BMJ Open

Salt content of instant noodles in Malaysia: a cross-sectional study

Chun Han Tan,[1] Zhen Yee Chow,[1] Siew Mooi Ching,[2,3] Navin Kumar Devaraj,[4] Feng J He,[5] Graham A MacGregor,[5] Yook Chin Chia[6]

To cite: Tan CH, Chow ZY, Ching SM, *et al*. Salt content of instant noodles in Malaysia: a cross-sectional study. *BMJ Open* 2019;**9**:e024702. doi:10.1136/bmjopen-2018-024702

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2018-024702).

Received 12 June 2018
Revised 13 January 2019
Accepted 7 March 2019

[1]Faculty of Medicine and Health Sciences, University Putra Malaysia, Serdang, Selangor, Malaysia
[2]Department of Family Medicine, Universiti Putra Malaysia, Serdang, Malaysia
[3]Department of Gerontology, Universiti Putra Malaysia, Serdang, Malaysia
[4]Department of Family Medicine, Universiti Putra Malaysia, Selangor, Selangor, Malaysia
[5]Wolfson Institute of Preventive Medicine, Queen Mary University of London, London, UK
[6]Department of Primary Care Medicine, University of Malaya, Kuala Lumpur, Malaysia

Correspondence to
Dr Chun Han Tan;
chunhan931013@gmail.com

ABSTRACT

Objective To determine the salt content in instant noodles sold in Malaysia.

Study design A cross-sectional survey was done involving 707 different flavours and packaging of instant noodles sold in six hypermarkets and retailer chains in Malaysia and the corresponding brand's official websites in 2017.

Methods The salt content (gram per serving and per 100 g) was collected from the product packaging and corresponding brand's official website.

Results Of the 707 different packaging and flavours of instant noodles, only 62.1% (n=439) provided the salt content in their food label. The mean (±SD) salt per 100 g of instant noodles was 4.3±1.5 g and is nearly four times higher than the salt content of food classified in Malaysia as a high salt content (>1.2 g salt per 100 g). The salt content for instant noodle per packaging ranged from 0.7 to 8.5 g. 61.7% of the instant noodles exceeded the Pacific Salt Reduction Target, 11.8% exceeded the WHO recommended daily salt intake of <5.0 per day and 5.50% exceeded Malaysia Salt Action Target. 98% of instant noodles will be considered as high salt food according to the Malaysia Guidelines. The probability of the instant noodles without mixed flavour (n=324) exceeding the Pacific Salt Reduction Target was tested on univariate and multivariate analysis. Instant noodles with soup, Tom Yam flavour, pork flavour and other flavours were found to be predictors of instant noodles with the tendency to exceed Pacific Salt Reduction Target when compared with instant noodles without mixed flavours (p<0.05).

Conclusion Only 62% of instant noodles displayed the salt content on their food label. Salt content in instant noodles is very high, with 90% exceeding the daily salt intake recommended by WHO. Prompt action from regulatory and health authorities is needed to reduce the salt content in instant noodles.

Strengths and limitations of this study

- Our study is one of the few studies done in Asia to examine the salt level in instant noodles.
- A total of 46 brands comprising 707 different flavours were included in this study, and this is quite comprehensive as most of the instant noodles available in the local market would have been included.
- The data of salt content among instant noodles were obtained from the packaging labels, which means that we relied on the information provided on the labels and assumed that the manufacturers provide it accurately.

INTRODUCTION

There is abundance of evidence that high salt intake is associated with raised blood pressure and the occurrence of cardiovascular diseases (CVD).[1–4] In addition, high salt intake is also associated with increased risk of kidney disease, gastric cancer and osteoporosis.[4–11] Indeed, salt reduction is one of the most cost-effective public health policies in the prevention of hypertension and CVD. Hence, WHO had repeatedly prioritised the reduction of global population's intake of salt, and has set a target of <5 g a day for all adults and a lower salt level for children based on their energy requirement.[12 13] Meanwhile, the Malaysia Salt Action has recommended a reduction in salt intake to <6 g a day for Malaysian adults.[14] In Malaysia, the salt content in food is classified according to two local guidelines, which are the Malaysia Dietary Guideline 2010 and Malaysia Food Regulations 1985 with Food Act 1983. According to the Malaysian Food Regulations 1985 and Food Act 1983, food in Malaysia is grouped as salt-free food, very low salt food and low salt food when the food has a salt content below 0.01 g/100 g, 0.10 g/100 g and 0.30 g/100 g, respectively.[15] Meanwhile, the Malaysia Dietary Guidelines 2010 defines moderate and high salt food as food containing salt of 0.30–1.20 g/100 g and >1.20 g/100 g, respectively.[16]

There are several methods for estimating or measuring the daily salt intake. Salt intake can be measured and estimated subjectively by using a food diary, 24 hours diet recall and Food Frequency Questionnaires.[17 18] On the other hand, objective measurements will require the use of 24 hours urine sodium excretion (gold standard), nighttime urine, early morning urine and 'spot' urine tests.[17] Several studies have been conducted previously to identify the daily salt intake by Malaysians. MySalt 2016 reported that Malaysians'

mean salt intake based on 24 hours urine sodium excretion was 7.2 g/day.[19] This was higher than the WHO recommended daily salt intake (5 g/day). MySalt also had identified instant noodles as one of the most frequently consumed Malaysian food.[19] This was supported by another study by Choong *et al*.[20] The World Instant Noodle Association meanwhile reported that Malaysia was ranked 13th globally in the demand for instant noodles in 2016 and there has been an increasing trend of this demand since 2012.[21]

A recent systematic review done in 2015 concluded that countries of all regions and income levels, including Malaysia, had already implemented population salt reduction strategies. In Malaysia, meetings with the key players involved in the salt industry had been done and, consequently, there had been industrial reports on the salt reduction of food products such as biscuit (11%–35%), tomato sauce (9.5%–40%), instant noodles (2%–20%), flavourings cubes/powder (1.1%–16%) and frozen meat (13%).[22]

