

Original Article

Impact of COVID-19 lockdown on meat or equivalent consumption behavior among Sri Lankan adults: a cross-sectional study

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Abstract

Background: The COVID-19 lockdown severely affected dietary behaviors, particularly meat or equivalent consumption. This study aimed to understand the impact of COVID-19 confinement on meat or equivalent consumption pattern among Sri Lankans.

Methods: A cross-sectional study was conducted from 27th May to 2nd June 2021 as a national-level online survey in Sri Lanka using a self-administered questionnaire developed as Google forms. The questionnaire consisted of questions related to socio-demographics and dietary behaviors. Descriptive, univariate, and multinomial logistic regression was performed. The statistical significance is considered at less than 0.05.

Results: A total of 3600 respondents were included, with the majority being women (60.1%). A higher proportion of the participants increased their consumption of eggs (53.7%), dhal (47.0%), and dry fish and sprats (36.3%). A big trend was observed in cutting down the fish (41.1%) and other seafood (52.0%) consumption. Nearly half of the respondents did not change their consumption of meat other than chicken (54.5%), pulses (52.6%), soya meat (52.1%), dry fish and sprats (48.9%), canned fish (47.6%), sausages and meatballs (45.1%), and chicken (43.7%). The males (odds ratio (OR) 0.852; 95% CI: 0.738 to 0.984, P = 0.029) and Tamil (OR = 1.605, 95% CI: 1.150 to 2.239, P = 0.005) showed a significant likelihood to increase egg consumption. Respondents with a lower income <25,000 LKR (OR 2.220; 95% CI 1.672-2.947, P = 0.000) were more than twice likely to report increased dhal consumption. The same income group (< 25,000 LKR) (OR = 2.752; 95% CI: 2.024-3.741, P = 0.000) reported more than twice reduction in fish consumption. Respondents in municipal area (OR = 1.523; 95% CI: 1.186 to 3.292, P = 0.009) showed a significantly higher likelihood to reduction in other seafood consumption.

Conclusion: An overall change in meat or equivalent consumption behavior among Sri Lankan adults was evidenced. Furthermore, nutrition recommendations should be revised to avoid future long-term consequences. Fish and other seafood intake declined, while consumption of eggs, dhal, dry fish, and sprats increased.

Keywords: Meat Consumption, COVID-19, Fish Consumption, Seafood Consumption, Dietary Behaviour, Sri Lanka

Background

Meat and equivalents are considered essential food groups for being a major source of protein, vitamins, and minerals in the human diet. They play important roles in many metabolic and physiological processes [1], particularly due to bioavailable iron, zinc, vitamins A, D, B1, B12, and niacin [2-5]. An adequate intake of zinc, iron, vitamins A, B12, B6, C, and E is essential to strengthen the immune system and maintain immune function [6]. Due to its ability to build and maintain a robust human immune system against viruses, the title role of

meat and its substitutes in the human diet is the subject of intense research today. One recommended nutritional strategy to fight Coronavirus disease in 2019 (COVID-19) is to include meat or equivalent in two to three portions per day in the diet [5]. However, the succession waves of the global pandemic (COVID-19) have seriously threatened millions of people worldwide [7,8]. In response to the COVID-19 pandemic emergency, many governments implemented social confinement strategies, such as self-isolation, lockdown, or social distancing. These restrictions have severely affected dietary behaviors, particularly meat and fish consumption in individual and global contexts [9]. According to a recent population-based Italian survey, 37.3% of respondents have changed their eating habits and lifestyle as a direct impact of the COVID-19 lockout, including reduced processed meat intake

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and higher consumption of eggs [10]. They further claimed that more than half of the population experienced changes in appetite and satiety levels during the COVID-19 lockdown. Interestingly, it was documented that there was a significant increase in consumption of pulses, dhal, and legumes among adults in the Jain community in Mumbai city as a result of the COVID-19 lockdown [11]. Furthermore, Rahman et al. [12] found that the meat consumption pattern was altered during the lockdown period among non-vegetarian Indians. Undoubtedly, the COVID-19 epidemic has modified the high-quality protein-rich meat and seafood consumption behavior worldwide [9]. The third pandemic wave of the COVID-19 infection in Sri Lanka prompted the government to implement extremely rigid lockdown restrictions, which included limitations on crossing district borders. However, the immediate impact of COVID-19 restrictions on dietary behavior, especially in terms of meat or equivalent, has not yet been well understood. Therefore, this online survey aimed to determine how the COVID-19 pandemic affected meat consumption or its equivalent during the COVID-19 containment in Sri Lanka.

