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Determination of fat, salt and sodium contents of selected fast food items available for sale in Colombo city, Sri Lanka: An approach to colour coding of fast foods

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Fast food has become a popular trend among Sri Lankan population. However, the nutritional facts of these food items are scantly found in Sri Lanka. This study aimed to analyse fat, salt and sodium contents of selected fast food types sold in Colombo city with an attempt to assign colour codes. A questionnaire-based survey was conducted to identify the fast food consumption patterns of the target population. The fat, salt and sodium contents of most preferred fast food types were selected based on the survey, namely; Chinese fish roll (CR), *wade* (WD), chicken *koththu*(CK), chicken fried rice (FR) and doughnut (DG) were analysed using soxhlet, titration and flame photometry methods. The survey results showed that 73.80% of respondents were students, 79.30% were between 18-25 years of age. Among the respondents, 68% preferred to consume fast foods between main meals, and most (57.3%) preferred to consume chicken-based foods. When comparing the analytical results with international guidelines, a serving portion of the selected fast food items did not exceed ($p>0.05$) the DV (daily value) of fat. However, CK and FR exceeded ($p<0.05$) the DV of salt and sodium. Further, when comparing the calculated fat and sodium as a percentage of DV (DV%) with the established DV% references, CK and FR were identified as high-fat foods. All the selected food types were identified as high-sodium foods. When comparing the results obtained for fat with Sri Lankan colour coding regulations, WD and DG were red, while CR, CK, and FR were amber in colour. Considering the salt content, only DG was designated with amber, whereas the other four types of food were categorised under red in colour. This study showed that frequent fast-food consumption is associated with elevated fat, salt and sodium intake and would create a risk of exceeding the relevant DVs. Therefore, the attempt to assign colour code for fast-food would be a great approach to raise nutritional awareness among Sri Lankan population towards fast food.

1. Introduction

Globalisation and urbanisation have influenced the eating habits of people. As a result, there is a tendency to adopt convenient food patterns such as fast food (Ashakiran & Kiran, 2012). Nowadays, there is a rising demand for fast foods due to their exhilarating sensory attributes, convenience and relatively low prices. However, fast food has become a concern, particularly in urban areas due to its high consumption and other quality characteristics that are known to harm public health. Based on reported data, food

and health specialists recommend minimal fast-food consumption due to the possible associations between fast-food intake and the prevalence of non-communicable diseases in a population (Jayawardena et al., 2013). Previous research on fast food showed that they could be considered as poor-quality diets (Rekha et al. 2013) since they contain high amounts of processed meat, refined carbohydrates, sodium, total fat, trans fats, saturated fats, and cholesterol (Bahadoran et al., 2015). The growing body of evidence suggested that the frequent consumption of fast food is associated with the occurrence of various diseases such as; obesity, type-2 diabetes, hypertension and cardiovascular diseases (Bahadoran et al., 2015; Charlton et al., 2007; Johnson et al., 2010; Stender et al., 2007).

International regulatory bodies like the World Health Organization (WHO) and Food and Drug Administration (FDA) have established criteria and recommendations regarding the daily value of fat and salt. The "Daily Value" (DV) of a particular nutrient is defined as the "reference amounts of nutrients to consume or not to exceed each day" (FDA, 2020a). According to the guidelines issued by WHO, "adults should consume less than 2,000 mg of sodium and at least 3,510 mg of potassium per day". Moreover, they have established the recommended maximum salt intake as 5 g per day for adults (WHO 2020). The FDA recommends that individuals should consume no more than 2,300 milligrams of sodium per day (FDA 2020a; Pineo 2018). In terms of fats, FDA has set the daily value of total fat at 78g (FDA 2020b).

The fast-food industry has gained more popularity among the Sri Lankan population and has in some ways altered traditional diet patterns (Rasanthika and Gunawardena, 2013). A range of fast-food types is available for sale in local food outlets, yet, their nutritional data are scarce. Since fast food is consumed at a high frequency, an approximate estimate of nutritional components in fast food should be made to raise consumer awareness for daily fat, salt and sodium intake. The nutritional profiling of fast food would help to reduce the risk of exceeding DV of these components recommended by WHO and FDA. In an attempt to approach nutritional profiling, the Ministry of Health in Sri Lanka has developed a colour code labelling system of solid and semisolid food items to indicate the sugar, salt, and fat contents to enhance consumer awareness and precautionary measures. As a result, Food (Colour Coding for Sugar, Salt and Fat) Regulations (2019) were published by the Minister of Health, Nutrition and Indigenous Medicine under Section 32 of the Food Act, No. 26 of 1980. Currently, only salt, sugar and fat contents from packaged solid and semi-solid food items are controlled by this food regulation. Therefore, the primary objective of this study was to find out the most preferred fast food types in food outlets of Colombo city and to analyse fat and salt contents to assign colour codes for these food items according to the Sri Lankan food colour coding regulations (2019). Moreover, this study aimed to compare these fast foods' total fat, salt and sodium content with the international criteria and elaborate on the extension to which these components fulfil the daily requirement. Therefore, the findings of this study would be helpful to bring awareness to the general public on the nutritional quality of fast food.

2. Materials and methods

2.1 Data collection

School children, university students, employees and non-employees in Colombo city, who were in the age range from 18-40 years, were identified as the target population. Those with a permanent residence, temporary residence in the Colombo municipal council (CMC) area, and who came to the CMC area regularly and consumed foods from food outlets in Colombo city from October to November 2018 were included in the study. A voluntary online survey was conducted using a questionnaire. The survey results were used to identify the fast food items that were consumed frequently during the specified period.

