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Consumption Patterns and Perception on Intake of Drinking Water in Klang Valley, Malaysia

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Abstract: This study aims to report on drinking water consumption patterns and perception on usage of drinking water available in Klang Valley, Malaysia. A total of 225 adults aged 21-65 completed the questionnaire which consists of three sections. Socio-demographic data, drinking water consumption patterns were determined. Perceptions were based on the quality and price as well as reasons for intake of tap, bottled drinking water and bottled mineral water. About 79% of the subjects drank 5 to 12 glasses of water a day. Among the subjects, 73%, 14.8% and 11.9% consumed tap water, bottled mineral water and bottled drinking water, respectively. The reasons for consuming bottled water include safety, health, quality and taste. The results also showed that the subjects perceived low to acceptable qualities for tap water, while bottled drinking water and mineral were perceived as having relatively higher quality. Tap water was considered cheap in price by all subjects, while bottled drinking and mineral waters were rated acceptable to high by most subjects. Findings of this study exemplify the importance of consumers' perception on drinking water as a mean of education and communication on quality of drinking water they consume.

Key words: Consumption pattern, drinking water, perception, price, quality

INTRODUCTION

Water is an essential element in maintaining life and needed for the survival of all organisms. It is abundantly available in this world as about 70% of water covers the earth's surface. Drinking water is crucial for the population in any parts of the world as living without proper water supply. Drinking water must be clean, free from any impurities and drinkable without any side effects (Gadgil, 1998). Tap water from ground water, river, sea or lake is the examples of drinking water available for human consumption and usage.

Drinking water is also called portable water. The quality of drinking water is important as contamination of water supply is common (Gadgil, 1998; Clasen and Bastable, 2003). Quality drinking water must be safe for consumption without causing any harm. Quality drinking water (also called safe drinking water) is generally obtained from various sources, which has undergone water treatment and filtration processes (Betancourt and Rose, 2004). Municipal tap water is the drinking water in most towns and cities, which is delivered by domestic water systems. In Malaysia, the quality of tap water is extensively monitored by several local authorities. For example, "Syarikat Bekalan Air Selangor" (Syabas) is a private company that responsible for the monitoring and supplying of portable water to residents in Selangor.

In Malaysia, commercial drinking water is more preferable by consumers beside tap water. All commercial drinking water should comply with Food Regulations 1985 and Food Act 1983 (Legal Research Board, 2008) to ensure their quality and safety. The control of quality and safety of commercial drinking water is under the Regulation 360A for Natural Mineral Water and Regulation 360B for Packaged Drinking Water. Regulation 360A (1) of the Food Regulations 1985 stated that natural mineral water is ground water obtained for human consumption from various sources, while Regulation 360B (1) of the same regulation define packaged drinking water (which includes reverse osmosis water) as treated potable water that is filled in bottles or other packages for the purpose of human consumption.

Generally, the intake of drinking water is high among Malaysian as Norimah et al. (2008) have reported Malaysian adults have consume a mean frequency of 5.8 times (240 ml). However, the source of plain water is not known. The importance of plain water intake is related to the function of water as physiological fluids. In the present study, we aimed to investigate the consumption and perception of consumers related to tap and commercial drinking water available in Malaysia, specifically in Klang Valley areas. Klang Valley was chosen as it includes major cities and towns with average household income of >RM1500 that is considered high (Safiah et al., 2008).

This information is important as it may reveal public understanding on the quality of drinking water they consumed everyday. Besides, this will provide points for public health authorities in ensuring high quality of drinking water available to consumers.

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MATERIALS AND METHODS

Subjects: This cross-sectional study was carried out in Klang Valley (Kuala Lumpur, Klang, Petaling Jaya, Shah Alam, Kajang, Bangi and Putrajaya) involving a total of 225 subjects (102 male and 123 female) of age ranging from 21 to 65 year old. The survey was conducted in May to June 2009. Stratified sampling method was used in subject selection, where subjects were randomly selected from the identified locations in the towns and cities of Klang Valley.