Methods

Study population and sample

This study was conducted in Sri Lanka as a part of a national-level cross-sectional online survey that aimed to investigate the immediate impact of the COVID-19 pandemic on lifestyle-related behaviors. A detailed description of the study population, methods, and the impact on other lifestyle patterns have been published elsewhere [13-15]. Data were collected through a self-administered questionnaire accessible through the Google Forms web survey platform. The survey was active from 27th May to 2nd June 2021, when island-wide confinement for the third COVID-19 wave was imposed. Participants did not receive monetary or any form of compensation for their participation. The participants were invited to take part in the survey by sharing the Google form's link mainly through the social networks of the research team. Social media platforms: Facebook, Instagram, Twitter, and WhatsApp were used for this purpose. The study's purpose and confidentiality declaration were briefly described before taking part in the survey. Then informed consent was obtained from all participants for voluntary participation in the study and inclusion in the research. Then consenting participants were subjected to interview through a self-administered questionnaire.

Inclusion and exclusion criteria

The respondents should be; a) age ≥ 16 years, b) living in Sri Lanka c) of Sri Lankan nationality to be included in the study. Respondents excluded from the study who have; a) illnesses or other conditions that change the regular dietary pattern, including pregnancy, b) incomplete questionnaire.

Sample size

The online Raosoft sample size calculator was used to calculate the sample size. The assumptions made in the sample size calculation were; a) Sri Lankan population size is 14.4 million, b) 50% response rate c) 20% incomplete forms since this was an online survey. The calculated sample size was 385 at a 95% confidence level, and 5% margin of error, and the final minimal

required sample size was 482 with assumed dropouts. However, a total of 3714 responses were received. After removing duplicates and incomplete data, 3600 respondents who satisfied the inclusion criteria were included in the analysis.

Study instrument

The data collection was carried out through a structured digital self-administered questionnaire. It was available in Tamil, Sinhala, and English and was predicted to take 5 to 10 minutes. Questions with multiple choices and direct answers were included in the questionnaire. The validity and reliability of the questionnaire were assessed by pilot testing. The questionnaire was comprised of two sections: personal and diet-related. A total of eleven key questions were included in the first section to collect socio-demographic data, including the year of birth, district of residence, nature of the residential area, gender, ethnicity, education level, current employment status, and monthly family income. The presiding district was reported from a drop-down list of all the 25 districts in Sri Lanka. The selections for the nature of residential area were municipal council, city council, and rural. The resided districts of the participant were grouped as Colombo, Gampaha, Kandy, and other districts based on the descending order of the frequency. The gender was recorded under three categories: male, female, and prefer not to say. The categories included for ethnicity were Sinhalese, Sri Lankan Tamil, Indian Tamil, Sri Lankan Moors, and others. However, the ethnic groups were further summarized into "Sinhala, Tamil, Moors, and others". The categories to depict the education level were no schooling, primary education, secondary education, tertiary education, degree or above, and preferred not to say. Eight categories were used to categorize each respondent's employment status: employed, self-employed, unemployed, engaged in home duties, retired from employment, full-time student/pupil, other, and prefer not to say. The income level was recorded under five categories, ranging from less than 10,000 LKR (50 USD as of 27th May 2021) to higher than 200,000 LKR (1000 USD as of 27th May 2021). However, the monthly family income of participants was further summarized to be <25,000 (125 USD as at 27th May 2021), 25,000-49,999 (125-249.99 USD as at 27th May 2021), 50,000-99,999 (250 – 499.99 USD as at 27th May 2021), 100,000-199,999, (500-999.99 USD as at 27th May 2021) >200,000 (1000 USD as at 27th May 2021) by combining income groups: <10,000 LKR (50 USD as at 27th May 2021) and 10,000-24,999 LKR (50-124.99 USD as at 27th May 2021). The second section of the questionnaire was based on dietary behavior-related questions to assess the key objective of the study: the impact on diet habits due to COVID-19. The participants were asked to report whether they increased, decreased, or not changed the consumption of eleven meat and equivalent food types: fish, other seafood (prawns, cuttlefish), chicken, other meat, eggs, dry fish and sprats, canned fish, sausages and meatballs, soya meat, dhal and other pulses (chickpea, green gram). The successfully filled questionnaire was sent to the Google platform, where the database was downloaded.

Dependent and independent variables

Dependent variables were recorded under three strata; increased, decreased, and not change the consumption of eleven

meat and equivalent food types: fish, other seafood (prawns, cuttlefish), chicken, other meat, eggs, dry fish and sprats, canned fish, sausages and meatballs, soya meat, dhal and other pulses (chickpea, green gram). Independent variables were year of birth, residing district, nature of the residential area, gender, ethnicity, education level, current employment status, and monthly family income.

Statistical analysis

All variables were analyzed and expressed as numbers (n) and percentages (%). Descriptive statistics were employed to describe the changes in meat or equivalent consumption behavior. Results were presented as frequency and percentage in parentheses (%) for socio-demographic variables. Bivariate analysis using the Chi-square test was performed to determine the associated socio-demographic variables with dependent variables. Multinomial linear regression analyses were recruited to examine the direction of association between dependent variables and socio-demographic variables. A P-value less than 0.05 was considered statistically significant. All data were cross-checked for consistency and analyzed using SPSS ver. 23.0 (IBM, Chicago, IL, USA).