Worldwide, there have been only a few studies that reported the salt content in instant noodles, but none of the reports was on instant noodles found in Malaysia. According to Bendich *et al*., the mean salt content per 100 g serving of instant noodles available in ASEAN was 4.94 g/100 g.[23 24] Furthermore, an observational study by Farrand *et al*. in 10 Asian countries such as China, Indonesia and India, also demonstrated that the mean salt content per 100 g of instant noodles was high at 4.86, 4.79 and 2.28 g, respectively.[25] In this same study, Farrand *et al*. also reported that two-thirds of the Asian countries in the study had <55% instant noodle products that meet the Pacific Salt Reduction Target (4 g/100 g of salt).[25 26]

Hence, instant noodles could be one of the most often neglected high salt staple food that may lead to increased incidence of hypertension and CVDs. This study aims to determine the mean salt content of instant noodles sold in Malaysia hypermarkets, retailer chains as well as the brand's official webpage. This study also aims to examine the predictors of instant noodles that exceeded Pacific Salt Reduction Target.

METHODS

Study design

This was a cross-sectional study that used a universal sampling method. It was conducted at the outlets of the six hypermarkets and retailer chains in Malaysia along with the corresponding brand's official website.

Data collection

Data were collected by taking snapshot of the nutritional information label of each instant noodle available at the hypermarkets and from official webpage of the brand of instant noodles. The instant noodles from the respective brand's official webpage was included in view of its availability for the consumers and retailers to order through online services. The data extracted from the snapshots that were taken included the brand name, product name, flavour, types of noodles, types of packaging, types of instant noodle preparation, serving size and salt content (salt per 100 g and salt per serving). Each brand name was searched through online search engines to locate the respective brand's official website. Any additional instant noodles information found on the website was also recorded as well to include instant noodles that might be out of stock at the time of the data collection. The value of the sodium content was converted to salt content by multiplying it by 2.5.[27]

Salt content (g)=Sodium content (g) x 2.5

If the salt or sodium content was not provided on the nutritional label of an instant noodle, it was listed as 'Absent'. If nutritional labels cannot be found on the product or through their respective official website, the missing data were labelled as 'No Nutritional Label'. The nutritional label on the product found in the hypermarkets and the retailer chains was chosen if different nutritional values of the same product was found on its corresponding brand's official website at the same time. The salt content eventually may still be inaccurate if the manufacturer did not provide accurate and up-to-date information on its nutritional label.

Inclusion and exclusion criteria

The inclusion criteria were all instant noodles that have a nutritional label in English, Malay or the Chinese language, found either in the hypermarkets or websites. Plain instant noodles with no flavouring were excluded.

Data quality

A second researcher was asked to double check all entries. Data cleaning was done and outliers, if any, was removed, to ensure the quality of the final data.

Data classification

All the instant noodles were classified based on their individual characteristics, which include the source of information, brand name, types of flavours, types of noodles, types of packaging and types of instant noodle preparation.

The source of information was either from supermarket or from the official websites. Brand names were given a code to avoid legal issues and were classified into common (brands with number of products of ≥15) and uncommon (brands with number of products of <15) brands.

Types of flavours that were included were chicken, seafood, pork, curry, abalone, curry laksa, vegetable (including mushroom), Tom Yam, Soup Spices, Asam Laksa, spicy, original, Soto, beef, pepper (including Black Pepper), Satay, cheese, sesame oil, soya sauce, chilli, sambal, rendang, laksa, Pad Kee Mao, Moo Nam Tok, Duck, Tom Saab, Yentafo, Ice, Korean Spices, Clear Soup, lontong, Pad Thai, Miso, Kyushu Black, Tokyo Shoyu, Kimchi, Kyushu Soup, Claypot, Udon, Japanese Style, XO Sauce, Masala, Aglio Olio, and corn. 'Mixed

flavoured' was defined as the presence of two or more flavours in the same instant noodle. The flavour with sample size <10 products was then grouped under 'Others'.

Types of noodles included noodles, Rice Vermicelli, Kuey Teow, E-Men, Macaroni, Ho Fan, Charcoal Noodle, Rice Fettuccine and Purple Wheat Noodle. The types of noodles with sample size <10 products were then listed under 'Others'.

Types of packaging were cup, bowl or pack. Types of instant noodle preparation were soup noodle or fried noodle.

Data analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) V.21.

The salt per 100 g of each instant noodles was re-coded and categorised into salt-free food, very low salt food, low salt food, moderate salt food and high salt food based on the available Malaysian salt guidelines (Malaysia Dietary Guidelines 2010, Malaysian Food Regulations 1985 and Food Act 1983).[16 28 29]

The salt content per 100 g of each instant noodle was also used to determine the proportion of instant noodles that exceed the Pacific Salt Reduction Target (<4 g salt per 100 g).[26] The salt content per serving was used to determine the percentage of instant noodles that exceeds the recommended level of daily salt intake by WHO (<5 g/day) and Malaysia Salt Action Target (<6 g/day).[12 14]

The dependent variable was defined as whether the salt content in instant noodle exceeded the Pacific Salt Reduction Target or not. The independent variables were the characteristics of instant noodle as described in the Data classification section. Mean salt content was also calculated and the categorical data was reported as percentage. Subgroup analysis of instant noodles without mixed flavour was done to look at the salt content in each individual flavour. Categorical variables were then analysed with χ^2 or Fisher exact test. All variables with p value <0.05 in univariate analysis and those variables with p value <0.25 and yet clinically significant were subjected to multiple logistic regression analysis to obtain predictors of high salt content in instant noodles.

Result

A total of 707 instant noodle products with 45 different brands and 49 types of flavours was found to be available in Malaysia.

