailor their sales pitch to suit each individual customer [17]. Network marketing lets the salespeople persuade customers into becoming their downstream agents, who will be awarded with bonuses according to the number of people in their own downstream and the sale performance of their entire network [18].

The purpose of this survey-based study is to identify consumer characteristics which are associated with dietary supplement consumption and also the factors influencing the purchase of dietary supplements by consumers who are aged 20 years or older in Chiang Mai, using some multivariate statistics, namely binary logistic regression, principal component analysis and discriminant analysis.

MATERIALS AND METHODS

Participants and Survey Instrument

The participants consisted of adults aged 20 years or older residing in Chiang Mai province. They were divided into 4 age groups: 20-29, 30-39, 40-49 and 50 years or older, and each age group contained at least 50 males and 50 females.

A questionnaire was designed to collect data on demographics, dietary supplement consumption, behaviour related to health and factors influencing dietary supplement purchase. A pretest was conducted using 12 volunteers to evaluate the clarity of the survey queries. The improved questionnaire and 8 trained interviewers were used to collect data from 494 participants between July-August 2011.

Statistical Analysis

Collected data were first analysed by descriptive statistics including frequency, percentage, mean and standard deviation. Some multivariate statistics were also used. Binary logistic regression was used to identify demographic factors associated with dietary supplement consumption. Principal component analysis was employed to group behaviour related to health and factors influencing dietary supplement purchasing. Differentiation of users and non-users of dietary supplements was made by discriminant analysis using the same behaviours and factors. All analysis was done by SPSS 16.0 Family.

RESULTS AND DISCUSSION

According to the survey on the participants' demographics and data on dietary supplement use (Table 1), almost 40% of the participants had a higher body mass index than is considered appropriate (18.5-22.9 kg/m^2) and about 30% of them had longer waistlines than the recommended values ($\leq$ 90 cm for males and $\leq$ 80 cm for females). These results agree with a report of the Bureau of Policy and Strategy, Office of the Permanent Secretary, which states that 1 in 3 people have a risk of visceral obesity [19]. Its concern is related to the fact that excess abdominal fat is associated with chronic non-communicable diseases such as diabetes, hypertension, vascular and heart diseases, and cancer. In this survey, hypertension was found to be the most common congenital disease.

In this survey 38.5% of the participants reported that they regularly consumed dietary supplements. In two previous surveys that were conducted in 2008, a year well within the period of the Thai economic crisis [20], the first, conducted in Nakhon Ratchasima, reported that only 14.2% of the participants, including those under 20 years old, consumed dietary supplements [21]. The second study was an online survey which showed that 66% of the Thai participants consumed dietary supplements [22], although there were only 34.6% of participants in this study who used the internet, and most of them were aged between 20-29 (51.8%) and 30-39 (24.7%) and held a Bachelor's degree or higher (86.5%). The differences between the three surveys can probably be attributed to differences in the participants who were recruited for the respective studies, if the period of time between studies is neglected.

In this study, about 80% of dietary supplement users purchased products for themselves with an average monthly purchase of 1,046.8 Baht. Vitamins and minerals were the most consumed dietary supplements, which matches the study in Nakon Ratchasima [21]. The following items were found to be the next most commonly consumed dietary supplements: functional drinks, functional foods, protein extracts, dietary fibre, cod liver oil, phytochemicals, algae products, fat absorbers, fish oils and bee products in that order. The reasons given by non-users for not consuming dietary supplements were: the products are unnecessary and have a high price tag; the claims (benefits) made for the products are incredible and thus undesirable; the products are not palatable; and the products are not in an interesting form.