2.2 Development and the pre-test of the questionnaire

The development and pretesting of the questionnaire were done before conducting the survey. Before the proper survey, an exploratory survey was done to identify the consumption frequency of fast food and the relevant fast-food items to be included in the final questionnaire. A preliminary questionnaire was developed with a sample population of 25 respondents (n=25). This group included people from different categories: school children, college students such as university students, employees, and non-employees from the Colombo city area. The proper questionnaire

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was developed using the details that were obtained through the preliminary questionnaire.

An undeclared pre-test was conducted to check the validity of the questionnaire. For that purpose, a representative sample of respondents comprised of 15 (n=15) were selected from the target population. The developed proper questionnaire was distributed among the representative population, and the responses were observed. The pre-test results were compared with the expected results and checked the ability of each question to interpret the domain of interest. Modifications were done to the questions that were not able to provide a sufficient intended outcome.

2.4 Sample collection and preparation

During the survey, the respondents were guided to vote for the most preferred fast food items (up to 8 items) from the list. The overall percentage of preference for each fast-food type was calculated by dividing the "number of votes for a particular food type" by "total number of respondents" and converting to percentage values. According to the results, five different types of fast food items were selected for compositional analysis: Chinese fish roll (fried roll filled with fish), *wade* (fried lentil cake), chicken *koththu* (tempered shredded wheat flour roti with chicken), chicken fried rice (tempered rice with chicken) and doughnuts. Ten food outlets were identified from different areas of Colombo city to collect samples of selected food items. The unit weight of each sample was weighed, homogenised separately and analysed in triplicate. The moisture of homogenised samples was removed at 105 °C until two consecutive weighing were less than 0.1% deviation, and they were ground into fine particles using a grinder (Sisil, 02 Jar Mixer Grinder, 350 W). Samples were stored in an airtight package at -4 °C until taken for analysis. The study was conducted from October 2018 to February 2019.

2.5 Determination of fat

Total fat content was determined by adopting the soxhlet method given in AOAC (2005) and described by Akmar et al. (2013). Five grams of moisture-free homogenate was used with hexane (GC grade, ≥ 99%, boiling point- 69 °C, purchased from Sigma – Aldrich, France) at 70 °C for 6 -7 h to extract fat in the extraction unit. The solvent evaporation was done using a rotary evaporator at 70 °C followed by oven drying at 70 °C until the difference of two consecutive weighing was less than 0.1%.

2.6 Determination of salt

The salt content of fast food was determined according to the method described by Khan and Martin (1983). Five grams of dried homogenised food sample was soaked in 20 mL of distilled water for 3 min while stirring intermittently. After filtering, a 10 mL aliquot of the filtrate was mixed with 5 drops of 5 % potassium dichromate and titrated against 0.1 N silver nitrate solution. Method validation was done by spiking the known weight of analytical grade NaCl with the known weight of the sample and then by analysing the recovery results.

2.7 Determination of sodium

Quantitative detection of sodium was done following the method described by Ranst et al. (1999) with some modifications. Accurately 1-3 g of dried fast-food sample was ashed at 525 °C for 6 -8 h. The ashen sample was digested using 5 mL of 6M nitric acid by gentle boiling followed by adding 5 mL of 3M nitric acid and reheating for a few minutes. The digested extract was filtered while warm into a 50 mL volumetric flask using an ashless filter paper (Whatman, 42, ashless, 110 mm). The extract was topped to 50 ml with deionized water and diluted with 1% nitric acid to obtain values between the calibrations. The samples were analysed using the flame photometer (Jenway, PEP 7, Japan), calibrated with a 0,5,10,15,25,30 µg/mL standard sodium solution series. Method validation was done by spiking the known volume of sodium standard (AAS grade) with a known weight of the sample and by measuring the recovery. The amount of sodium coming from salt was subtracted from the analysed total sodium content to obtain the value for sodium contribution from other sources apart from salt (sodium*). The sodium content coming from salt was calculated as 2.5 g of salt equivalent to 1 g of sodium (Harvard Health Publishing, 2010).

2.8 Statistical Analysis

Results were statistically analysed using Minitab 15 software at α=0.05 (95% confidence interval). The difference of the mean values obtained for fat, salt, sodi-

um and sodium* contents of five fast food items were statistically analysed based on randomised block design (RCBD) using a general linear model considering the selected food outlets (n=10) as blocks and the type of fast food as the treatment (n=5). When the F values were significant, mean differences were compared using the Tukey test at a 5% significance level. One sample t-test (upper tailed) was conducted for values of fat, salt and sodium obtained for serving portions with the relevant DV specified by WHO and FDA.

3. Results

3.1 Online survey

One hundred and fifty (150) people answered the questionnaire. The results gathered from the survey are summarized in Table 1 and Figures 1 and 2. According to Table 1, the majority of respondents were female; therefore, the results could be biased towards the female population. The highest proportion (79%) of the respondents represented 18-25-year-olds, and around 74% of the respondents were students. Furthermore, the majority of the respondents preferred to consume chicken-based food items.

