RESEARCH ARTICLE

COVID-19 epidemic lockdown-induced changes of cereals and animal protein foods consumption of Iran population: the first nationwide survey

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Abstract

Background: The COVID-19 epidemic has affected diverse issues of life including economy, health and nutrition. This nationwide study was conducted to evaluate the effects of the epidemic lockdown-induced socio-economic changes on animal source proteins and cereals intakes of Iran population for the first time.

Methods: This was a cross-sectional descriptive-analytical study using a web-based electronic self-administered questionnaire. A questionnaire was designed with the aim of detecting any changes in the dietary pattern of the Iranian household following coronavirus epidemic.

Results: A total of 21,290 households participated in the study. Approximately 33%, 24%, 14.2% and 7% of the households had decreased the weekly consumption of red meat, white meat, eggs and rice/bread, respectively, following COVID-19 epidemic. The results of ordered logistic regression showed that the female-headed households, as compared with male-headed ones, were 30% more likely to decrease their weekly consumption of white meat (OR = 1.3, 95% CI: 1.1–1.5). About 8.6% of the households had reduced all three major dietary sources of animal protein. Close to half of the households (46.9%) who decreased their intake of the animal protein sources had increased their intake of rice or bread, too. The major reasons for these changes were decrease of income and job loss.

Conclusion: In conclusion, animal protein food consumption decreased during epidemic lockdown but the amounts of rice and bread, as the major sources of dietary energy, have increased. These changes, if persist long enough, can seriously affect micronutrient status of the whole population. Early nutritional interventions for needy families are warranted.

Keywords: COVID-19, Lockdown, Animal proteins, Cereals, Households

Introduction

The new coronavirus infection and related disease, severe acute respiratory syndrome (SARS) or COVID-19, has now become a global health problem with million cases of morbidity and hundreds of thousands deaths [1, 2]. COVID-19 challenges food security through interfering with food systems and impairing food access, as well [3, 4]. Thus, this newly emerged viral disease has many

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socio-economic implications [5]. Social distancing and lockdown, though necessary for the protection of the population, have seriously damaged world economy, with minor retails as the main casualties. As a result, incomes of many households reduced dramatically due to massive job loss [5, 6].

The relationship between socioeconomic status (SES) and dietary pattern of household is self-evident. With reducing income the items of food basket would be inevitably adjusted with the available and more affordable resources, with increasing the amount of main energy sources usually at the expense of reduction or sometimes omission of micronutrient and protein rich sources [7]. Some studies have demonstrated that fruits and vegetables are the first line of this sacrificing followed by dairy products (notably milk) and meats which may be accompanied by a concomitant increase in other dietary energy sources like refined sugar, white bread and cereals [8–11]. As dietary sources of animal protein are rich in micronutrients that may not be provided by other food groups in sufficient amounts especially in low income families, these changes may have several health consequences. On the other hand, cereals, notably bread and rice, are the far less expensive staple foods providing the major part of dietary energy in Iran [12, 13]. This nationwide study was, therefore, conducted to evaluate the possible effects of these COVID-19 epidemic lockdown-induced socioeconomic changes on animal source proteins and cereals intakes of Iran population using a rapid nationwide IT-based household survey for the first time.

Methods

Study design

This was a cross-sectional descriptive-analytical study using a web-based electronic self-administered questionnaire. Several virtual sessions were held to design a questionnaire with the aim of detecting any changes in the dietary pattern of the Iranian household following coronavirus epidemic. The content validity was assured by a panel of seven internal (involved in compilation of the questionnaire) and three external (not involved in the compilation of the questionnaire) nutrition experts. A web link was created (https://panel.rabit.ir/s/c1NEP PXL483.html) and the questionnaire was uploaded. Then, an official letter from the Community Nutrition Office, Deputy of Health, Ir. Ministry of Health (MOH), was submitted to the vice-chancellors in health affairs and the Community Nutrition Offices of the medical universities of all provinces. In this letter, the objectives of the project and the related link were explained and it was requested that the provincial health and nutrition workers to notice the community under their service coverage. In addition, the link was distributed massively to all popular social

media networks such as Telegram, WhatsApp and also through the MOH website (corona.research.ac.ir). This phase of survey was conducted from 4 to 25 April 2020, during which Iran was in the coronavirus epidemic lockdown. The protocol of this study has already been fully described elsewhere [14]. To compare variables among provinces with different food security situations, we used the latest national report in which provinces are categorized to food insecure (deprived), semi-secure (semi-deprived) and secure (non-deprived) [15].