Figure 1 shows that 288 and 419 instant noodles were found, respectively, from hypermarkets and retailer chains and, each brand's official website in Malaysia. After removal of the instant noodle without any labelling of its salt content (n=94), and those without a nutritional label altogether (n=174), 439 instant noodles were entered into the descriptive analysis. Instant noodles with mixed flavour (n=115) were removed from the subgroup analysis.

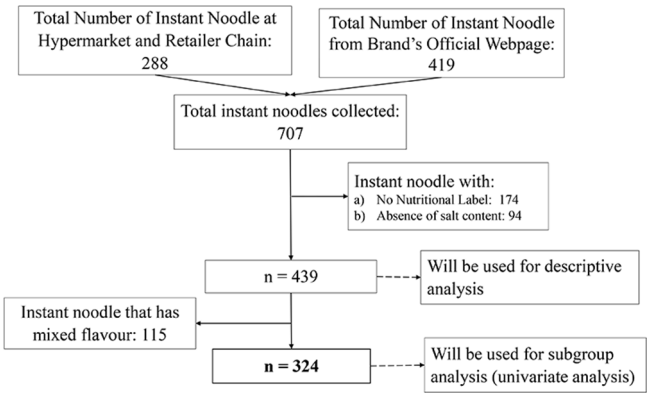

Figure 1 Flowchart of derivation of sample size used for overall salt content and the sample size for the subgroup analysis.

Salt label availability

Table 1 compares the salt label availability of instant noodles sold at hypermarkets and retailer chains with those sold at respective brand's official webpage. 69.1% and 57.3% of instant noodles from hypermarket and retailer chains along with brand's official website provided nutritional label with salt content, respectively. 30.9% of the instant noodles sold at hypermarket and retailer chains were sold without any salt content labelled on its nutritional label. Regarding instant noodles sold at the brand's official website, only 1.2% provided nutritional label without any salt content while up to 41.5% of instant noodles were found not to have any nutritional labels altogether.

Salt content and serving size of instant noodles

The mean salt content per 100 g of 439 instant noodles was 4.5±1.6 g/100 g, ranging from 0.8 g/100 g to 9.8 g/100 g. Meanwhile, the mean salt content per serving was 3.6 g/serving (range 0.7–8.6). The average serving size of the instant noodles in Malaysia was 82.9±31.8 g (range 33–405).

Top 10 instant noodles with the highest and lowest salt content per serving

Table 2 shows the top 10 instant noodles with the highest salt content per serving and their characteristics. Instant noodle A is the instant noodles with the highest salt content per serving, which was 8.6 g/serving. It was a product of brand 20 that came with a

Table 1 Salt label availability (n=707)

	Source of instant noodles	
	Hypermarket and retailer chains (%)	Brand's official website (%)
Absent	89 (30.9)	5 (1.2)
Present	199 (69.1)	240 (57.3)
No nutritional label	0 (0.0)	174 (41.5)
Total	288 (100)	419 (100)

Table 2 Top 10 instant noodles with the highest salt content per serving in Malaysia and its characteristics (in descending order)

No	Instant noodles	Brand	Types of packaging	Types of noodles	Types of noodle preparation	Flavour	Source of instant noodles	Serving size (g)	Salt (g/100 g)	Salt (g/serving)
1	A	20	Bowl	Noodles	Soup	Sesame Oil	Hypermarket and retailer chain	110	7.77	8.55
2	B	5	Bowl	Noodles	Soup	Beef	Official webpage	120	6.79	8.15
3	C	5	Bowl	Noodles	Soup	Pork	Official webpage	116	6.88	7.98
4	D	5	Bowl	Noodles	Soup	Pork	Official webpage	122	6.46	7.88
5	E	5	Bowl	Noodles	Soup	Vegetable	Official webpage	107	7.33	7.84
6	F	5	Bowl	Noodles	Soup	Spicy	Official webpage	113	6.85	7.74
7	G	20	Bowl	Noodles	Soup	Pork	Official webpage	120	6.17	7.41
8	H	20	Cup	Noodles	Soup	Spicy	Official webpage	103	7.09	7.30
9	I	20	Bowl	Noodles	Soup	XO Sauce	Hypermarket and retailer chain	112	6.47	7.25
10	J	21	Bowl	Noodles	Soup	Kimchi	Hypermarket and retailer chain	117	5.97	6.98

soup preparation, in bowl packaging, with a sesame oil flavour and was sold at the Hypermarkets and Retailer chains. Other than that, 5 out of the top 10 highest salt per serving are from Brand 5, which includes instant noodle B, C, D, E and F.

Table 3 shows top 10 instant noodles with the lowest salt content per serving and its characteristics. Instant noodle K was the instant noodles with the lowest salt content per serving (0.7 g/serving). It was a fried noodle that came from Brand 1 in a pack, with a vegetable flavour and was sold at hypermarkets and retailer chains.

Salt reduction target, recommended salt intake and Malaysian salt food classification

Figure 2 shows the Malaysian guidelines for classification of salt content in food and the percentage of instant noodle that exceed the Pacific Salt Reduction Target, WHO Recommended Salt Level and Malaysia Salt Action Target. 61.7% of instant noodles exceeded Pacific Salt Reduction Target as shown in figure 2. 11.8% of the instant noodles exceeded daily recommended salt intake by WHO while 5.5% exceeded the Malaysia Salt Action Target. As high as 98.2% of instant noodles were found to

Table 3 Top 10 instant noodles with the lowest salt content per serving in Malaysia and its characteristics (in ascending order)