Table 1. Abridged characteristics and dietary supplement consumption of consumers

Characteristic	Description	Frequency	Per cent
Gender	Male	246	49.8
	Female	248	50.2
Age (years)	20 - 29	131	26.5
	30 - 39	123	24.9
	40 - 49	120	24.3
	50 and over	120	24.3
Marital status	Single	231	46.8
	Married	258	52.2
	Others	5	1.0
Body mass index (kg/m^2)	18.5 or less	63	12.8
	18.5 - 22.9	235	47.6
	23.0 - 24.9	70	14.2
	25.0 - 29.9	105	21.3
	30 or more	21	4.3
Waistline (cm)	Male $\leq$ 90, Female $\leq$ 80	343	69.4
	Male > 90, Female > 80	151	30.6
Education	Primary education	82	16.6
	Secondary education	87	17.6
	Diploma / certificate	49	9.9
	Bachelor degree	239	48.4
	Master degree or higher	31	6.3
	Others	6	1.2
Monthly income (Baht)	5,000 or less	110	22.3
	5,001 - 10,000	197	39.9
	10,001 - 15,000	85	17.2
	15,001 - 20,000	49	9.9
	20,001 or more	53	10.7
Congenital disease	Yes	104	21.1
	No	327	66.2
	Do not know	63	12.7
Congenital disease list (per cent based on 104)	Hypertension	38	36.5
	Allergy	26	25
	Gastrointestinal problem	20	19.2
	Diabetes	17	16.3
	Respiratory problem	8	7.7
	Coronary heart disease	5	4.8
	Others	6	5.8

Table 1. (continued)

Characteristic	Description	Frequency	Per cent
Dietary supplement consumption	Yes	190	38.5
	No	304	61.5
Dietary supplement list (per cent based on 190)	Vitamins and minerals	78	41.1
	Functional drinks	62	32.6
	Functional foods	56	29.5
	Protein extracts	41	21.6
	Dietary fibre	35	18.4
	Cod liver oil	34	17.9
	Phytochemicals	30	15.8
	Algae products	20	10.5
	Fat absorbers	18	9.5
	Fish oil	18	9.5
	Bee products	12	6.3
Dietary supplement purchase by oneself (per cent based on 190)	Yes	155	81.6
	No	35	18.4
Monthly purchase of dietary supplement (Baht) (per cent based on 155) Mean = 1,046.8	500 or less	60	38.7
	501 - 1,000	40	25.8
	1,001 - 1,500	25	16.1
	1,501 - 2,000	19	12.3
	2,001 - 3,000	5	3.2
	3,001 or more	6	3.9
Reasons for not consuming dietary supplement (per cent based on 304)	Not necessary	127	41.8
	High price	86	28.3
	Undesirable product	63	20.7
	Incredible health benefit	55	18.1
	Unpalatable	26	8.6
	Uninteresting product form	22	7.2

In binary logistic regression, dietary supplement consumption is used as dependent variable and demographic factors (gender, age, marital status, body mass index, waistline, education, monthly income and congenital disease) are used as independent predictors. Gender, waistline and income are found to be significantly different ($p \leq 0.10$). Females, participants who have recommended waistline and

those with higher income tend to have higher consumption of dietary supplements as shown by the odds ratios in Table 2. The odds ratio is a way of determining whether the probability of a certain event is the same for two groups, i.e. reference and compared groups. An odds ratio of 1 implies that the event is equally likely in both groups, while an odds ratio greater than one implies that the event is more likely in the reference group, and an odds ratio less than one implies that the event is less likely in the reference group [23].

Table 2. Demographic factors associated with dietary supplement consumption (n = 494)

Factor	Odds ratio[*]	95% Confident interval	P value
Gender			0.000
Male	1.00		
Female	1.95	1.35 – 2.82	
Waistline (cm)			0.096
Male < 90, Female < 80	1.41	0.94 – 2.11	
Male > 90, Female > 80	1.00		
Monthly income (Baht)			0.026
5,000 or less	1.00		
5,001 - 10,000	1.62	0.97 – 2.71	
10,001 - 15,000	2.15	1.17 – 3.93	
15,001 - 20,000	3.08	1.52 – 6.23	
20,001 or more	3.31	1.45 – 7.55	

[*] Odds ratio greater than one implies that the consumption is more likely in the reference group (1.00)