Development of the questionnaire

The comprehensive process of development of the questionnaire can be found elsewhere [14]. Each respondent had to complete the questionnaire on behalf of his/her household. The questionnaires were anonymous to ensure the privacy and independence of participants for giving their responses. Questions were asked about socioeconomic (SES) and nutritional status of the household before and during corona epidemic. SES section included data regarding gender, education, and occupation of head of the household, household size, province and region of the residency (urban/rural), presence of high-risk person in the household (under-5 children, pregnant or lactating women, elder), and any changes in household income during the coronavirus epidemic. The presence of a person with the history of COVID-19 within the household was also asked. In the nutrition section, the questions were asked regarding the change of frequency in consumption of the selected food items and the reasons for changing consumption frequency during the epidemic.

Ethical issues

Completion of the questionnaire was voluntary and anonymous. Furthermore, the respondents were assured about confidentiality of information and privacy. Therefore, the completion of the questionnaire was considered as the consent of the respondent to participate in the study. This study was approved by the Ethics Committee of the National Nutrition and Food Technology Research Institute (IR.SBMU.NNFTRI.REC.1399.066).

Statistical analysis

The descriptive analysis was conducted to assess the distribution of socio-demographic status among respondents. Ordinal logistic regressions were fitted to examine which factors contributed to changes in frequency of consumption of selected food items. Two outcomes were considered as dependent variables in regression models: 1. Changes of frequency of red and white meats, eggs and rice/bread consumption on a weekly basis (increase vs. no changes vs. decrease) 2. Descriptive amount of decrease in consumption of the given foods (slight

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reduction vs. reduced by half vs. omitted from household food basket). After the test for overall parallel assumption at 0.05 significance, it was indicated that the overall parallel assumption of models has not been violated.

The sex of household head (male, female), living in urban/rural areas (urban, rural), household size (one to two, three to five, six and more), being high risk member(s) in a household (none, under five years old, pregnant/ lactating, elder, more than one member), occupation of head (employee, freelance, retired, health worker, teacher, driver, other), educational status of head (master and higher, bachelor, associate, diploma, high school, theological education (preacher)), changes in income (no changes, small decrease, half, cut), COVID-19 in family (no, yes) and food security status of the province (secure, semi-secure, deprived) were the independent variables assessed. The categorization of the provinces based on food security was according to the latest available national report [15].

In all analyses, sampling weights were used to account for the complex sampling design and to allow inferences valid for the population. Analyses were performed using Stata version 16.0 (StataCorp LLC). A two-tailed $p < 0.05$ was considered significant.

Results

A total of 21,290 households were included in the analyses. Table 1 shows the socio-demographic characteristics of respondent households. The mean (95% confidence interval [CI]) of age of household head was 44.7 (44.2, 44.9) years, and the data indicated that 26.2% of the households (weighted percentage) were from rural areas.

Data showed approximately 33%, 24%, 14.2% and 7% of the households had decreased the weekly consumption of red meat, white meat, eggs and rice/bread, respectively, following COVID-19 epidemic (Table 2).

The results of ordered logistic regression are presented in Table 3. The dependent variables were changes in consumption frequency of red meat, white meat, eggs and rice/bread following COVID-19 epidemic in the models (increased consumption, no changes or decreased consumption). The results showed that the households whose heads were women, as compared with those with men as heads, were 30% more likely to decrease their weekly consumption of white meat after coronavirus epidemic (OR = 1.3, 95% CI: 1.1–1.5).

Living in rural areas was not a predictor of changing the intake of the selected food items. However, household size was a determinant as the households with more than six members were more likely to decrease their weekly red meat intake compared with households with 1 to 2 members (OR = 1.2, 95% CI: 1.0–1.4).

Table 1 Characteristic of the participant households

Variable	*n* (%)[a]
Urban/rural	
Urban	14,191 (73.8)
Rural	7099 (26.2)
Household size	
1–2	2883 (15.7)
3–5	16,798 (78.2)
> 6	1609 (6.1)
High risk members in household	
None	11,511 (52.6)
Under five years old	4881 (21.8)
Pregnant/ lactating	660 (2.8)
Elder	2110 (0.4)
More than one member	2128 (8.7)
Sex of the household head	
Male	19,255 (89.8)
Female	2035 (10.2)
Occupation of the household head	
Officer	3942 (20.5)
Freelance	7755 (34.3)
Retired	1988 (11.7)
Health workers	572 (2.7)
Teacher	715 (3.1)
Driver	883 (3.9)
Other	5435 (23.8)
Education of the household head	
Under diploma	7981 (32.6)
Diploma	5277 (24.1)
Associate	1540 (7.3)
Bachelor	4022 (21.2)
Master/higher	2338 (14.4)
Theological (preacher)	132 (0.5)

[a] Percentages are weighted

Table 2 Changes in consumption of red and white meat, eggs, rice/bread intake in household per week after COVID-19 epidemic