Results

Descriptive and general characteristics of related factors

The study sample comprised 3600 respondents after removing incomplete and duplicate results. The socio-demographic characteristics of the participants are presented in Table 1. The majority were women (2163, 60.1%), while the mean (SD) age of the participants was 33.05 (\pm 9.74). Ages 26 to 30 account for nearly one-fourth of the population, and 82.1% of the respondents were Sinhalese. However, all other minor ethnic groups were also represented by the sample. Respondents symbolized the entire country, whereas a higher proportion (61.1%) were found in Colombo, Gampaha, and Kandy districts. Although 32.5% of respondents resided in municipal council regions, most lived in rural areas (40.3%). Approximately 70% of the survey population had a degree or higher educational level education, and 26% had a tertiary educational level. A higher fraction (86.0%, 2506) of participants were either workers or students, while 365 (10.1%) were unemployed, and 54 (1.5%) were retired. Almost half of the respondents (49.0%; 1766) had a monthly family income beyond 100000 Sri Lankan Rupee (LKR) equivalent to 500 US Dollar (USD).

Table 1: Demographic characteristics of the study population (n=3600)

Variables	Male N (%)		Female N (%)		Total N (%)	
	N	%	n	%	n	%
Observation	1437	39.9	2163	60.1	3600	100
Age						
18-25 years	218	6.1	567	15.8	785	21.8
26-30 years	314	8.7	577	16.0	891	24.8
31-35 years	306	8.5	441	12.3	747	20.7
36-40 years	211	5.9	277	7.7	488	13.6
>40 years	388	10.8	301	8.4	689	19.1
District						
Colombo	561	15.6	808	22.4	1369	38.0
Gampaha	193	5.4	297	8.3	490	13.6
Kandy	108	3.0	233	6.5	341	9.5
Other	575	16.0	825	22.9	1400	38.9
Area of residence						
Municipal council area	504	14.0	664	18.4	1168	32.5
City council area	376	10.4	603	16.8	979	27.2
Rural area	558	15.5	895	24.9	1453	40.3
Ethnicity						
Sinhala	1113	30.9	1844	51.2	2957	82.1
Tamil	166	4.6	185	5.1	351	9.8
Moors and others	158	4.4	134	3.7	292	8.1
Education level						
Secondary education or below	47	1.3	91	2.5	138	3.8
Tertiary education	338	9.4	594	16.5	932	25.9
Degree or above	1052	29.2	1478	41.1	2530	70.3
Employment status						
Employed	1146	31.8	1360	37.8	2506	69.6
Unemployed	86	2.4	279	7.8	365	10.1
Retired	29	0.8	25	0.7	54	1.5
Full-time student or pupil	136	3.8	456	12.7	592	16.4
Other	40	1.1	43	1.2	83	2.3
Monthly family income (in LKR)						
< 25,000	96	2.7	214	5.9	310	8.6
25,000-49,999	183	5.1	406	11.3	589	16.4
50,000-99,999	363	10.1	572	15.9	935	26.0
100,000-199,999	387	10.8	482	13.4	869	24.1
>200000	408	11.3	489	13.6	897	24.9

Changed behavior of meat or equivalents consumption

The changes in meat or equivalents consumption of the study population during the COVID-19 lockdown are depicted in Figure 1. Participants were more likely to increase their consumption of eggs (53.7%), dhal (47.0%), dry fish, and sprats (36.3%) during the COVID-19 lockdown period. It was further observed a big trend in cutting down the consumption of fish (41.1%) and other seafood (52.0%) consumption during the COVID-19 restricted period. Relatively, higher proportions of the population kept their intake pattern the same in terms of their consumption of meat other than chicken (54.5%), other pulses (52.6%), soya meat (52.1%), dry fish and sprats (48.9%), canned fish (47.6%), chicken (43.7%), sausages and meatballs (45.1%). However, nearly one-fourth of respondents had increased intake levels with other pulses (28.4%), chicken (26.8%), and soya meat (25.8%).