Data collection was carried out based on the identified locations, where well-trained enumerators approached any potential subjects and requested for an interview. Subjects were recruited from shopping streets, supermarkets, restaurants or public areas of the cities. Agreement was obtained and subjects were asked to answer the designated questions. Some approached subjects refused to be interviewed and were not considered in the data. The non-response rate was ~30%.

All subjects were interviewed using a semi-structured questionnaire and were asked to answer 18 questions regarding their status of water consumption and perception on usage of drinking water. The questionnaire also consisted of 6 items on socio-demographic characteristics, such as age, ethnic, education level, income and residential type.

Questionnaire: Whole day water consumption was evaluated by recall method on the type and amount of water intake. The breakdowns of water intake during main meals and in between meals were reported following specified time of a day. The perception on usage of drinking water was determined based on quality and price of tap water, bottled drinking water and bottled mineral water.

A 5-point Likert-type model (Muraki, 1990) was used to determine the scoring for the perception on usage of drinking water, ranging from '1 = worst quality' to '5 = best quality'. While for perception on drinking water prices ranged from '1 = very cheap' to '5 = very expensive'. Scores on items contributing to each scale were computed by averaging the points. An average score of 5 was considered 'best quality' or 'very expensive', while an average score of 1 was considered 'worst quality' or 'very cheap'. The questionnaire has Cronbach's α score of 0.71 and is categorized as reliable. Besides, descriptive statistics were used on drinking water consumption pattern data.

Data analysis: Descriptive statistics were used on safe drinking water consumption data, while the perception scores for quality and price of tap water, bottled drinking water and bottled mineral water were presented as mean perception scores for the subjects based on gender, age group, ethnicity, education level, income group and residential. Data were also statistically analyzed by applying t-test and Analysis of Variance (ANOVA). ANOVA test was coupled with Bonferroni's multiple comparison and significant value was set at p = 0.05. Statistical Package for Social Sciences® (SPSS) version 15.0 was used for the purpose of analysis.

Table 1: Socio-demographic characteristics of the subjects by sex

Socio-demographic characteristics	Men (n = 102)	Women (n = 123)	Total (n = 225)
		Number (%)	
Age (year old)			
21-30	57 (55.9)	101 (82.1)	158 (70.2)
31-40	25 (24.5)	15 (12.2)	40 (17.8)
41-50	12 (11.8)	6 (4.9)	18 (8.0)
>50	8 (7.8)	1 (0.8)	9 (4.0)
Ethnic			
Malay	91 (89.2)	80 (65.0)	171 (76.0)
Chinese	8 (7.8)	35 (28.5)	43 (19.1)
Indian	3 (2.9)	3 (2.4)	6 (2.7)
Other	0 (0.0)	5 (4.1)	5 (2.2)
Education level			
Primary	1 (1.0)	0 (0.0)	1 (0.4)
Lower secondary	1 (1.0)	2 (1.6)	3 (1.3)
Upper secondary	18 (17.6)	9 (7.3)	27 (12.0)
Higher certificate/Diploma	19 (18.6)	11 (9.0)	30 (13.3)
First degree	58 (56.9)	87 (70.7)	145 (64.5)
Master degree	4 (3.9)	13 (10.6)	17 (7.6)
Other	1 (1.0)	1 (0.8)	2 (0.9)
Income (RM)			
≤1000	44 (43.2)	88 (71.5)	132 (58.7)
1001-3000	42 (41.2)	30 (24.4)	72 (32.0)
3001-5000	10 (9.8)	5 (4.1)	15 (6.7)
5001-7000	3 (2.9)	0 (0.0)	3 (1.3)
>7000	3 (2.9)	0 (0.0)	3 (1.3)
Residential			
Village	4 (3.9)	12 (9.8)	16 (7.1)
Town	14 (13.7)	13 (10.6)	27 (12.0)
City	50 (49.0)	73 (59.3)	123 (54.7)
Big city	32 (31.4)	23 (18.7)	55 (24.4)
Other	2 (2.0)	2 (1.6)	4 (1.8)