Figure 1 shows the respondents' preference for different food items. According to figure 1, the descending order of preference was obtained for fried rice (83.29 %), *koththu* (67.30 %), *wade* (54.7 %), Chinese roll (52.70 %) and pastry (50 %). Among confectionaries, doughnuts had the highest preference (28.70 %). Following the results depicted in Table 1, the respondents prioritised chicken -based foods when selecting food

Table 1. Demographic characteristics of respondents who participated in the questionnaire survey

Character		Percentage (%)
Gender	Male	37.30
	Female	62.70
Designation	Student	73.80
	Employee	24.80
	Non- Employee	1.4
Age	18-25 years	79.30
	26-35 years	19.30
	15-17 years	0.8
	36-50 years	0.6
Food preference	Chicken-based foods	57.30
	Fish-based foods	9.3
	Egg-based foods	20
	Vegetable-based foods	13.30
Time preference to eat fast food	As the main meal (Breakfast, Lunch, Dinner)	32
	In between main meals	68

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items. However, fish Chinese rolls were selected for analysis due to less availability of chicken and vegetable Chinese rolls in food outlets. Considering this information on preference for food items, Chinese fish roll (CR), *wade* (WD), chicken *koththu*(CK), chicken fried rice (FR) and doughnut (DG) were selected for this study.

The consumption frequency of the most preferred fast food items by the respondents is described in Figure 2. It shows that a more significant number of respondents tend to consume these fast food types less than two times per week. Moreover, a considerable number of respondents consumed these fast food 2-4 times per week. A comparatively small proportion of respondents consume these foods 5-7 per week, while some respondents consumed them up to 8-9 times per week.