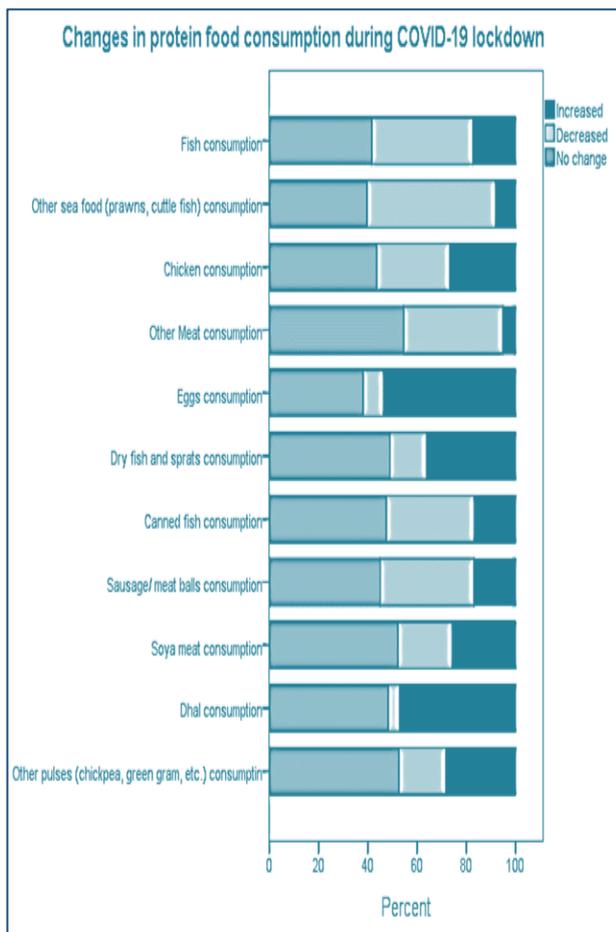


Figure 1. Changes in meat or equivalent consumption during COVID-19 lockdown

Association between meat or equivalents consumption and socio-demographic factors

The cross-tabulation was performed to investigate the association of socio-demographic factors with observed meat or equivalents intake patterns, and the results are presented in Table 2. The cross-tabulation indicated that gender (chi-square test ($\chi^2(2) = 26.985, P = 0.000$), age group ($\chi^2(8) = 18.035, P = 0.021$), nature of residence area ($\chi^2(4) = 17.185, P = 0.002$), and ethnicity ($\chi^2(4) = 28.811, P = 0.000$), and monthly family income level ($\chi^2(8) = 67.464, P = 0.000$) were significantly associated with decreased fish consumption. However, the reduction in other seafood consumption was significantly

associated with gender ($\chi^2(2) = 21.544, P = 0.000$), nature of residence area ($\chi^2(4) = 48.354, P = 0.000$), ethnicity ($\chi^2(4) = 45.007, P = 0.002$), employment status ($\chi^2(8) = 20.945, P = 0.007$), and monthly family income level ($\chi^2(8) = 78.283, P = 0.000$).

As implied by the crosstabs analysis, gender ($\chi^2(2) = 22.300, P = 0.000$), residing district ($\chi^2(6) = 60.904, P = 0.000$), nature of residence area ($\chi^2(4) = 66.199, P = 0.000$), ethnicity ($\chi^2(4) = 59.893, P = 0.000$), employment status ($\chi^2(8) = 25.159, P = 0.001$), and monthly family income level ($\chi^2(8) = 132.273, P = 0.000$) were significantly associated with reduced chicken intake during COVID-19 confinement. The declined intake of other meat items was significantly related to gender ($\chi^2(2) = 20.950, P = 0.000$), age group ($\chi^2(8) = 16.735, P = 0.033$), residing district ($\chi^2(6) = 42.210, P = 0.000$), nature of residence area ($\chi^2(4) = 70.671, P = 0.000$), ethnicity ($\chi^2(4) = 88.775, P = 0.000$), an education level ($\chi^2(8) = 31.581, P = 0.000$), employment status ($\chi^2(8) = 36.284, P = 0.000$), and monthly family income level ($\chi^2(8) = 168.724, P = 0.000$).

Moreover, increased egg consumption of respondents was significantly associated with gender ($\chi^2(2) = 7.021, P = 0.030$), residing district ($\chi^2(6) = 15.790, P = 0.015$), nature of residence area ($\chi^2(4) = 11.117, P = 0.025$), an education level ($\chi^2(8) = 12.949, P = 0.012$), and monthly family income level ($\chi^2(8) = 44.867, P = 0.000$).

Apart from that, observed growth in dry fish intake behavior was significantly associated with gender ($\chi^2(2) = 9.443, P = 0.009$), residing district ($\chi^2(6) = 14.955, P = 0.021$), nature of residence area ($\chi^2(4) = 19.086, P = 0.001$), ethnicity ($\chi^2(4) = 52.693, P = 0.000$), and monthly family income level ($\chi^2(8) = 26.262, P = 0.001$).

Nevertheless, the flattened trend of canned fish consumption was significantly associated with ethnicity ($\chi^2(4) = 17.399, P = 0.002$), education level ($\chi^2(8) = 20.015, P = 0.000$), employment status ($\chi^2(8) = 34.972, P = 0.000$), and monthly family income level ($\chi^2(8) = 66.151, P = 0.000$) only.