RESULTS AND DISCUSSION

The majority of subjects participated in this study were from age group of 21-30 years old (70%). A total of 102 male and 123 female subjects were interviewed. Majority of the subjects Malay (76%) of the total subjects (Table 1), while college and university graduates made up around 85% of the total subjects. Around 60% of low income subjects were recruited and high participation rate (~93%) from town to city folks were included. A high over-sampling of income less than RM 3000 (90.6%) compared to >RM 3000 per month of household income occurred. More than 90% of subjects were residential of town, city and big city. The intake of plain water by subjects is shown in Table 2. The results show that 79% of the subjects drank 5 to 12 glasses of water. Among the subjects interviewed, 73%, 14.8% and 11.9% of the subjects have consumed tap water, bottled mineral water and bottled drinking water, respectively.

Table 2: Intake of plain water among subjects

Amount of water drank	Number of subjects	%
<3 glasses	11.0	4.9
3-4 glasses	24.0	10.7
5-6 glasses	61.0	27.1
7-8 glasses	59.0	26.2
9-10 glasses	39.0	17.3
11-12 glasses	19.0	8.5
>12 glasses	12.0	5.3
Total	225.0	100.0
Source		
Tap water	165.0	73.3
Municipal water		
Mineral water	33.3	14.8
Brands (29)		
Reverse osmosis water	26.7	11.9
Brands (28)		
Total	225.0	100.0

Table 3: Frequency of beverages and plain water intake by subjects daily

Time (24 h)	Amount (glass) (250 ml)	No. of subjects	
		Plain water	Beverages
0400-0600	0	61	180
	<2	153	43
	2-4	10	2
	>4	1	0
0700-0900	0	134	56
(Breakfast)	<2	84	166
	2-4	7	3
0900-1100	0	57	190
	<2	105	25
	2-4	62	10
	>4	1	0
1100-1300	0	45	150
(Lunch)	<2	133	71
	2-4	47	4
1300-1500	0	67	188
	<2	116	35
	2-4	42	2
1500-1700	0	127	126
	<2	90	94
	2-4	8	5
1700-1900	0	70	195
(Dinner)	<2	123	30
	2-4	32	0
1900-2100	0	43	169
	<2	138	50
	2-4	44	6
2100-2300	0	51	199
(Supper)	<2	160	23
	2-4	13	3
	>4	1	0

Beverages include coffees (white coffee, black coffee and instant coffee), teas (include milk tea), malt drinks, hot chocolates (instant cocoa beverage, etc.), syrups, "the tarik", milk and soy drinks. Plain water includes home boiled water, home filtered water, commercial drinking and mineral waters

Daily consumption pattern of drinking water and other beverages: The patterns of drinking water consumption by the subjects daily are shown in Table 3. Early in the morning before 6 am, most of the subjects take one or two glass (es) of plain water. For breakfast (0700-0900), more subjects (74%) tend to have other beverages instead of drinking plain water (37%). However, there was one subject who reported intake of more than four cups of plain water after waking up from bed, morning tea and supper. Besides, more than 70% of the subjects prefer taking plain water than other beverages during lunch (1300-1500), dinner (1900-2100) and supper (2100-2300).

Generally, 84.4% of the subjects are health conscious where they reported between 5-19 glasses (250 ml per glass) of plain water daily (Table 2). However, about 80% of subjects have 4-12 glasses of plain water intake daily. Following Malaysian Dietary Guidelines (2010), 6-8 glasses of water is considered optimum to maintain health. Based on this suggestion, only 38% of subjects were close to the recommendation; while 30% take less than 6 glasses per day and a balance of 32% take more than 8 glasses per day. The plain water was obtained either from boiled tap water or bottled drinking and mineral waters.

The patterns of bottled drinking water and mineral water intake were evaluated based on the amount of water consumed daily. The results showed that 57% and 38% of the subjects do not drink bottled drinking water and mineral water daily, respectively (data not shown). About 23% and 40% of subjects reported intake of one liter and lesser amounts of bottled drinking water and mineral water daily, respectively. However, about 9% of the subjects reported to drink bottled drinking water of more than two liters per day, while 12% of them consumed more than two liters of bottled mineral water daily. A study by Jones *et al.* (2007) revealed that daily bottled water intake of Canadians ranged from one-half to twenty-eight 250 ml servings, with a median value of five 250 ml servings. Compared to the bottled water consumption in the present study, the frequency of bottled water consumption is very low.