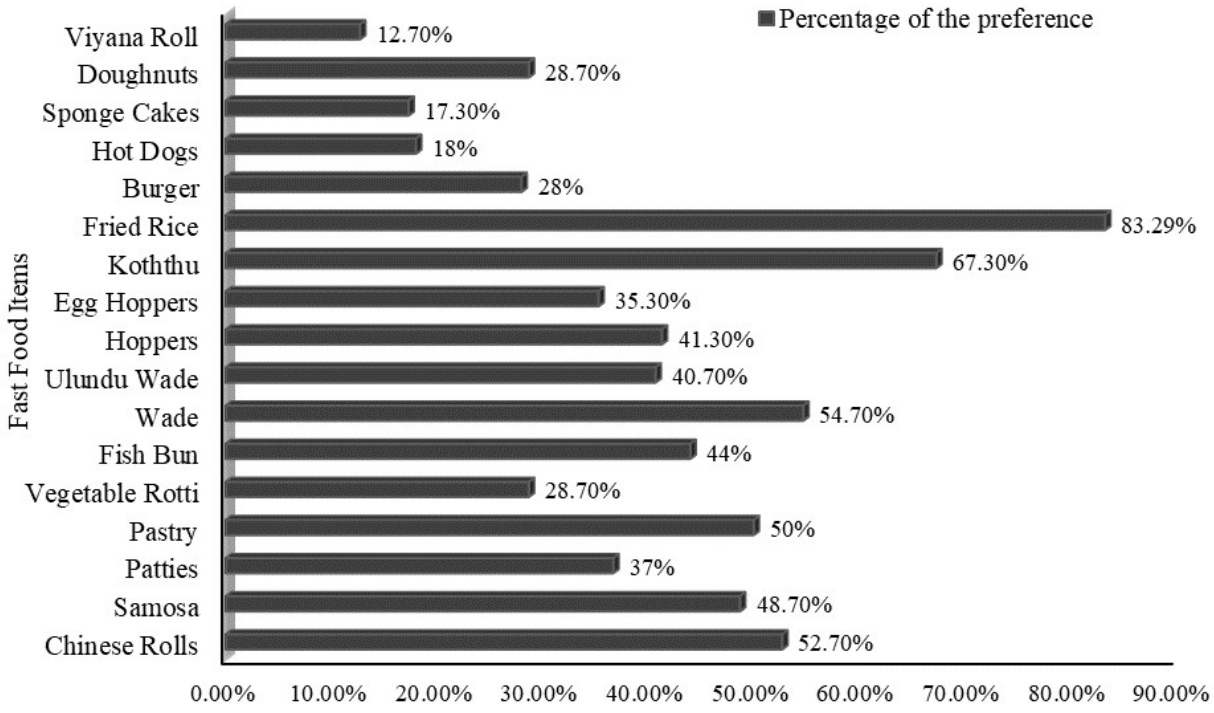

Figure 1. Preference for different food items by respondents

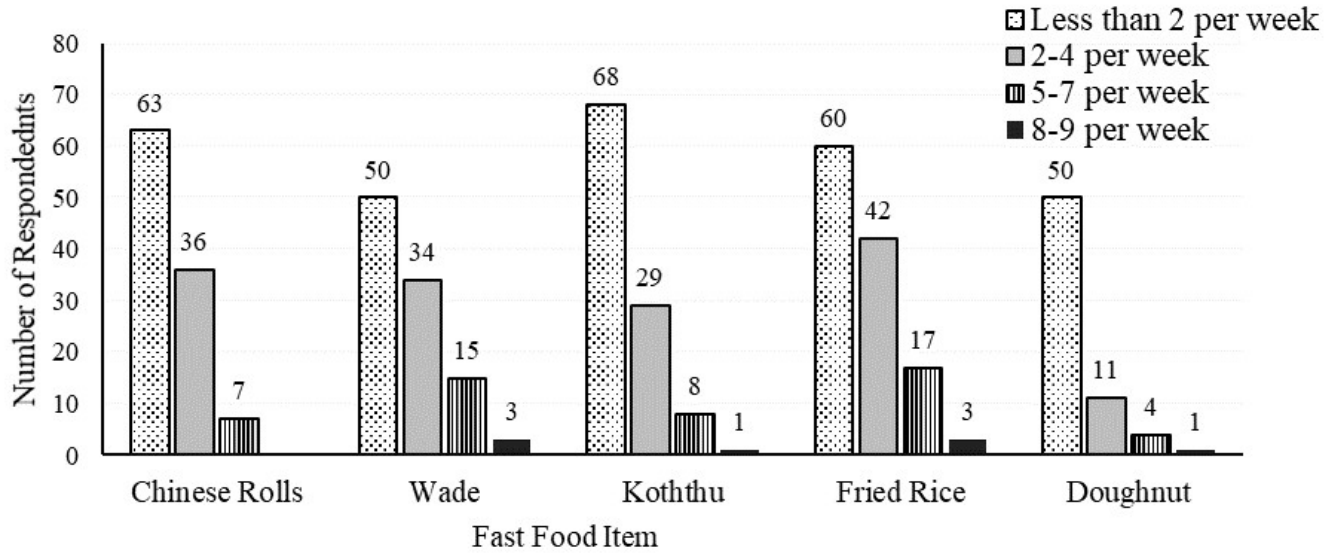

Figure 2. The frequency of consumption of fast food: Chinese rolls, *wade*, *koththu*, fried rice and doughnut by respondents.

3.2 Fat content

Table 2 shows the mean values for total fat content and the contribution to calorie intake of selected fast foods. According to the data, *wade* (18.86 ± 1.65 g) and doughnut (18.69 ± 4.26 g) resulted in significantly highest ($p<0.05$) fat contents in 100 g portion of food while chicken fried rice showed the lowest (5.19 ± 1.28), which was not significantly different ($p>0.05$) from chicken *koththu*. When considering the fat content in one serving, chicken *koththu* resulted in a significantly high ($p<0.05$) amount of fat (46.31 ± 7.27 g) while Chinese roll gave the lowest value (6.17 ± 1.97). The mean fat percentage of *wade* in this study was compared with a previous study conducted by Jayasinghe and De Silva (2014), which was 16.68 g / 100 g dry weight.

FDA has specified the DV for total fat as 78 g, based on a diet that provides 2,000 calories per day. Moreover, the guidelines stated that "5% DV or less of total fat per serving is considered low while 20% DV or more of total fat per serving is considered high" (FDA, 2020b). When comparing with the results, the mean fat values of a serving portion of these food items did not significantly exceed the DV (78 g) ($p>0.05$). However, chicken *koththu* and fried rice were identified as foods with high total fat contents, based on the calculated DV% (Table 2). Fat is a major calorific source and provides 9 calories from each 1 g of fat (FDA, 2020b). The calorie contribution from fats in a serving size of each fast food item was calculated (Table 2). According to the data, one serving of chicken *koththu* (416.77 kcal) and chicken fried rice (249.48 kcal) noticeably contributed to the daily calorie intake. In Sri Lanka, *koththu* and fried rice are consumed as main meals. Since fat extracted from chicken *koththu* was providing more than 400 calories per serving (table 2), it can be identified as a high-calorie food according to the FDA guidelines (FDA, 2020c)

3.3 Salt content

Table 3 shows the mean salt contents of selected fast foods. According to the data, *wade* (2.69 ± 0.58) had significantly ($p<0.05$) highest salt content when considering 100 g of food. Meanwhile, doughnuts resulted in the lowest salt content (1.15 ± 0.13 g), where the value was not significantly different ($p>0.05$) from the results obtained for chicken fried rice and chicken *koththu*. When considering a serving portion, Chicken *koththu* (12.06 ± 2.30 g) resulted in the highest amount of salt, which was significantly ($p<0.05$) different from the others. Whereas doughnut showed the lowest salt content (0.84 ± 0.19 g) and the values obtained for Chinese fish roll and *wade* did not show any significant difference ($p>0.05$) with doughnut. However, previous studies on the salt content of Sri Lankan

Table 2. Mean total fat content compared with the daily value of fat (78g) and calories (2000 kcal) for adults

Food "type"	Fat(g) / 100g of food	Fat (g) content in a serving of food	Calculated % of fat (in a serving of food) as DV (78 g)	Calculated calories from fat, in a serving of food (kcal)	Calculated % of calories from fat (In a serving of food) as DV (2000 kcal)
CR (n=10)	9.33 ± 2.27^{b}	6.17 ± 1.97^{a}	7.91	55.50	2.77
WD(n=10)	18.86 ± 1.65^{c}	10.79 ± 4.16^{b}	13.83	97.08	4.85
CK(n=10)	$6.56 \pm 1.27^{a,b}$	46.31 ± 7.27^{d}	59.37	416.77	20.84
FR (n=10)	5.19 ± 1.28^{a}	27.72 ± 6.82^{c}	35.54	249.48	12.47
DG(n=10)	18.69 ± 4.26^{c}	14.55 ± 6.56^{b}	18.65	130.91	6.55

CR: Chinese fish roll, WD: *Wade*, CK: Chicken *koththu*, FR: Chicken fried rice, DG: Doughnut, DV: Daily value. Each value in the 2nd and 3rd columns of the table represents the mean (mean ± standard deviation) of ten samples collected from ten different food outlets. The means bearing different superscript letters in the same column are significantly different ($p < 0.05$). The mean weight (g) of serving portion of fast food items; CR, 65.5 ± 8.39; WD, 56.4 ± 18.68; CK, 712± 54.96; FR, 534.6 ± 27.51; DG, 77 ± 17.79

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fast food are not available for comparison. According to the WHO guidelines, the DV for salt is less than 5 g per day for adults (WHO 2020). When comparing the obtained mean value of salt with the DV for salt, one serving of chicken *koththu* and chicken fried rice exceeded the DV of salt significantly ($p<0.05$) while the salt contents of the rest food items remained below DV.