As explained by the cross-tabulation, age group ($\chi^2(8) = 32.738, P = 0.000$), residing district ($\chi^2(6) = 62.501, P = 0.000$), nature of residence area ($\chi^2(4) = 59.267, P = 0.000$), ethnicity ($\chi^2(4) = 10.696, P = 0.000$), an education level ($\chi^2(8) = 45.182, P = 0.000$), employment status ($\chi^2(8) = 61.669, P = 0.000$), and monthly family income level ($\chi^2(8) = 119.844, P = 0.000$) were significantly associated with constant consumption in sausages and meatballs during COVID-19 lockdown in Sri Lanka. However, unchanged behavior of soya meat consumption was significantly associated with age group ($\chi^2(8) = 26.676, P = 0.001$), ethnicity ($\chi^2(4) = 16.179, P = 0.003$), education level ($\chi^2(8) = 11.397, P = 0.022$), employment status ($\chi^2(8) = 19.170, P = 0.014$), and monthly family income level ($\chi^2(8) = 47.530, P = 0.000$) only.

Interestingly, increased dhal consumption was significantly associated with gender ($\chi^2(2) = 6.714, P = 0.035$), residing district ($\chi^2(6) = 14.885, P = 0.021$), ethnicity ($\chi^2(4) = 25.688, P = 0.000$), and monthly family income level ($\chi^2(8) = 68.568, P = 0.000$) whereas the unmoved behavior of other pulses intake was significantly associated with age group ($\chi^2(8) = 19.448, P = 0.013$), ethnicity ($\chi^2(4) = 21.116, P = 0.000$), education level ($\chi^2(8) = 11.323, P = 0.023$), and monthly family income level ($\chi^2(8) = 56.175, P = 0.000$).

Table 2: Statistical data of crosstab and chi-square analysis ($p \leq 0.05$ is significant at a 95% confidence interval)

Meat or equivalent food	χ^2 , p-value	Gender	Age group	District	Nature of residence area	Ethnicity	Education level	Employment status	Monthly family income level
Fish	χ^2 value	26.985	18.035	11.162	17.185	28.811	3.110	8.338	67.464
	p-value	0.000	0.021	0.083	0.002	0.000	0.540	0.401	0.000
Other Seafood	χ^2 value	21.544	9.239	9.003	48.354	45.007	6.285	20.945	78.283
	p-value	0.000	0.323	0.173	0.000	0.000	0.179	0.007	0.000
Chicken	χ^2 value	22.300	11.020	60.904	66.199	59.893	7.501	25.159	132.273
	p-value	0.000	0.201	0.000	0.000	0.000	0.112	0.001	0.000
Other meat	χ^2 value	20.950	16.735	42.210	70.671	88.775	31.581	36.284	168.724
	p-value	0.000	0.033	0.000	0.000	0.000	0.000	0.000	0.000
Eggs	χ^2 value	7.021	11.327	15.790	11.117	8.819	12.949	15.238	44.867
	p-value	0.030	0.184	0.015	0.025	0.066	0.012	0.055	0.000
Dry fish and sprats	χ^2 value	9.443	10.568	14.955	19.086	52.693	2.419	5.100	26.262
	p-value	0.009	0.227	0.021	0.001	0.000	0.659	0.747	0.001
Canned fish	χ^2 value	4.682	4.320	10.255	7.761	17.399	20.015	34.972	66.151
	p-value	0.096	0.827	0.114	0.101	0.002	0.000	0.000	0.000
Sausages and Meatballs	χ^2 value	3.609	32.738	62.501	59.267	10.696	45.182	61.669	119.844
	p-value	0.165	0.000	0.000	0.000	0.030	0.000	0.000	0.000
Soya meat	χ^2 value	0.016	26.676	3.285	6.184	16.179	11.397	19.170	47.530
	p-value	0.992	0.001	0.772	0.186	0.003	0.022	0.014	0.000
Dhal	χ^2 value	6.714	5.643	14.885	5.356	25.688	1.691	8.767	68.568
	p-value	0.035	0.687	0.021	0.253	0.000	0.792	0.362	0.000
Other pulses	χ^2 value	2.394	19.448	7.709	7.373	21.116	11.323	7.364	56.175
	p-value	0.302	0.013	0.260	0.117	0.000	0.023	0.498	0.000

Socio-demographic factors associated with changed behavior of meat or equivalent consumption in multinomial logistic regression

The final model of the multinomial logistic regression is presented in Table 3. The males (odds ratio (OR) 0.852; 95% CI: 0.738 to 0.984, $P = 0.029$) and Tamil (OR = 1.605, 95% CI: 1.150 to 2.239, $P = 0.005$) were significantly likely to report increased egg consumption compared to females and Moors and other ethnic groups respectively.

In comparison to the rural participants, respondents living in municipal area (OR = 1.105; 95% CI: 0.928 to 1.315, $P = 0.263$) and city area (OR = 1.149; 95% CI: 0.963 to 1.372, $P = 0.123$) were more likely to increase their egg consumption. Respondents in the lowest monthly family income group, less than 25,000 LKR (125 LKR) (OR = 1.310; 95% CI: 0.975 to 1.759, $P = 0.073$) were more likely to consume eggs at increased levels compared to the highest monthly family income group more than 200,000 LKR (1000 USD). In terms of increased dhal intake, Tamils (OR = 1.571; 95% CI: 1.131 to 2.183, $P = 0.007$) showed significantly higher odds than Moors and other ethnicities.