No	Instant noodles	Brand	Types of packaging	Types of noodles	Types of noodle preparation	Flavour	Source of instant noodles	Serving size (g)	Salt (g/100 g)	Salt (g/serving)
1	K	1	Pack	Noodles	Fried	Vegetable	Hypermarket and retailer chain	90	0.80	0.72
2	L	6	Pack	Noodles	Soup	Curry	Hypermarket and retailer chain	50	1.47	0.73
3	M	1	Pack	Noodles	Soup	Soup Spices	Hypermarket and retailer chain	90	0.91	0.82
4	N	1	Pack	Noodles	Soup	Chicken	Hypermarket and retailer chain	90	0.96	0.86
5	O	38	Pack	Noodles	Soup	Asam Laksa	Hypermarket and retailer chain	120	0.91	1.10
6	P	18	Pack	Noodles	Fried	Seafood	Hypermarket and retailer chain	100	1.24	1.24
7	Q	16	Cup	Noodles	Soup	Vegetable	Hypermarket and retailer chain	60	2.11	1.27
8	R	13	Pack	Purple Wheat Noodle	Fried	Aglio Olio	Official webpage	60	2.25	1.35
9	S	20	Bowl	Noodles	Fried	Chicken	Official webpage	57	2.46	1.40
10	T	20	Pack	Macaroni	Soup	Vegetable	Official webpage	90	1.56	1.41

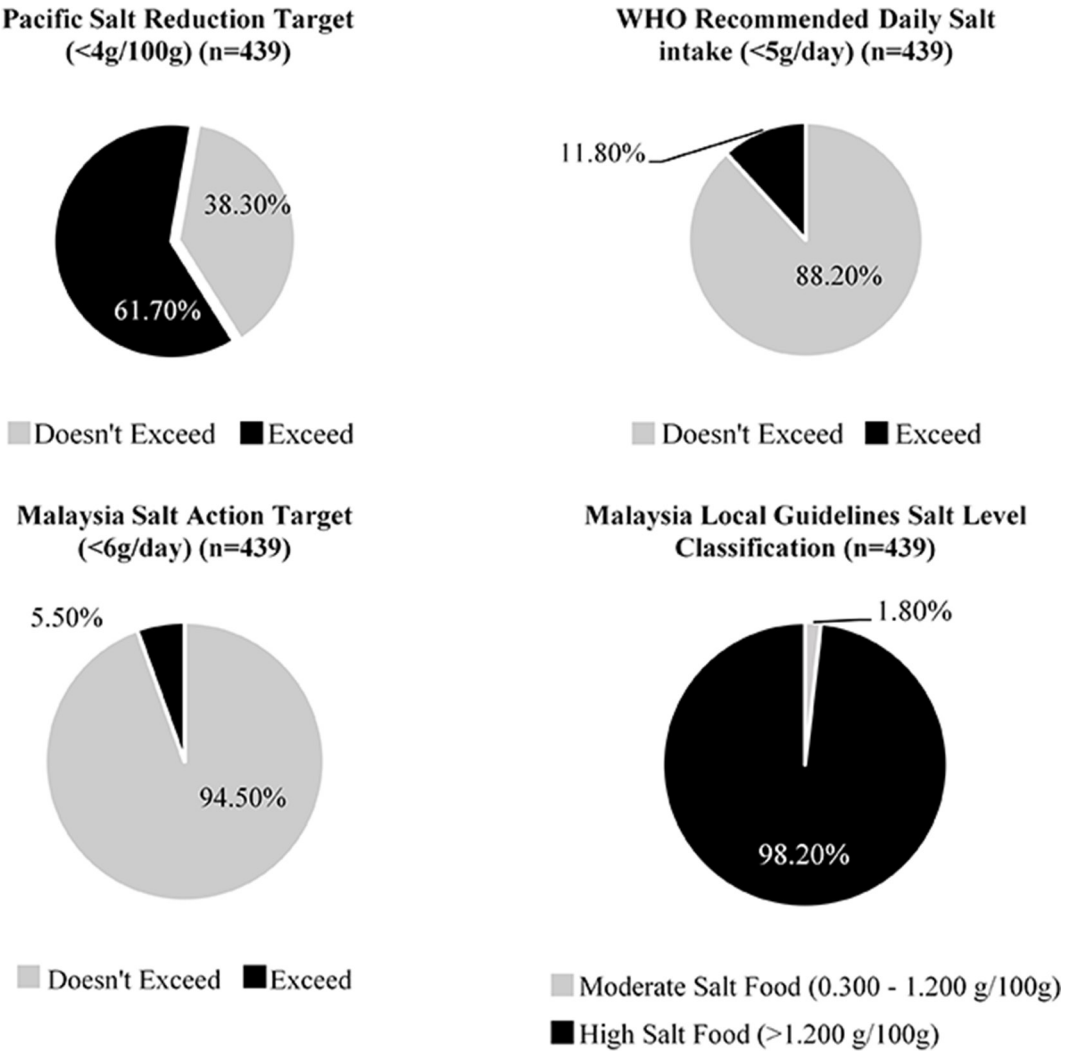

Figure 2 Malaysian local guideline salt-level classification and percentage of instant noodles that exceed Pacific Salt Reduction Target, WHO Recommended Salt Level and Malaysia Salt Action Target.

be high salt food, while 1.8% were classified as moderate salt food. None of the available instant noodles can be classified as low salt food, very low salt food and salt-free food.

Subgroup analysis

Subgroup analysis was done among the instant noodles without mixed flavour to look at the salt content of each of the individual flavours. Tables 4 and 5 compare whether the instant noodles flavour complies with the Pacific Salt Reduction Target using univariate analysis and the association between the characteristics of instant noodles that exceeded the Pacific Salt Reduction Target. From the χ^2 test, it was found that the types of flavour ($p<0.001$), types of preparation ($p<0.001$) and source of information ($p<0.017$) of the instant noodles had significant association with it exceeding the Pacific Salt Reduction Target.