3.4 Total sodium content

Table 4 shows the mean values of total sodium and sodium* obtained for each fast food item. As depicted in the data, *wade* had the highest value of sodium (1.60 ± 0.62 g) while doughnut (0.80 ± 0.29 g) had the lowest value in 100 g. However, the values varied within a narrow range where only *wade* and doughnut were significantly different from each other ($p<0.05$). In contrast, the other three food types did not show a significant difference ($p>0.05$) with the results of *wade* and doughnut. When comparing the results obtained for a serving portion, Chicken *koththu* had the highest sodium value (8.85 ± 3.47 g), which was significantly different ($p<0.05$) from other food items. Meanwhile, doughnut (0.59 ± 0.18 g) contained the lowest value, which was not significantly different ($p>0.05$) from the values obtained for Chinese fish roll and wade.

No significant difference ($p>0.05$) was observed among values obtained for sodium* in 100 g of food. Chicken *koththu* (4.14 ± 2.70 g) showed the highest sodium* content in a serving portion though the value was not significantly different ($p>0.05$) from the sodium* content of chicken fried rice. The lowest sodium* content was observed in doughnut (0.27 ± 0.15), and this value did not show a significant difference ($p>0.05$) with the values obtained for Chinese fish rolls, *wade* and chicken fried rice. The FDA guidelines have specified the DV of sodium as less than 2.3 g per day (FDA, 2020a; Pineo, 2018). When compared with given DV with the results of this study, the mean sodium content of a serving of chicken *koththu* and chicken fried rice was significantly ($p<0.05$) higher than the respective DV.

As a general guide, FDA states, "5% DV or less of sodium per serving is considered low while 20% DV or more of sodium per serving is considered high" (FDA, 2020a). When comparing these reference values with the calculated DV% of fast foods considering the total sodium (Table 4), all the selected fast food types were able to identify as foods with high sodium contents. However, when considering the DV% of sodium coming from other sources apart from salt, Chinese fish rolls, chicken *koththu* and chicken fried rice exceeded the 20 DV% claiming their high sodium contents.

The overall results of this study showed that the fat, salt, and sodium contents coming from these foods largely depended on the serving portion's size. As Chinese fish roll, *wade* and doughnut are sold as small serving portions, people may tend to eat more than one serving of the same food or more than one type of fast food. Data given in Table 1 shows that the majority of the respondents (68%) prefer to consume fast food in between main meals. Therefore, for these respondents, the consumption of these foods can act as an additional source of these nutrients, and there is a

Table 3. Mean salt content of fast food compared with the daily value of salts (5g) for adults

Food type	Salt (g) / 100g of food	Salt (g) content in a serving of food	Calculated % of salt (In a serving of food) as DV(5g)
CR (n=10)	2.09 ± 3.56^{b}	1.37 ± 0.33^{a}	27.4
WD(n=10)	2.69 ± 0.58^{c}	1.48 ± 0.5^{a}	29.6
CK(n=10)	$1.70 \pm 0.33^{a,b}$	12.06 ± 2.30^{c}	241.2
FR (n=10)	1.45 ± 0.64^{a}	7.72 ± 3.44^{b}	154.4
DG (n=10)	1.15 ± 0.13^{a}	0.84 ± 0.19^{a}	16.8

CR: Chinese fish roll, WD: *Wade*, CK: Chicken *koththu*, FR: Chicken fried rice, DG: Doughnut, DV: Daily Value. Each value in the 2nd and 3rd columns of the table represents the mean (mean ± standard deviation) of ten samples collected from ten different food outlets. The means bearing different superscript letters in the same column are significantly different ($p < 0.05$). The mean weight (g) of serving portion of fast food items; CR, 65.5 ± 8.39; WD, 56.4 ± 18.68; CK, 712± 54.96; FR, 534.6 ± 27.51; DG, 77 ± 17.79

Table 4. Mean values of the sodium content of fast food compared with the daily value of sodium (2.3 g) for adults

Food type	Total sodium (g) / 100g of food	Total sodium (g) content in a serving of food	Calculated % of total sodium (in a serving of food) as DV (2.3 g)	Sodium* (g)/ 100 g of food	Sodium* (g) in a serving of food	Calculated % of sodium* (in a serving of food) as DV (2.3 g)
CR (n=10)	$1.38 \pm 0.57^{a,b}$	0.93 ± 0.50^{a}	40.43	0.72 ± 0.42^{a}	0.50 ± 0.36^{a}	21.74
WD(n=10)	1.60 ± 0.62^{b}	0.89 ± 0.4^{a}	38.70	0.63 ± 0.40^{a}	0.35 ± 0.24^{a}	15.22
CK(n=10)	$1.25 \pm 0.50^{a,b}$	8.85 ± 3.47^{c}	384.78	0.59 ± 0.39^{a}	4.14 ± 2.70^{b}	180.00
FR (n=10)	$1.02 \pm 0.53^{a,b}$	5.42 ± 2.79^{b}	227.82	0.46 ± 0.34^{a}	$2.42 \pm 1.79^{a,b}$	105.22
DG(n=10)	0.80 ± 0.29^{a}	0.59 ± 0.18^{a}	25.65	0.35 ± 0.24^{a}	0.27 ± 0.15^{a}	11.74