Moreover, the respondents with monthly income levels of less than 200,000 LKR (1000 USD) were significantly more likely to report increased consumption of dhal. Among them, the lowest monthly family income group; <25,000 LKR (125 LKR) (OR 2.220; 95% CI 1.672-2.947, $P = 0.000$), were more than twice likely to report increased dhal consumption

compared to respondents with the highest monthly family income levels (>200,000 LKR/1000 USD). Furthermore, respondents in middle monthly family income groups; 25,000-49,999 LKR (125.00-249.99 USD) (OR = 1.981; 95% CI: 1.583 to 2.478, $P = 0.000$), 50,000-99,999 LKR (250.00-499.99 USD) (OR = 1.507; 95% CI: 1.242 to 1.828, $P = 0.000$), and 100,000-199,999 LKR (500.00-999.99 USD) (OR = 1.254; 95% CI: 1.034 to 1.522, $P = 0.021$), had significantly higher likelihood for the elevated dhal consumption behavior.

However, in the final multinomial logistic regression model, respondents living in municipal areas (OR 0.828; 95% CI: 0.691 to 0.993, $P = 0.042$) were significantly less likely to report increased dry fish consumption and sprats in comparison to rural participants. Nevertheless, Tamils (OR 1.519; 95% CI 1.057-2.181, $P = 0.024$) reached the significantly increased levels in consumption of dry fish and sprats compared to Moors and others ethnic group whereas both the lowest monthly family income group; < 25,000 LKR (125 USD) (OR = 1.687; 95% CI: 1.253-2.271, $P = 0.001$) and 25,000-49,999 LKR (125.00-249.99 USD) (OR = 1.356; 95% CI: 1.070-1.718, $P = 0.012$) were also showed significantly higher odds in increased levels of dry fish and sprats consumption compared to respondents with >200,000 LKR (1000 USD) monthly family income level.

Table 3. Odds Ratios (OR) for the likelihood of increased consumption of meat or equivalents by socio-demographic variables

Variables	Eggs			Dhal			Dry fish and sprats		
	OR	(95% CI)	P-value	OR	(95% CI)	P-value	OR	(95% CI)	P-value
Gender									
Male	0.852	0.738-0.984	0.029	1.058	0.920-1.218	0.427	0.865	0.745-1.005	0.058
Female (Reference)	1			1			1		
Nature of living area									
Municipal	1.105	0.928-1.315	0.263	0.994	0.839-1.178	0.945	0.828	0.691-0.993	0.042
City	1.149	0.963-1.372	0.123	0.998	0.840-1.184	0.977	0.934	0.779-1.120	0.461
Rural (Reference)	1			1			1		
Ethnicity									
Sinhala	1.252	0.968-1.620	0.086	1.216	0.937-1.578	0.141	1.116	0.839-1.485	0.451
Tamil	1.605	1.150-2.239	0.005	1.571	1.131-2.183	0.007	1.519	1.057-2.181	0.024
Moors and other (Reference)	1			1			1		
Monthly family income level (LKR)									
< 25,000	1.310	0.975-1.759	0.073	2.220	1.672-2.947	0.000	1.687	1.253-2.271	0.001
25,000-49,999	0.985	0.784-1.238	0.900	1.981	1.583-2.478	0.000	1.356	1.070-1.718	0.012
50,000-99,999	1.173	0.963-1.428	0.114	1.507	1.242-1.828	0.000	1.177	0.957-1.447	0.124
100,000-199,999	1.044	0.858-1.270	0.669	1.254	1.034-1.522	0.021	1.136	0.923-1.398	0.228
>200,000 (Reference)	1			1			1		

Multinomial logistic regression model

As per the final multinomial logistic regression model, the socio-demographic factors associated with decreased fish and other seafood consumption are demonstrated in Table 4. Interestingly, all income groups were significantly more likely to report decreased fish consumption than their counterparts with the highest monthly family income level (>200,000 LKR/1000 USD). Moreover, the lowest monthly family income group; < 25,000 LKR (125 USD) (OR = 2.752; 95% CI: 2.024-3.741, P = 0.000) reported more than twice reduction in fish consumption whereas other middle income groups; 25,000-49,999 LKR (125.00-249.99 USD) (OR = 1.860; 95% CI: 1.460-2.370, P = 0.000) 50,000-99,999 LKR (250.00-499.99 USD) (OR = 1.535; 95% CI: 1.246 to 1.890, P = 0.000), and 100,000-199,999 LKR (500.00-999.99 USD) (OR = 1.341; 95% CI: 1.089 to 1.652, P = 0.006), had significantly higher likelihood for the reduced fish consumption behavior compared respondents with highest monthly family income level more than 200,000 LKR (1000 USD).