Perception on quality and price of drinking water: Plain drinking water is available in the form of home boiled plain water. Quality, price and type of drinking water can influenced the consumption pattern of people around the world (Doria, 2006). The quality of drinking water can be measured based on the price. A study by Zeithaml (1988) revealed that product quality is best measured by price, where product price is the extrinsic attribute for the quality. Besides, Malaysians can afford to purchase natural and clean drinking water for consumption to maintain good and lower the risk of water-borne diseases (Ferrier, 2001).

ANOVA test showed that the perception scores of the interviewed subjects on tap water quality were significantly different (p<0.05) among the subjects from different age and income groups, while the scores for mineral water quality were significantly different (p<0.05)

Table 4: Mean score of perception on quality (A) and price (B) of drinking water available in Malaysia

Mean scores	Tap water		Bottled drinking water		Bottled mineral water	
	A	B	A	B	A	B
Sex						
Male	2.6	2.8	3.8	3.1	4.1[a]	3.7[a]
Female	2.8	2.7	3.6	3.2	3.8[a]	3.3[a]
Age (year old)						
21-30	2.8[a]	2.7	3.7	3.3	3.9	3.5
31-40	2.3[a]	2.9	3.6	3.3	4.0	3.5
41-50	2.5	2.9	3.5	3.2	3.9	3.3
>50	2.8	2.7	3.9	3.2	3.9	3.4
Ethnicity						
Malay	2.7	2.8	3.7[a]	3.3	4.0[a]	3.4
Chinese	2.6	2.7	3.3[a,b]	3.3	3.5[a,b]	3.6
Indian	2.8	2.7	4.3[b]	3.5	4.3[b]	3.3
Other	2.6	3.2	4.0	3.2	3.8	3.6
Education level						
Primary	4.0	3.0	3.0	3.0	3.0	3.0
Lower secondary	2.3	3.0	3.3	3.0	3.7	2.7
Upper secondary	2.8	3.2	3.7	3.3	3.9	3.3
Higher certificate/Diploma	2.4	2.7	3.7	3.4[a]	3.9	3.7
First degree	2.8	2.7	3.7	3.3[b]	4.0	3.5
Master degree	2.6	2.8	3.5	2.8[a,b]	4.1	3.2
Other	3.0	3.0	4.5	3.0	4.0	3.0
Income (RM)						
≤1000	2.8[a]	2.7	3.6	3.2	3.8	3.5
1001-3000	2.7[b]	3.0	3.8	3.3	3.9	3.5
3001-5000	1.9[a,b]	2.3	3.9	3.5	4.2	3.6
5001-7000	3.0	3.3	3.3	3.3	3.7	3.3
>7000	2.0	2.3	3.7	3.3	4.3	3.3
Residential						
Village	2.9	2.8	3.4	3.2	3.9	3.6
Town	2.8	3.0	3.4	4.4	3.7	3.7
City	2.7	2.8	3.7	3.2	4.0	3.4
Big city	2.6	2.6	3.7	3.3	3.7	3.4
Other	2.8	3.3	3.8	3.0	3.8	3.5

Similar superscript lower case letters show a significant different between the variables within each group for A and B (t-test for sex category and ANOVA for other categories). Score for perception: 1 (worst); 2 (low); 3 (acceptable); 4 (high); 5 (best). Score for price: 1 (very cheap); 2 (cheap); 3 (acceptable); 4 (expensive); 5 (very expensive)

among the subjects from different income groups. Besides, significant differences (p<0.05) were found in the perception scores of drinking water and mineral water qualities for subjects of different ethnicity.