CR: Chinese fish roll, WD: *Wade*, CK: Chicken *koththu*, FR: Chicken fried rice, DG: Doughnut, DV: Daily Value. sodium*; sodium contribution from other sources apart from salt. Each value in the 2nd, 3rd, 5th and 6th columns of the table represents the mean (mean ± standard deviation) of ten samples collected from ten different food outlets. The means bearing different superscript letters in the same column are significantly different ($p < 0.05$). The mean weight (g) of serving portion of fast food items; CR, 65.5 ± 8.39; WD, 56.4 ± 18.68; CK, 712± 54.96; FR, 534.6 ± 27.51; DG, 77 ± 17.79

chance to exceed the relevant DV. The range of each fat, salt and sodium of a particular fast food sample obtained from different fast food outlets (10 outlets) varied within a broad range. The variation could be due to the implementation of different culinary practices as the ingredients and preparation methods could vary according to the chef's interest and with the preference of customers.

Sri Lankan government has imposed food colour coding regulations 2019 for solid and semi-solid foods concerning sugar, salt and fat contents. In this system, the term fat refers to the total fatty acids in the form of triglycerides and salt refers to the total salt in the food, in the form of sodium chloride (food (colour coding for sugar, salt and fat) regulations, 2019). The summary of the colour coding labelling of selected fast food items is shown in Table 5.

Summary of Table 5 depicted that *wade* and doughnut could be indicated with red colour while chicken fried rice, chicken *koththu* and Chinese fish roll could be indicated with amber colour based on their total fat contents. Considering the salt contents, only doughnut could be indicated with amber colour, whereas the other four types of food were assigned to the red colour category (food (colour coding for sugar, salt and fat) regulations, 2019).

4. Discussion

The rate of fast food consumption among children and adolescents has increased steadily and rapidly during recent years. This nutritional transition can significantly impact those individuals as these fast foods possess a low dietary quality (Rouhani et al., 2012).

According to a study performed by Jayasinghe and De Silva (2014), the majority of students of a Sri Lankan university tend to consume fast food daily and at least once a day. The vast prevalence of fast foods services would act as one of the main reasons for the rising consumption of these foods. It is reported that the geographical concentration of fast food outlets is interrelated with negative health effects of a population, including the rising number of all-cause mortality and comorbidities associates with overweight and obesity (Kruger et al., 2014). Further, the consumption frequency of fast food was associated with the occurrence of risk for cardiovascular diseases, insulin resistance, obesity and diabetes (Bahadoran et al., 2015; Rouhani et al., 2012). Further, it is reported that the consumption of fast food for two times or more per

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Table 5. Colour coding for fat and salt content of 100g of solid and semisolid foods compared to selected fast food items. Source: Food (Colour Coding for Sugar, Salt and Fat) Regulation (2019), Section 32, Food Act, No 26/1980.

Colour	Fat g / 100g	Salt g / 100g	Fast food items (Fat)	Fast food items (Salt)
Red	More than 17.50	More than 1.25	*Wade* and doughnut	*Wade*, Chinese fish rolls, chicken *koththu*, chicken fried rice
Amber	3 to 17.5	0.25 to 1.25	Chinese fish rolls, chicken *koththu*, chicken fried rice	Doughnut
Green	Less than 3	Less than 0.25	-	-

week would raise the risk of having various non-communicable diseases (Bahadoran et al., 2015).

This study showed that the selected fast food types contain considerably high amounts of total fats, some with high DV% that contribute to a plentiful amount of calories (Table 2). However, an indiscriminate intake of saturated fats and calories can occur if the fat intake exceeds 35% of an individual's daily calorie requirements (Dhaka et al., 2011). Therefore, elevated daily consumption of fast food would increase the possibility of exceeding these specifications. Excessive calorie intake is known to directly impact the increment of body weight (WHO, 2004). According to Table 2, the total fat content in 100 g of food was high in deep-fried food items; wade, doughnut, Chinese fish rolls than the others. Previously, Jayasinghe and De Silva (2014) have analysed the proximate composition of selected fast food varieties sold in Sri Lanka. They also have reported relatively higher total fat contents in 100 g of egg rolls, vegetable roll and *wade*, which were prepared by deep-frying than in vegetable roti. Moreover, they stated that consuming a unit of one of these fast foods once a day would provide a maximum of 151.99 kcal of dietary energy.

Most of the fast-food sold at Sri Lankan food outlets is prepared by deep-frying. Cutlets, Chinese rolls, French fries, doughnuts, samosa, patties, and *wade* are some common examples. This cooking method results in the high-fat content of deep-fried food items. Regardless of the calories that come from fat, these fats can cause detrimental health issues. During the frying process, the composition of food and the frying medium itself is modified through the oxidation, hydrogenation and polymerization processes. When the same oil is used repeatedly for the frying process, the fatty acid composition of the oil is altered due to its deterioration. These degraded products could be absorbed by food during the frying process (Cahill et al., 2014). The reuse of deep-fried oil for fast food preparation would increase the possibility of imposing negative health impacts associated with fast food consumption (Goswami et al., 2016). Therefore, it indicates that an in-depth study is needed to identify the contribution of fast food to the well-being of the Sri Lankan population.