Consumer behaviours related to health are expressed in Table 3 and are analysed by principal component analysis. Twelve measurements of behaviour can be reduced to 5 independent principal components (PCs) that explain 60.0% of the variance. The numbers in each PC column in Table 3 are the PC loadings, i.e. the regression correlations between behaviour and PC, and they are used together with the participants' data to compute the PC score of each participant [24]. Thus, 3 meals a day, exercise and sport, sufficient sleep and annual health checkup are all highly related to PC1. Feeling stressed and being sick are highly related to PC2. Consumption of fruits/vegetables and drinking of water are highly related to PC3. Drinking of alcoholic beverages and smoking are highly related to PC4, and consumption of spicy and instant or processed foods are highly related to PC5. Since all high factor loadings are positive numbers, this means that participants have the same pattern for all forms of behaviour which are highly related to each PC. For example, participants who have 3 meals a day tend to get exercise or play sports, have sufficient sleep and have annual health checkup (PC1).

To differentiate users and non-users of dietary supplements, the PC scores of all participants are used as independent predictors and the dietary supplement consumption is used as dependent variable in the discriminant analysis. A significant discriminant function ($p \leq 0.05$) for predicting dietary supplement consumption of the participants with 59.7% of correct classification is found and the mean scores of users and non-users are 0.272 and -0.173 respectively. The following equation is the discriminant function:

Discriminant score = $0.007 - 0.085 \, PC1 + 0.748 \, PC2 + 0.626 \, PC3 - 0.134 \, PC4 - 0.267 \, PC5$

Table 3. Consumer self-rating on their own behaviours related to health and the results of grouping by principal component analysis (n = 494)

Behaviour	Mean[a] ± S.D.	PC1[b] (13.9%)	PC2[b] (11.9%)	PC3[b] (11.8%)	PC4[b] (11.3%)	PC5[b] (11.1%)
Have 3 meals a day (breakfast, lunch, dinner)	3.77±1.07	0.663	-0.190	-0.116	-0.047	0.308
Prefer spicy foods	3.16±1.08	-0.147	-0.022	0.165	0.193	0.759
Prefer instant or processed foods	2.57±0.93	0.015	0.313	0.042	0.006	0.676
Prefer fruits/vegetables	3.80±0.91	0.147	0.108	0.798	-0.127	0.105
Prefer drinking water to other drinks	3.75±0.97	0.252	-0.163	0.748	-0.026	0.015
Drink alcoholic beverage	2.30±1.12	-0.057	0.136	0.051	0.844	0.039
Smoke	1.53±1.02	0.115	0.014	-0.024	0.790	-0.019
Get exercise and play sport	2.74±0.97	0.593	0.194	0.199	0.077	-0.120
Have sufficient sleep	3.37±0.90	0.703	-0.094	0.226	0.108	0.079
Feel stressed	2.90±1.00	-0.124	0.789	0.144	0.152	0.114
Be sick	2.31±0.85	0.189	0.784	-0.204	0.019	0.082
Have annual health checkup	2.40±1.21	0.554	0.259	0.290	-0.154	-0.083

[a] 5 = very much or always, 4 = much, 3 = moderate, 2 = little, 1 = very little or never
[b] Numbers in each PC column are the correlation coefficients between behaviours and PCs; each PC accounts
for its strong correlated behaviours ($> |0.5|$), and the PC percentage is the explained variance
(13.9+11.9+11.8+11.3+11.1 = 60%).

Since good predictors tend to have a large discriminant coefficient [25], PC2 and PC3 may be considered good predictors. This means that behaviours which are highly related to PC2 and PC3 may also be considered as good predictors. Thus, participants who feel stressed and are sick and who prefer fruits/vegetables and drinking of water tend to be users of dietary supplements. Correctly classified cases for this discriminant function are found to be only 59.7%, because there are other factors that influence dietary supplement consumption, such as demographic characteristics, some of which are found in the binary logistic regression.