Table 6 shows the multivariate logistic regression analysis done to identify the predictors of high salt content of instant noodles that exceeded the Pacific Salt Reduction Target. Instant noodles prepared in soup (p=0.001, OR 83.1, 95% CI 10.9 to 632.9) was found to be 83 times more likely to exceed the Pacific Salt Reduction Target when compared with fried instant noodles. Chicken flavoured (p=0.041, OR 2.8, 95% CI 1.1 to 7.6), seafood flavoured (p=0.046, OR 2.9, 95% CI 1.0 to 8.5), other flavours (p=0.003, OR 4.4, 95% CI 1.7 to 11.6), beef flavoured (p=0.022, OR 5.8, 95% CI 1.3 to 25.9), pork flavoured (p=0.008, OR 7.7, 95% CI 1.7 to 34.9) and Tom Yam flavoured (p=0.003, OR 11.5, 95% CI 2.3 to 59.2) instant noodles were found to be 2.8 times, 2.9 times, 4.4 times, 5.8 times, 7.7 times and 11.5 times more likely to exceed Pacific Salt Reduction target, respectively, when compared with curry flavoured instant noodles.

DISCUSSION

Overall, the mean salt content in the instant noodles available in Malaysia was 4.5 g/100 g. Worryingly, this is nearly four times higher than the salt content of high salt food (>1.2 g/100 g) as defined by the Malaysian guidelines.[16 28 29] Consuming a serving or packet of instant noodles is nearly equal to the amount of recommended

Table 4 Comparison between instant noodles flavours according to whether or not it adheres to Pacific Salt Reduction Target (n=324)

Characteristics	n	Pacific Salt Reduction Target			Salt (g/100 g)
		Does not exceed (%)	Exceed (%)	P value	Mean±SD
Flavour					
Chicken	55	23 (41.8)	32 (58.2)	**0.001***	4.12±1.26
Seafood	38	15 (39.5)	23 (60.5)		4.28±1.29
Vegetable	31	17 (54.8)	14 (45.2)		3.78±1.36
Curry	28	18 (64.3)	10 (35.7)		3.88±1.47
Spicy	23	13 (56.5)	10 (43.5)		4.18±1.32
Pork	21	3 (14.3)	18 (85.7)		5.24±1.62
Tom Yam	19	3 (15.8)	16 (84.2)		5.09±1.30
Beef	17	4 (23.5)	13 (76.5)		4.71±1.00
Original	10	8 (80.0)	2 (20.0)		2.87±1.50
Others					
Soto	3	1 (33.3)	2 (66.7)		4.19±1.29
Pepper	2	1 (50.0)	1 (50.0)		3.35±1.83
Satay	2	1 (50.0)	1 (50.0)		4.79±1.53
Cheese	2	1 (50.0)	1 (50.0)		2.78±2.29
Sesame Oil	8	0 (0.0)	8 (100.0)		5.32±1.21
Soya Sauce	7	2 (28.6)	5 (71.4)		4.71±1.62
Chilli	5	4 (80.0)	1 (20.0)		4.12±1.70
Sambal	1	1 (100.0)	0 (0.0)		3.71±0.00
Rendang	2	2 (100.0)	0 (0.0)		2.81±0.00
Laksa	5	1 (20.0)	4 (80.0)		4.75 ±1.30
Pad Kee Mao	1	1 (100.0)	0 (0.0)		3.55±0.00
Moo Nam Tok	2	0 (0.0)	2 (100.0)		5.09±0.01
Duck	7	1 (14.3)	6 (85.7)		6.03±1.34
Tom Saab	2	0 (0.0)	2 (100.0)		8.06±0.50
Yentafo	1	0 (0.0)	1 (100.0)		6.83±0.00
Korean Spices	1	0 (0.0)	1 (100.0)		6.00±0.00
Clear Soup	2	0 (0.0)	2 (100.0)		7.54±3.21
Lontong	2	2 (100.0)	0 (0.0)		2.82±0.01
Pad Thai	1	1 (100.0)	0 (0.0)		3.11±0.00
Miso	2	1 (50.0)	1 (50.0)		4.25±1.59
Kyushu Black	1	0 (0.0)	1 (100.0)		4.59±0.00
Tokyo Shoyu	1	0 (0.0)	1 (100.0)		4.91±0.00
Kimchi	5	1 (20.0)	4 (80.0)		5.42±1.19
Claypot	4	0 (0.0)	4 (100.0)		4.57±0.21
Abalone	1	1 (100.0)	0 (0.0)		1.92±0.00
Curry Laksa	1	1 (100.0)	0 (0.0)		1.97±0.00
Udon	2	1 (50.0)	1 (50.0)		4.09±0.41
Soup Spices	1	1 (100.0)	0 (0.0)		0.91±0.00
Asam Laksa	3	1 (33.3)	2 (66.7)		4.16±2.91
Japanese Style	1	0 (0.0)	1 (100.0)		4.06±0.00
Masala	1	1 (100.0)	0 (0.0)		2.94±0.00
Aglio Olio	1	1 (100.0)	0 (0.0)		2.25±0.00
Corn	2	1 (50.0)	1 (50.0)		3.30±1.13

Bold indicates significant p value (<0.05).
*X^2 test.

Table 5 Comparison between instant noodles characteristics according to whether or not it exceeds the Pacific Salt Reduction Target (n=324)

Characteristics	n	Pacific Salt Reduction Target			Salt (g/100 g)
		Doesn't exceed (%)	Exceed (%)	P value	Mean±SD
Brands					
Common brands	237	91 (38.4)	146 (61.6)	0.126*	4.43±1.40
Uncommon brands	87	42 (48.3)	45 (51.7)		4.10±1.78
Types of packaging					
Pack	205	91 (44.4)	114 (55.6)	0.259*	4.24±1.49
Cup	65	22 (33.8)	43 (66.2)		4.31±1.60
Bowl	54	20 (37.0)	34 (63.0)		4.78±1.44
Types of noodles					
Noodles	295	123 (41.7)	172 (58.3)	0.420*	4.33±1.50
Vermicelli	10	2 (20.0)	8 (80.0)		5.16±2.11
Others					
Kuey Teow	1	0 (0.0)	1 (100.0)		5.27±0.00
E-Men	6	1 (16.7)	5 (83.3)		4.57±0.64
Macaroni	2	2 (100.0)	0 (0.0)		1.94±0.53
Ho Fan	1	1 (100.0)	0 (0.0)		3.30±0.00
Rice Fettuccine	5	0 (0.0)	5 (100.0)		5.40±0.71
Purple Wheat Noodle	4	4 (100.0)	0 (0.0)		2.99±0.70
Types of noodles preparation					
Fried	42	40 (95.2)	2 (4.8)	**0.001***	2.84±0.93
Soup	282	93 (33.0)	189 (67.0)		4.57±1.46
Source of instant noodles					
Hypermarket and retailer chains	156	75 (48.1)	81 (51.9)	**0.017***	4.10±1.63
Brand's official webpage	168	58 (34.5)	110 (65.5)		4.57±1.37