Salt intake can be considered a public health issue in many countries due to the prevalence of diseases associated with high salt intake, such as hypertension, stomach cancer, heart and kidney diseases, stroke, obesity and osteoporosis (Rekha et al., 2013). Therefore, WHO has targeted the development and implementation of strategies to reduce the daily salt intake of the population (WHO, 2020). However, according to the findings given in Table 3, fast food consumption would be a challenge to accomplish this task as they contained a high amount of salts, and more often, they were found to exceed the recommended DV. Salt consumption is directly interrelated with sodium consumption, and the results of this study supported this statement. According to the DV% values, the selected fast food types were identified as high sodium foods. (Table 4). Sodium intake was directly associated with human blood pressure, which is a major risk factor for cardiovascular diseases (Johnson et al., 2010).

Salt is the primary source of sodium in the diet, responsible for around 90% of it. Approximately one

teaspoon of salt is reported to contain 2300 mg of sodium (American Heart Association, 2019) and 2.5 g of salt is found to be equivalent to 1 g of sodium (Harvard Health Publishing, 2010). In contrast, sources such as monosodium glutamate (MSG), baking soda, curing salt like ingredients also contribute to the total sodium content of the diet (Cobb et al., 2012). However, the data depicted in Table 4 showed that the sodium from other sources are also noticeably contributing to total sodium content. Thus, some food items were identified as high sodium foods based on DV%, regardless of the sodium coming from salt (FDA, 2020a). This could be due to the addition of other sodium-based ingredients as discussed above and the naturally found sodium in raw food materials used for fast food preparation.

The results of this study emphasise the importance of establishing colour coding guidelines for the sodium content of fast foods in addition to the salt content. Regarding the adverse impacts of sodium on human health, international food labelling regulations and most dietary guidelines demand to include the sodium content in nutritional details (FDA, 2020a). According to Liem et al. (2011), the manufactured foods and the foods consumed from restaurants contribute to 75% of sodium in the diet. Sodium increases saltiness, enhances sweetness, and reduces bitterness, thus contributing to food's sensory attributes. Since the flavour of processed foods depends on the sodium content, it will be challenging to reduce the sodium in processed foods (Johnson et al., 2010). However, some researchers claim that a 15% reduction in sodium intake would prevent about 8.5 million global deaths associated with cardiovascular diseases over 10 years (Asaria et al., 2007; Liem et al., 2011).

The approach for colour coding of fast foods could be identified as a great milestone with regard to public health nutrition in Sri Lanka. This can be used to attract and raise the awareness of fast-food consumers by assigning a colour logo rather than using numerical values. The results depicted in Tables 2, 3 and 4 elaborated the compliance of fat, salt and sodium with the international criteria. The results emphasised the ultimate importance of applying the Sri Lankan colour coding regulation for fast foods sold in food outlets and thereby, fast-food consumers can have proximate knowledge of their daily intake of fat, salt and to what extent it complies with the relevant DV. The colour coding labelling is applied for various Sri Lankan food items sold in containers and packages. Nevertheless, colour coding of fast food types would become a challenge as they come with a large number of varieties and also due to their diversified preparation methods. However, the summary of the colour coding of the selected fast foods of this study would be an educative fact for Sri Lankan fast-food consumers. It would provide an initial step for future implementations regarding this purpose.

5. Conclusion

The lack of proper nutritional data of fast food available for sale in Sri Lanka has become a burden for improving public health. This study showed that the intake of fat, salt and sodium, sodium comes from fast food varied according to the food type and the weight of the serving portion of fast food. Among the selected food types, the highest total fat, salt and total sodium contents in 100 g of food resulted in wade. The highest total fat, salt, both total sodium and sodium* were contained in chicken *koththu* and was identified as a high-calorie food in a serving portion. In contrast, its salt and total sodium contents significantly ($p<0.05$) exceeded the relevant DV and thus was found to be a high-fat food based on DV%. Overall results showed that the frequent consumption of Chinese fish roll, wade, chicken *koththu*, chicken fried rice and doughnut could cause health issues as they contribute to a large daily intake of fats, sodium and salt. There is a possibility to exceed the relevant DV of these nutrients, depending on the size of the serving portion and the number of portions consumed per day. The results of this study emphasised the importance of employing colour coding regulations for fast foods. Following the criteria given by the colour coding system for fat, *wade* and doughnut were assigned with red colour while Chinese fish roll, chicken *koththu*, chicken fried rice were assigned with amber. Considering the salt content, only doughnut was assigned with amber colour, whereas the other four types were red. This study plays an important role in alarming consumer awareness concerning the nutritional quality of fast food. All these findings suggest that consciousness regarding the nutritional values and the consumption frequency of these fast food is essential and measures should be taken to regulate fast food quality and sales

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in Sri Lanka.

Conflict of Interest Statement

The authors declare that there is no conflict of interest. Besides, the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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Data Availability

The data supported the findings of this study will be provided by the corresponding author upon request.

References

Akmar, Z. D., Norhaizan, M. E., Azimah, R., Azrina, A., & Chan, Y.M. (2013). The trans fatty acids content of selected foods in Malaysia. Malaysian Journal of Nutrition, 19(1), 87-98.

American Heart Association. (2019, January 30). Get the scoop on sodium and salt. Retrieved from https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/sodium/sodium-and-salt

AOAC International (2005). Official Methods of Analysis of AOAC International, 18th edition. AOAC International, Rockville, Maryland, USA.

Asaria, P., Chisholm, D., Mathers, C., Ezzati, M., & Beaglehole, R. (2007). Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. Lancet, 370, 2044-2053. doi: 10.1016/S0140-6736(07)61698-5.

Ashakiran, S. & Kiran, D. (2012). Fast foods and their impact on health. Journal of Krishna Institute of Medical Sciences University, 1(2), 7-15.