As shown in Table 4, generally, the interviewed subjects have the perception that tap water has low to acceptable qualities (score, 2-3), while bottled water (drinking and mineral water) have moderate to high quality (score, 3-4). These observations are supported by Doria (2006) that some bottled water have higher quality than tap water, depending on parameters measured. Based on scores of the subjects, bottled mineral water was perceived to have higher quality than bottled drinking water (commonly reverse osmosis process of tap water). Male subjects thought that bottled drinking and mineral waters that are commercially available have higher quality than perceived by female subjects. The female subjects have higher score for tap water quality than the male subjects, where a significant different (p<0.05) was found for the quality score of mineral water between male and female subjects. However, Martin (2003) has reported that no significant different was

found between men and women regarding their perception on water quality.

Based on the results, adults from 31-40 year old have higher score for mineral water quality compared to other age groups, but was not significantly different (p≥0.05). Adults from this age group consume more bottled mineral water than other types of drinking water, which was they thought to have higher quality. Younger (21-30 years) and older adults (>50 years) had higher perception score for quality of tap water compared to subjects from other age groups, but a significant different was found for the quality scores between subjects from the age groups of 21-30 and 31-40 years old. From the study, we observed that older people are used to drink boiled tap water, while younger working adults prefer commercial bottled drinking water. Additionally, those below 30 years old have the perception that tap water have been well treated and monitored by local water authorities.

Among the different ethnicity, Indian subjects have higher quality scores for tap water and bottled water (drinking and mineral water) than other ethnics. Chinese

subjects scored lower than other ethnics for these three types of drinking water quality, where significant differences were found for the quality scores of bottled drinking and mineral waters between Chinese and Malay/Indian (p<0.05). In Klang Valley areas, most of the people are richer and able to purchase home filtration systems to filter the water they consumed daily. However, there are also economic disparities among the ethnic groups that might contribute to the differences between ethnics in their perception and usage of drinking water.

The perception of the subjects on quality of drinking water is unique. Results showed that the quality scores of tap water for subjects from different income groups were significantly different between RM 3001-5000 and RM ≤1000/1001-3000. Subjects with increased educational background perceived bottled drinking and mineral waters as higher quality compared to subjects with lower educational background. As for tap water, subjects with primary education perceived that tap water has high quality. Generally, different income status of subjects results indifferent perception on quality of drinking water in this study. On the other hand, Hobson *et al.* (2007) reported that low income Latino believed that tap water would make them sick; therefore high percentage of them consumed bottled or filtered water. Overall, this study identified that subjects living in cities distinguished the quality of tap water as lower than perceived by villagers. For bottled drinking water, city folks thought that the quality is higher compared to those subjects reside in the villages. However, no significant difference was found among the scores on the quality of bottled mineral water. It is well known that mineral water is a popular source of drinking water, regardless where people stay and what is their age!

The price of tap water was considered cheap and acceptable (score, 2.7-2.8) by most of the interviewed subjects (Table 3). The price of bottled drinking water is judged as acceptable (score, 3.1-3.2), while the bottled mineral is expensive (score 3.7) to some male subjects. The price of drinking water supply from the tap is not a main concern either by male or female subjects. No significant difference was found among the price scores of drinking water for different age groups (p≥0.05).

Based on the scores of subjects from different educational background, subjects who had obtained certificate or diploma thought that bottled water has higher prices as compared to subjects with other educational background. Results of ANOVA showed that there were significant differences (p<0.05) among bottled drinking and mineral waters prices scores of subjects from different educational background.

Results revealed that a significant difference was found for the tap water price scores among subjects from different income groups. Subjects with income of >RM 5000 thought that the price of bottled drinking water and mineral water was the same, as they scored similar price for both bottled water. Subjects from income groups of RM 3000-5000 perceived that bottled drinking water (score 3.5) and bottled mineral water (score 3.6) have higher prices compared to subjects from other income groups. Among subjects who are the town dwellers, they perceived that the price of bottled drinking water was higher than bottled mineral water.

Nowadays, people are switching to drink more water and other beverages, especially bottled drinking water (National Geographic, 2007). The increased in demand of bottled drinking has help to boost up the bottled water industry. Commonly, the cost of commercial drinking water is higher if compared with tap water. The price of bottled drinking water in Malaysia is between RM 0.50-1.00 per litre, while the price of bottled mineral water is higher, at RM 1-2 or more per litre. On the other hand, the tap water supply by local water authorities has the lowest price of US$ 0.10 (~RM 0.3) or lesser per 100 gallons as revealed by Cookson *et al.* (2010).