Bold indicates significant p value (<0.05).
*X^2 test.

daily salt intake by WHO of <5 g/day. Worse still is the fact that 10% of instant noodles available contain salt content per serving that exceeded the recommended daily salt intake by WHO and the highest salt content per serving available in Malaysia was nearly twice the amount of the recommended daily salt intake by WHO at 8.5 g/serving. Because of its high salt content and popularity (ie, by the high volumes sold every day), reducing the salt content in instant noodles will have a significant impact on reducing the overall daily salt intake among the Malaysian population.

Our finding of high salt content in instant noodles sold in Malaysia is similar to the findings of a study by Farrand *et al*, which showed a salt content of 4.3 g/100 g in UK, New Zealand, Australia, China, India, Samoa, South Africa, Fiji, Indonesia and Costa Rica.[25] In addition, this study also found that nearly 100% of instant noodles sold were classified as high salt food by the Malaysian guidelines on recommended daily salt intake.[16] There was no low salt instant noodles among all the different brands and flavours. While some brands of instant noodles had a lower level of salt content, they were still classified in the moderate salt food category. For instance, Brand 1 instant noodles can be considered as a better choice of instant noodles as its products consistently appear at the Top 10 with the lowest salt content per serving (table 3). Overall, Brand 1 instant fried noodles with vegetable flavour that came in a packet is the best moderate salt alternative among all the instant noodles available.

There is evidence that if salt reduction were introduced gradually in products, there would be no reduction in sales. The manufacturers need to be reassured on this matter in order to persuade them to reduce the salt content in their food products.

Comparing the mean salt content per 100 g of instant noodles available in Malaysia with the Pacific Salt Reduction Target for instant noodles, the mean salt content per 100 g of Malaysian instant noodles (4.5 g/100 g) was higher than the Pacific Salt Reduction Target for instant noodles as recommended by WHO for the Western Pacific Region (4 g/100 g).[26] Among the 439 instant noodles, there were more than 60% that exceeded the Pacific Salt Reduction

Table 6 Predictors of high salt content among instant noodles using the Pacific Salt Reduction Target (n=324)

Characteristic	Pacific Salt Reduction Target			
	OR	95% CI		Significance
		Lower	Upper	
Brands				
Uncommon brands	1.0			
Common brands	1.4	0.7	2.9	0.379
Flavour				
Curry	1.0			
Seafood	2.9	1.0	8.5	**0.046**
Chicken	2.8	1.0	7.6	**0.041**
Vegetable	1.3	0.4	3.8	0.665
Spicy	2.2	0.6	8.2	0.218
Pork	7.7	1.7	34.9	**0.008**
Tom Yam	11.5	2.3	59.2	**0.003**
Beef	5.8	1.3	25.9	**0.022**
Original	16.0	0.9	271.3	0.055
Others	4.4	1.7	11.6	**0.003**
Types of noodle preparation				
Fried	1.0			
Soup	83.1	10.9	632.9	**0.001**
Source of instant noodles				
Hypermarket and retailer chains	1.0			
Brand's official webpage	1.1	0.5	2.2	0.817

Bold indicate significant value (p>0.05).

Target. Our results are in agreement with the finding by Farrand *et al*, where only 40% of instant noodles product were known to meet the Pacific Salt Reduction Target in total. However, in this same study, Malaysia was found to perform better than Australia (33%), China (26%), Fiji (26%) and Costa Rica (22%) in terms of achievability of the Pacific Salt Reduction Target (38.3%) but the level of achievability was still not at a satisfactory level. Instead, Malaysia could learn from South Africa (96%) and New Zealand (83%) on their salt reduction initiative in instant noodle products.[25]

It was a sheer disappointment when looking into the labelling of the instant noodle products in Malaysia. Compared with the study by Farrand *et al*, where only 5% of instant noodles product that did not provide salt content on its nutritional label, Malaysia had as many as one-third of the instant noodles sold in hypermarkets and retailer chains without their salt content labelled. Furthermore, up to 40% of the instant noodles sold online did not even provide a nutritional label. This had greatly affected the research findings where we had identified 707 instant noodles that were actually available in Malaysia but only 62.1% (n=439) can be used for analysis due to the above reasons.

Based on our findings, there were two variables that had emerged as good predictors to identify instant noodles that will exceed Pacific Salt Reduction Target, which were flavours and types of noodle preparation. Although all flavours had a high salt content, the specific flavours that had a higher tendency to exceed the Pacific Salt Reduction Target were chicken, seafood, beef, pork flavours, Tom Yam and others flavour. The instant noodles with a soup preparation was found to be the strongest predictor where it is 83 times more likely to exceed the Pacific Salt Reduction Target when compared with fried instant noodles. This finding was supported by a study conducted in Hong Kong where they found that most of the noodles with a soup preparation had a high salt content.[30] Hence, this could lead to the assumption that the main source of the salt is from the soup and flavouring of the instant noodles.