Additionally, males (OR = 1.301; 95% CI: 1.006 to 1.681, P = 0.011) were significantly more likely to report decreased levels of other seafood (prawns, cuttlefish) consumption compared to their female counterparts. Compared to the rural participants, respondents living in the municipal area (OR = 1.523; 95% CI: 1.186 to 3.292, P = 0.009) showed a significantly higher likelihood of reduction in other seafood (prawns, cuttlefish) consumption. Similarly, Tamils (OR = 1.976, 95% CI: 1.186 to 3.292, P = 0.009) were significantly likely to report decreased intake levels of other seafood (prawns, cuttlefish) compared to Moors and other ethnic groups. In addition, the monthly family income groups; 25,000-49,999 LKR (125.00-249.99 USD) (OR = 0.596; 95% CI: 0.379-0.937, P = 0.025), and 100,000-199,999 LKR (500.00-999.99 USD) (OR = 0.627; 95% CI: 0.443 to 0.888, P = 0.008), had significantly less likelihood for the reduced seafood consumption behavior compared highest monthly family income level more than 200,000 LKR (1000 USD) group.

Table 4. Odds Ratios (OR) for the likelihood of decreased fish consumption of meat or equivalents by socio-demographic variables

Variables	Fish			Other Seafood		
	OR	(95% CI)	p-value	OR	(95% CI)	p-value
Gender						
Male	0.873	0.750-1.015	0.078	1.301	1.006-1.681	0.045
Female (Reference)	1			1		
Nature of living area						
Municipal	0.903	0.753-1.084	0.273	1.523	1.102-2.105	0.011
City	0.986	0.820-1.186	0.883	1.237	0.876-1.747	0.227
Rural (Reference)	1			1		
Ethnicity						
Sinhala	1.072	0.813-1.414	0.622	0.688	0.447-1.059	0.089
Tamil	1.089	0.760-1.560	0.643	1.976	1.186-3.292	0.009
Moors and other (Reference)	1			1		
Monthly family income level (LKR)						
< 25,000	2.752	2.024-3.741	0.000	0.955	0.554-1.646	0.867
25,000-49,999	1.860	1.460-2.370	0.000	0.596	0.379-0.937	0.025
50,000-99,999	1.535	1.246-1.890	0.000	0.873	0.623-1.223	0.430
100,000-199,999	1.341	1.089-1.652	0.006	0.627	0.443-0.888	0.008
>200,000 (Reference)	1			1		

Discussion

To our knowledge, the current study was among a few surveys designed to investigate the immediate consequence of the COVID-19 lockdown on meat or equivalent intake among Sri Lankans. Social distancing was the strategy adopted by many countries to reduce the spread of COVID-19 [15-21]. Among the imposed social confinements, lockdown measures resulted in a positive effect of flattening the epidemic curve [16,21]. Consequences of COVID-19 restrictions consist of substantial distress for numerous aspects of human lives, including dietary habits [22].

Results of our study indicated that meat or alternative intake patterns were impacted during the early period of COVID-19 restrictions in Sri Lanka. During the blockade, more than one-fourth of the Sri Lankans were more likely to consume eggs, dhal and other pulses, dry fish and sprats, soya meat, and chicken. Contrarily, over one-fourth of the population has reduced their intake of fish and other seafood, chicken and other meat, sausages and meatballs, and canned fish. Nearly half of the Sri Lankans have not changed their dhal and other pulses intake, dry fish and sprats, canned fish, soya meat, and other meat. Mandal et al. [23] assessed the impact of COVID-19 on fish consumption and household food security in Bangladesh, and a reduced behavior in the frequency of fish consumption per week was observed across all income groups. In Turkish adults, Haskaraca et al. [24] have found that only 13.0%, 11.0%, and 31.0% of the participants have reduced their red meat, poultry meat, and fish consumption, respectively, due to the impacts of the COVID-19 pandemic. Yu et al. [21] conducted a study in China to evaluate the impact of lockdown on dietary patterns. The authors indicated a significant increase in fish (7.5%), and egg (10.3%) consumption, whereas more participants stopped or reduced their intake of meat (8.4%) and poultry (9.5%).

The dynamics of meat or equivalent intake during COVID-19 have been discussed extensively in the literature. The sudden imposition of a countrywide lockdown affected all kinds of transport, shutting down markets and resulting in the scarcity of meat and alternatives. As per other investigations, the primary reason behind the change in meat or equivalent consumption was the non-availability of products due to barriers to transportation from other geographical areas [23].

A recent survey in India reported that the quantity of meat purchased had been reduced. Most consumers could not obtain sufficient meat and meat products during the lockdown period [12]. Reduced ability to purchase food, greater availability of stockpiled products and more time spent at home contributed to increased egg, dhal, dry fish, and "sprats" intake during the COVID-19 pandemic [25]. Moreover, food prices have surged, leading to the respondents' inability to buy certain foods [23].