Choice of brands and places for purchasing safe drinking water: The results showed that around 30 brands of each commercial drinking water and mineral water have been consumed by the interviewed subjects. From the information given, we found that one commercial brand was the favorite among subjects besides two popular brands of bottled mineral water. Ordinarily, subjects reported various places of buying bottled water, such as sundry shops, supermarkets, hypermarkets and others. In most cases, the choices of obtaining bottled water are mainly based on availability. In this modern lifestyle, rapid and convenient are the major factors contributed in choosing where to purchase bottled drinking water and mineral water (Martin, 2003). As reported by Ferrier (2001), bottled water consumption was found to be higher in urban areas, where urban populations have no time to prepare their own safe drinking water.

Reasons of consuming bottled water: Consumption of both bottled drinking water and mineral water is a modern trend (Frost and Sullivan, 2007; Reuters, 2007). Lesser people drink tap water where it happens in the olden days. The reason for consumption of bottled water is descriptively presented as part of the study. Based on responds from subjects, none of them consumed water from well, stream and river as the studied location is highly industrialized. Nowadays, lesser people obtained their drinking water from natural sources, such as underground water, lake, river or pond. Contamination of natural water sources is quite often. In Malaysia, some of the water sources, especially in urban area are contaminated with pollutants from fertilizers, industrial wastes, improper sanitation and urban garbage disposal (Ahmad *et al.*, 1997; Leong *et al.*, 2007).

There are several reasons for subject opted for bottled drinking water. The most important reason was the issue of safe drinking water. Most people go for bottled drinking water is probably due to health concern (Ferrier, 2001). In Malaysia, commercial packaged drinking water must abide to the Malaysian Food Act 1983 and Regulations (Legal Research Board, 2008). The drinking water also must undergone chlorination and filtration process, which is 99.99% bacterial-free and minimal level of contaminants (Betancourt and Rose, 2004). Therefore, bottled drinking water should be safe for consumption and conveniently purchased everywhere.

Health is another major issue regarding the type of drinking water consumed (Ferrier, 2001). Tap water contamination problems have created higher chance for bottled water consumption (Olson, 1999). Although tap water is treated in the water treatment plant, it is not 100% clean and may contain microorganisms. Tap water requires 100% boiling before drinking as the water supply is likely to be contaminated with microbial from water pipe corrosion (Geldreich, 1996). On the other hand, the issue of chlorine content in tap water is still continuing. The tap water is chlorinated before supplying to households. After boiling, concentrated level of chlorine in the water may pose a great health issue, with unknown signs and symptoms (Reckhow and Singer, 1990). High chlorine in tap water may also cause degenerative diseases or toxicity (Zani *et al.*, 2005). However, there are diverse possibilities for increasing bottled water consumption (Doria, 2006).

From the study, some subjects also thought that commercial drinking water is good and high in quality. They were influenced by advertisements and TV commercials, where they gain strong confidence in purchasing the specific types of packaged drinking water instead of drinking home boiled plain water (Martin, 2003). The taste and palatability of drinking water is another reason for the interviewed subjects to choose bottled drinking water. About 1% of the subjects feel that bottled drinking water have good taste as compared to tap water. Besides, minority of the interviewed subjects routinely consumed bottled drinking water and some of them possess self-assurance of consuming bottled drinking.

Conclusion: Quality drinking water is essential for maintaining good health. In general, the intake of water is adequate among the subjects studied with generous consumption of plain water. The selection of drinking water types and brands are based on individual choices. The perception and intake of subjects on drinking water quality and price also varied. Tap water was perceived as acceptable while bottled waters were regarded as high quality. The price for tap and bottled drinking water were considered low, while bottled mineral water was regarded high. Finding of this study exemplifies the important of nutrition education to emphasize on reads of nutritional information on label as a mean to educate consumers.

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