Several recommendations can be made to reduce the salt level in instant noodles and its intake. First and foremost, demographical study on the instant noodles' consumers should be done to identify the populations that are at risk. Searches through online engines had been done but none was found. This is crucial as approaches and interventions can then be modified accordingly to maximise the success rate of publicity and campaigns, let it be to improve the consciousness on recommended salt level or to improve the knowledge of salt intake and targets. Next, publicising and improving the knowledge

and awareness of salt level as well as recommended salt intake should not be neglected. Worrying statistic from a review by Sarmugam and Worsley had showed that majority of the participants in 13 studies reviewed involving the awareness of salt intake recommendation did not know the recommended amount of daily salt intake.[31] The high salt content in the instant noodles could be due to the lack of knowledge and awareness by the public, including the manufacturer themselves. Improving the public awareness and knowledge will substantially ease and maintain the continuity of the salt reduction action. Second, consumers should be advised to avoid instant noodles with predictors as explained above and to purchase instant noodles that are more likely to achieve Pacific Salt Reduction Target. Otherwise, consumer should also be advised to pour away and not consume the soup of the instant noodles. Third, we hope the manufacturers could reduce salt content of their instant noodles gradually and they should be given evidence that salt reduction in the food product will not affect the consumers' acceptability towards their food products. In the past few years, several studies had been done to look into the consumer's acceptability towards food product with a lower salt content. Systematic review by Jaenke *et al*. had gathered and meta-analysed all the articles on the consumer acceptance of salt-reduced food products, ranging from breads, cheeses, process meats, soup and miscellaneous food products.[32] Meta-analysis by Jaenke *et al*. had showed that reduction of salt can go up to 37% and 67% in bread and processed meats without affecting the consumer acceptability towards these products.[32] This was supported by studies done by Girgis *et al*., Hashem *et al*. and Leim *et al*.[33–35] Besides, a study by Ball *et al*. also showed that salt reduction by 43%–67% in soup significantly increased the liking scores by the consumers.[36] These studies are promising but not yet fully convincing because no study had been done on the effect of salt-reduced instant noodles towards the consumers' acceptability in Malaysia. Hence, we would recommend to initiate studies as such to further convince manufacturers to embark on salt reduction initiative in their food products. In addition, authorities should also be encouraged to mandate that salt content be displayed on nutritional label on all food products and also on their brand's official webpage. Instant noodle products should also have a clear label informing consumers whether those products contain higher or lower salt content.[37] This could aid the consumers in choosing products with lower salt content that are healthier.[22 37] Lastly, we support the suggestion from one of the reviews by Hoppu *et al*. where experts in the field of consumer science, nutrition, food technology, food chemistry, sensory science, food industry and food services should work hand-in-hand towards producing instant noodles with a low salt content that could both maintain consumer's expectation and acceptance towards their food products.[38] Hopefully, by addressing these issues, the global target of 30% reduction in salt intake by 2025 set by WHO will be achieved.[22]

Strengths and limitations

To the extent of our knowledge, this is the first study on salt content of instant noodles available in Malaysia. This is also the first study that reports the flavours of instant noodles available in the Asian market. This study is very comprehensive as it includes most of the brands of instant noodles found in the hypermarkets and also websites in Malaysia.

Findings from this study can be generalised to Malaysia as most Malaysian do consume instant noodles as part of their meal plan. Furthermore, established guidelines were used to determine the target salt level in instant noodles.

As mentioned previously, the data of salt content among instant noodles were obtained from the packaging labels. This means that we relied on the information provided on the labels and assumed that the manufacturers provide it accurately.

Despite the fact that the authors were not able to access those instant noodles with missing salt content value (n=248) on the labels, the results of this study are rather comprehensive and could serve as the first documentation on salt content of a popular food product in Malaysia, providing a platform for future research into this important subject area.

CONCLUSION

Our study shows that the mean salt content among instant noodles in Malaysia is high. Furthermore, 40% of the instant noodle does not have their salt content labelling. Those noodles with a soup preparation, Tom Yam flavour, pork flavour, beef flavour and other flavour were the predictors of instant noodle with high salt content that exceeded the Pacific Salt Reduction Target.

Contributors YCC conceptualised the study. Subsequently, YCC, SMC, NKD, CHT and ZYC designed the research. CHT and ZYC collected the data and did the data entry. Data analysis was done by CHT, ZYC, SMC and NKD. CHT and ZYC wrote the first draft of manuscript. The data interpretation and manuscript revision were performed by FJH, GAM, YCC, SMC, NKD, CHT and ZYC. FJH, GAM, YCC, SMC, NKD, CHT and ZYC contributed to the discussion of the study and came to the consensus to approve the final draft of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The original result showing the salt content of all the products is available on request to the corresponding author.