Factors influencing dietary supplement purchasing in Table 4 are analysed by principal component analysis. Ten factors are reduced to 2 independent PCs, which explain 58.3% of the variance and PC loadings for each original factor are shown in Table 4. Health benefits of product, Thai FDA sign, well-known manufacturer/brand, type and quantity of active ingredients and supporting research are highly related to PC1, while attractive advertising, attractive product/packaging, palatability, and ease of consuming and carrying are highly related to PC2. Thus, PC1 represents guarantee of product quality and PC2 represents product attractiveness and advertising. From this analysis, it seems that price is less correlated with dietary supplement purchasing than product quality and product attractiveness and advertising. Acceptable price might be a variable of many factors since it was not highly related with any PC by principal component analysis [24].

Table 4. Factors influencing dietary supplement purchase and results of grouping by principal component analysis (n = 494)

Factor	Mean[a] ± S.D.	PC1[b] (30.7%)	PC2[b] (27.6%)
Health benefits of product	4.01±0.87	0.859	0.070
Thai FDA sign	4.17±0.85	0.841	0.083
Well-known manufacturer/brand	3.84±0.93	0.599	0.427
Attractive advertising	3.41±0.94	0.192	0.724
Attractive product/packaging	3.41±0.91	0.133	0.793
Palatability	3.40±1.04	0.151	0.719
Ease of consuming and carrying	3.61±0.97	0.309	0.690
Type and quantity of active ingredients	3.96±0.96	0.723	0.377
Supporting research	3.89±0.92	0.656	0.403
Price	3.67±0.97	0.372	0.349

[a] 5 = extremely important, 4 = very important, 3 = moderately important, 2 = slightly important, 1 = not important

[b] Numbers in each PC column are the correlation coefficients between factors and PCs; each PC accounts for its strong correlating factors (> |0.5|), and the PC percentage is the explained variance (30.7+27.6 = 58.3%).

In the discriminant analysis the PC scores for all participants computed from PC loadings in Table 4 are used as independent predictors and dietary supplement consumption is used as dependent variable. A non-significant discriminant function ($p > 0.05$) for predicting dietary supplement consumption of the participants is found and the mean scores of users and non-users are 0.089 and -0.057 respectively. This result means that there is no significant difference between users and non-users regarding factors influencing dietary supplement purchase. This discriminant function is expressed by the following equation:

Discriminant score = -0.003 + 0.882 PC1 + 0.470 PC2

Although this discriminant analysis cannot distinguish between dietary supplement users and non-users, the large discriminant coefficients for both PCs show that both the product quality and product attractiveness can be good predictors, although the weight of the former is greater. This means that participants concentrate on the quality of dietary supplement rather than its attractiveness. As with previous studies of Bower et al. [26], Walker et al. [27] and Khongjeamsiri et al. [28], the purchase intention of functional foods significantly increases ($p \leq 0.05$) when consumers become aware of special health benefits of the products. However, consumer awareness could come from the advertisement for a product or from other sources without a scientific proof. In addition, the Thai FDA logo, which is used to guarantee the quality and safety of a product [29], could make some consumers believe in its health benefits. Kim et al. [13] showed that there was no correlation between dietary supplement consumption

and nutritional knowledge, and Aungapipatra et al. reported that there were misunderstandings regarding dietary supplement products [21].

CONCLUSIONS

From this survey, 30-40% of the participants aged 20 years or older could be considered overweight with excess abdominal fat indicated by the waistline and body mass index, and 38.5% of the participants consumed dietary supplements. Multivariate statistics can provide more and easier-to-understand information on consumers considered to be dietary supplement users and on the factors influencing their dietary supplement purchase. The following have been shown to be the characteristics of dietary supplement consumers: being female, people with recommended waistlines and those who have higher income, while their behaviours include feeling stress or sick, routinely taking fruits/vegetables or routinely drinking water. In making decision to purchase dietary supplements, consumers concentrate on product quality rather than attractiveness and advertisement, whilst an acceptable price of product seems to be influenced by many factors.

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