There was a general decline in the consumption of fresh foods among people in Denmark, Germany, and Slovenia, but an increase in the consumption of food with a longer shelf life [19]. Primarily this could be the reason for reduced intake of chicken and other meats, fish, and other seafood such as prawns and cuttlefish. A decrease in chicken and other meat, as well as value-added meat products, also might be due to the closure of fast-food restaurants. Since many purchases were processed online, the public hesitated to purchase perishables as some delay might occur in delivery, and it might negatively impact on

reduction in fish, chicken, and other meat consumption during the lockdown period [24].

Apart from economic reasons and inability to reach it, reduced meat or equivalents consumption behavior might be due to being concerned with them as a source of COVID-19 origin [12]. The fact that eggs can be stored in the open air while meat and fish need special storage conditions and greater attention to food safety may be the reason for the growing consumption of eggs over meat and fish [23]. The lower meat consumption could be further related to the lack of stock in some supermarkets and grocery stores [11]. Apart from these consequences, the fear of COVID-19 infection and death and the restrictions on individual freedom have worsened the stress load and altered habitual behaviors.

A recent review underlines that balanced nutrition, which can help maintain immunity, is essential for preventing and managing viral infections [5]. Considering that COVID-19 has no effective preventive and pharmacological therapies, healthy eating habits are crucial, and elective micronutrient supplementations (e.g., vitamins, trace elements, nutraceuticals, and probiotics) may be beneficial [5].

Generally, the mean daily intake of meat and fish portions among Sri Lankans is well below the minimum recommendations of the World Health Organization [26]. In a previous survey, daily consumption of meat or alternatives was 1.75 portions, and the sum of meat and pulses was 2.78 portions per day [27]. As reported in a recent review, two to three portions of meat or equivalent should be included daily to satisfy nutritional needs and maintain robust immune function to withstand any assault by the virus [5].

The present study's findings conveyed favorable and critical changes in meat and alternative consumption among Sri Lankans. The observed changes occurred in a short period, raising concerns about worsening the trends once the COVID-19 restrictions are prolonged. The long-term consequences are difficult to predict in terms of dietary behaviors. In aggregated terms, results indicated that consumers reacted initially to the COVID-19 lockdown by changing their meat or equivalent consumption pattern. Nutrition insecurity may increase the vulnerability to infection with COVID-19, and its more severe consequences may last longer [28].

Further, it can be expected to adversely affect the prevalence of diet-related non-communicable diseases such as obesity, type 2 diabetes, and cardiovascular diseases. Understanding the impact of the COVID-19 pandemic on meat and fish consumption is important to overcome the future implications of the nutritional burden on the Sri Lankan health system.

A significant limitation of the present study was that most of the participants were middle-aged youngsters who resided in Colombo city, and the respondents were predominately female. Given the variations in contextual factors within Sri Lanka, it is uncertain how much our results may be applied to other geographical areas. At the time of data collection, supermarkets, groceries, retail markets, restaurants, cafes, cinemas, and playgrounds were closed, public and in-home gatherings were banned, schools were closed, and people were encouraged to work from home. The government announced financial aid for those who were struggling financially as a result of the COVID-19 lockdown. The COVID-19 restrictions substantially disrupted Sri Lankans' regular lifestyle routines. The current

study did not record price fluctuations for food items and the changes in online shopping frequency. However, this type of investigation facilitated us to perform a nationwide survey during the pandemic constraints prolonging the opportunity to meet a relatively larger sample. Furthermore, our study disclosed the limited capacity of current dietary guidelines to endure during a global public health pandemic. These findings further suggest the prerequisite of revision for the existing nutritional programs and guidelines to support healthy eating across Sri Lanka, a low and middle-income country.

Conclusion

For the first time, data on changes in meat and its equivalent consumption among Sri Lankans during the COVID-19 lockdown were provided in this study. The dietary intake of meat and equivalents among Sri Lankan adults was changed due to the COVID-19 lockdown. While fish and other seafood intake decreased, consumption of eggs, dhal, dry fish, and sprats increased. However, as the COVID-19 pandemic is still ongoing worldwide, more research is required to determine its impact on dietary behavior locally and globally.

Abbreviation

COVID-19: Coronavirus; LKR: Sri Lankan Rupee; USD: US Dollar; OR: Odds Ratios

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Availability of data and materials

Data will be available by emailing ranil@physiol.cmb.ac.lk.

Authors' contributions

Ranil Jayawardena (RJ) contributed to conceptualization, project administration, and validation. RJ, PS, and TF contributed to data curation, formal analysis, investigation, supervision, and methodology. MG contributed to writing—original draft, while MG, RJ, PS and TF contributed to writing—review and editing. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The research was performed in accordance with the principles of the Declaration of Helsinki. The authors declared that the protocol of this article was part of a previously published [12-14] large initiative in Sri Lanka (2021-2022). Moreover, web-based informed consent was obtained from each participant after explaining the study objectives and the guarantee of secrecy.

Consent for publication

Not applicable

Competing interest

Open Access

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