Bahadoran, Z., Mirmiran, P., & Azizi, F. (2015). Fast food pattern and cardiometabolic disorders: A Review of Current Studies. Health Promotion Perspectives, 5(4), 231-40. doi:10.15171/hpp.2015.028.

Cahill, L. E., Pan A1, Chiuve, S. E., Sun, Q., Willett, W. C., Hu, F. B., & Rimm, E. B. (2014). Fried-food consumption and risk of type 2 diabetes and coronary artery disease: a prospective study in 2 cohorts of US women and men. The American Journal of Clinical Nutrition, 100(2), 667-75. doi: 10.3945/ajcn.114.084129.

Charlton, K. E., Steyn, K., Levitt, N. S., Jonathan, D., Zulu, J. V., & Nel, J. H. (2007). Development and validation of a short questionnaire to assess sodium intake. Public Health Nutrition, 11(1), 83-94. doi: 10.1017/S1368980007000146.

Cobb, L. K., Appel, L. J., & Anderson, C. A. M. (2012). Strategies to reduce dietary sodium intake. Current Treatment Options in Cardiovascular Medicine, 14(4), 425–434. doi: https://doi.org/10.1007/s11936-012-0182-9.

Dhaka, V., Gulia, N., Ahlawat, K. S., & Khatkar, B. S. (2011). Trans fats - sources, health risks and alternative approach- A review. Journal of Food Science and Technology, 48(5), 534-54. doi: 10.1007/s13197-010-0225-8.

FDA. (2020a) Sodium in Your Diet. Retrieved from https://www.fda.gov/food/nutrition-education-resources-materials/sodium-your-diet

FDA. (2020b). Total fat. Retrieved from https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/assets/InteractiveNFL_TotalFat_March2020.pdf

FDA. (2020c). What's on the nutrition facts label. Retrieved from https://www.accessdata.fda.gov/scripts/interactivenutritionfactslabel/assets/InteractiveNFL_WhatsOnTheNFL_March2020.pdf

Food (Colour Coding for Sugar, Salt and Fat) Regu-

lations 2019, Section 32, Food Act- No 26/1980. Retrieved from http://eohfs.health.gov.lk/food/images/pdf/regulations/Colour-coding-solids-English.pdf

Goswami, G., Bora, R., & Mahipat, S. R. (2015). Oxidation of cooking oils due to repeated frying and human health. Proceedings of the 2nd International Conference on Science, Technology and Management (ICSTM-15). Delhi University, Conference Centre, New Delhi.

Rasanthika, A. H. B. S., & Gunawardena, T. S. L.W. (2013). Fast food consumption: Identifying working women's attitude towards consumption of fast foods. Proceedings of the 2nd International Conference on Management and Economics (ICME 2013). Matara, Sothern Province, Sri Lanka

Harvard Health Publishing. (2010). Salt and your health, Part I: The sodium connection. Retrived from https://www.health.harvard.edu/newsletter_article/salt-and-your-health

Jayasinghe, J. M. J. K., & De Silva, L. P. U. (2014). Fast food consumption and health status of students of a University in Sri Lanka. Journal of Food and Agriculture, 7(1- 2), 38-50. doi: 10.4038/jfa.v7i1-2.5192.

Jayawardena, R., Byrne, N., Soares, M., Katulanda, P., & Hills, A. (2013). Food consumption of Sri Lankan adults: An appraisal of serving characteristics. Public Health Nutrition, 16(4), 653-8. doi: 10.1017/S136898001200301.

Johnson. C. M., Angell, S. Y., & Lederer, A. (2010). Sodium content of lunchtime fast food purchases at major us chains. Archives of Internal Medicine, 170(8), 732–734. doi:10.1001/archinternmed.2010.72.

Khan, M. A., & Martin, J. A. (1983). Salt content of selected snack foods. Journal of Food Science, 49, 656-657. doi: 10.1111/j.1365-2621.1983.tb10816.x

Liem, D. G., Miremadi, F., & Keast, R. S. (2011). Reducing sodium in foods: the effect on flavor. Nutrients, 3(6), 694-711. doi: 10.3390/nu3060694.

Pineo, C. (2018). The FDA recommended sodium intake. Retrieved from https://healthyeating.sfgate.com/fda-recommended-sodium-intake-1873.html

Ranst, E. V., Verloo, M., Demeyer, A., & Pauwels, J. M. (1999). Manual for the soil chemistry and fertility laboratory: Analytical Methods for Soils and Plants Equipment, and Management of Consumables (pp. 178-179). University of Ghent, Belgium.

Rekha, R., Nandini, S. K., Sashikala, T., & Rao, P. K. V. S. (2013). Study of salt (sodium chloride) content in different fast food meals available in college and office canteens in Visakhapatnam city. Journal of Community Nutrition & Health, 2(1), 15-19.

Rouhani, M. H., Mirseifinezhad, M., Omrani, N., Esmaillzadeh, A., & Azadbakht, L. (2012). Fast food consumption, quality of diet, and obesity among Isfahanian adolescent girls. Journal of Obesity, 2012. doi: https://doi.org/10.1155/2012/597924

Stender, S., Dyerberg, J., & Astrup, A. (2007). Fast Food: Unfriendly and Unhealthy. International Journal of Obesity, 31(6), 887–890. doi: https://doi.org/10.1038/sj.ijo.0803616

WHO. (2004). World Health Organization expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. The Lancet, 363, 157-163.

WHO. (2020). Salt reduction. Retrieved from https://www.who.int/news-room/fact-sheets/detail/salt-reduction

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