REFERENCES

1. Erdem Y, Arici M, Altun B, *et al*. The relationship between hypertension and salt intake in Turkish population: SALTURK study. *Blood Press* 2010;19:313–8.
2. Strazzullo P, D'Elia L, Kandala NB, *et al*. Salt intake, stroke, and cardiovascular disease: meta-analysis of prospective studies. *BMJ* 2009;339:b4567.
3. Ha SK, Sk H. Dietary salt intake and hypertension. *Electrolyte Blood Press* 2014;12:7–18.
4. MacGregor G. Salt—more adverse effects. *Am J Hypertens* 1997;10:37S–41.
5. Peleteiro B, Barros S, Castro C, *et al*. Worldwide burden of gastric cancer in 2010 attributable to high sodium intake in 1990 and predicted attributable burden for 2030 based on exposures in 2010. *Br J Nutr* 2016;116:728–33.
6. Marmot M, Atinmo T, Byers T, *et al*. Food, nutrition, physical activity, and the prevention of cancer: a global perspective. 2007.
7. Glade MJ. Food, nutrition, and the prevention of cancer: a global perspective. American institute for cancer research/world cancer research fund, American institute for cancer research, 1997. *Nutrition* 1999;15:523–6.
8. Kim Y, Kim HY, Kim JH. Associations between reported dietary sodium intake and osteoporosis in Korean postmenopausal women: The 2008-2011 Korea national health and nutrition examination survey. *Asia Pac J Public Health* 2017;29:430–9.
9. Salgado E, Bes-Rastrollo M, de Irala J, *et al*. High sodium intake is associated with self-reported rheumatoid arthritis: a cross sectional and case control analysis within the SUN cohort. *Medicine* 2015;94:e924.
10. Hu Y, Sparks JA, Malspeis S, *et al*. Long-term dietary quality and risk of developing rheumatoid arthritis in women. *Ann Rheum Dis* 2017;76:1357–64.
11. Sundström B, Johansson I, Rantapää-Dahlqvist S. Interaction between dietary sodium and smoking increases the risk for rheumatoid arthritis: results from a nested case-control study. *Rheumatology* 2015;54:487–93.
12. Salt Reduction. Secondary salt reduction. http://www.who.int/nmh/ncd-tools/target4/en/ (Accessed 3rd Dec 2017).
13. Guideline. *Sodium intake for adults and children*. Geneva: World Health Organization, 2012.
14. Malaysia Salt Action Summary. Secondary malaysia salt action summary. http://www.worldactiononsalt.com/worldaction/asia/53960.html (Accessed 3rd Dec 2017).
15. Food regulations. *Malaysian food act. PU(A) 437 OF*. Malaysia: Food regulations, 1985.
16. National Coordinating Committee on Food and Nutrition. *Malaysia dietary guidelines*: National Coordinating Committee on Food and Nutrition, 2010.
17. Kawano Y, Tsuchihashi T, Matsuura H, *et al*. Report of the working group for dietary salt reduction of the japanese society of hypertension: (2) assessment of salt intake in the management of hypertension. *Hypertens Res* 2007;30:887–93.
18. Bentley B. A review of methods to measure dietary sodium intake. *J Cardiovasc Nurs* 2006;21:63–7.
19. (IPH) IfPH. Determination of dietary sodium intake among the ministry of health staff 2016 (MySalt 2016). 2016.
20. Choong SS, Balan SN, Chua LS, *et al*. Preference and intake frequency of high sodium foods and dishes and their correlations with anthropometric measurements among Malaysian subjects. *Nutr Res Pract* 2012;6:238–45.
21. WINA. Global demand for instant noodles. secondary global demand for instant noodles. 2017 https://instantnoodles.org/en/noodles/market.html (Accessed 3rd Dec 2017).
22. Webster J, Trieu K, Dunford E, *et al*. Target salt 2025: a global overview of national programs to encourage the food industry to reduce salt in foods. *Nutrients* 2014;6:3274–87.
23. Bendich A, Deckelbaum RJ. *Preventive nutrition: the comprehensive guide for health professionals*: Springer, 2016.
24. ASEAN Food Composition Database, Electronic version 1, February 2014, Thailand. Secondary ASEAN food composition database, electronic version 1, February 2014, Thailand. 2014 http://www.inmu.mahidol.ac.th/aseanfoods/composition_data.html (Accessed 21st April 2018).
25. Farrand C, Charlton K, Crino M, *et al*. Know your noodles! assessing variations in sodium content of instant noodles across countries. *Nutrients* 2017;9:612.
26. World Health Organization. *Pacific salt reduction targets: why setting targets for salt in food?. Western pacific region*. Geneva, Switzerland: World Health Organization, 2014.
27. Labels R. Secondary reading labels. http://www.worldactiononsalt.com/less/how/labels/ (Accessed 12th April 2018).
28. Food Regulations. Malaysia. 1985.
29. Food Act. Malaysia. 1983.
30. Joint Consumer Council Study. *Sodium and energy contents of asian-style noodles-in-soup dishes. secondary joint consumer council study: sodium and energy contents of asian-style noodles-in-soup dishes*: Joint Consumer Council Study. http://www.cfs.gov.hk/english/programme/programme_rafs/programme_rafs_n_01_2 4_abstract.html
31. Sarmugam R, Worsley A. Current levels of salt knowledge: a review of the literature. *Nutrients* 2014;6:5534–59.
32. Jaenke R, Barzi F, McMahon E, *et al*. Consumer acceptance of reformulated food products: a systematic review and meta-analysis of salt-reduced foods. *Crit Rev Food Sci Nutr* 2017;57:3357–72.
33. Girgis S, Neal B, Prescott J, *et al*. A one-quarter reduction in the salt content of bread can be made without detection. *Eur J Clin Nutr* 2003;57:616–20.
34. Hashem KM, He FJ, Jenner KH, *et al*. Cross-sectional survey of salt content in cheese: a major contributor to salt intake in the UK. *BMJ Open* 2014;4:e005051.
35. Liem DG, Miremadi F, Keast RS. Reducing sodium in foods: the effect on flavor. *Nutrients* 2011;3:694–711.
36. Ball P, Woodward D, Beard T, *et al*. Calcium diglutamate improves taste characteristics of lower-salt soup. *Eur J Clin Nutr* 2002;56:519–23.
37. Pietinen P, Valsta LM, Hirvonen T, *et al*. Labelling the salt content in foods: a useful tool in reducing sodium intake in Finland. *Public Health Nutr* 2008;11:335–40.
38. Hoppu U, Hopia A, Pohjanheimo T, *et al*. Effect of salt reduction on consumer acceptance and sensory quality of food. *Foods* 2017;6:103.

Correction: *Salt content of instant noodles in Malaysia: a cross-sectional study*

Tan CH, Chow ZY, Ching SM, *et al*. Salt content of instant noodles in Malaysia: a cross-sectional study. *BMJ Open* 2019;9:e024702. doi: 10.1136/bmjopen-2018-024702.

This article was previously published with an error in the co-author affiliation.

The correct affiliations for Chia Yook Chin are
Department of Medical Sciences, School of Healthcare and Medical Sciences, Sunway University, Selangor, Malaysia.
Department of Primary Care Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.

BMJ Open 2019;**9**:e024702corr1. doi:10.1136/bmjopen-2018-024702corr1