Variable	Change of weekly consumption	*n* (%)[a]
Red meat	No changes	13,234 (63.3)
	Decrease	7350 (32.9)
	Increase	706 (3.8)
White meat	No changes	14,794 (70.3)
	Decrease	5468 (24.4)
	Increase	1028 (5.3)
Egg	No changes	15,343 (70.8)
	Decrease	3342 (14.2)
	Increase	2605 (15.0)
Bread and rice	No changes	7776 (66.2)
	Both increase	1263 (7.9)
	Both decrease	1612 (7.0)
	Decrease in rice	2807 (13.5)
	Increase in rice	1075 (5.4)

[a] Percentages are weighted

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Table 3 Ordered logistic regression models of changes in weekly consumption of selected food items in COVID-19 epidemic

Variable	Red meat OR (95%CI)	White meat OR (95%CI)	Egg OR (95%CI)	Bread and rice OR (95%CI)
Sex of household head				
Male	–	–	–	–
Female	1.15 (0.9, 1.33)	1.3 (1.1, 1.5)	1.09 (0.9, 1.3)	1.02 (0.8, 1.2)
Urban/Rural				
Urban	–	–	–	–
Rural	0.8 (0.7, 0.9)	0.95 (0.9, 1.05)	1.08 (0.9, 1.2)	1.18 (1.08, 1.3)
Household size				
1–2	–	–	–	–
3–5	1.1 (0.96, 1.2)	0.9 (0.8, 1.06)	0.8 (0.7, 0.9)	0.96 (0.85, 1.09)
> 6	1.2 (1.0, 1.4)	1.07 (0.9, 1.3)	0.98 (0.8, 1.2)	1.05 (0.88, 1.2)
High risk members				
No	–	–	–	–
< 5 years old	1.2 (1.07, 1.3)	1.09 (0.9, 1.2)	1.07 (0.9, 1.2)	1.01 (0.9, 1.12)
Pregnant/lactating mothers	1.2 (0.9, 1.5)	1.3 (1.03, 1.5)	1.2 (0.9, 1.56)	1.12 (0.89, 1.4)
Elder	1.1 (0.9, 1.3)	1.1 (0.9, 1.2)	0.97 (0.84, 1.1)	1.15 (1.0, 1.32)
More than one	1.4 (1.2, 1.6)	1.5 (1.3, 1.7)	1.3 (1.14, 1.5)	1.07 (0.94, 1.23)
Occupation				
Employee	–	–	–	–
Freelance	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)	0.8 (0.7, 0.93)	0.88 (0.75, 1.01)
Retired	1.1 (0.9, 1.3)	1.14 (0.9, 1.3)	1.15 (0.97, 1.4)	1.13 (0.9, 1.35)
Health workers	0.8 (0.6, 1.1)	0.9 (0.7, 1.2)	1.16 (0.9, 1.5)	1.03 (0.8, 1.35)
Teacher	1.4 (1.1, 1.8)	1.4 (1.08, 1.8)	1.13 (0.8, 1.46)	1.43 (1.16, 1.7)
Driver	0.8 (0.7, 1.1)	0.9 (0.7, 1.23)	0.75 (0.58, 0.9)	1.27 (1.01, 1.6)
Other	0.9 (0.7, 1.06)	0.9 (0.8, 1.1)	1.05 (0.9, 1.23)	1.28 (1.1, 1.49)
Change in income				
No changes	–	–	–	–
Low decrease	1.5 (1.3, 1.6)	1.5 (1.3, 1.6)	1.19 (1.07, 1.3)	1.16 (1.04, 1.3)
Half	3.7 (3.3, 4.1)	3.5 (3.07, 3.9)	1.6 (1.42, 1.8)	2.09 (1.85, 2.3)
Cut	6.3 (5.6, 7.2)	7.3 (6.4, 8.3)	2.76 (2.39, 3.2)	3.86 (3.4, 4.41)
COVID-19 in family				
No	–	–	–	–
Yes	0.9 (0.7, 1.1)	0.8 (0.7, 1.12)	0.84 (0.7, 1.08)	0.8 (0.63, 1.02)
Education				
Master./ higher	–	–	–	–
Bachelor	1.4 (1.2, 1.6)	1.5 (1.2, 1.7)	1.24 (1.06, 1.5)	1.14 (0.9, 1.34)
Associate	1.8 (1.5, 2.3)	1.7 (1.4, 2.1)	1.5 (1.2, 1.82)	1.2 (1.01, 1.5)
Diploma	1.8 (1.5, 2.2)	1.7 (1.4, 2.0)	1.9 (1.6, 2.26)	1.3 (1.13, 1.6)
High school	2.2 (1.8, 2.6)	2.1 (1.7, 2.5)	2.48 (2.1, 2.9)	1.6 (1.34, 1.9)
Theological education	2.7 (1.7, 4.4)	3.4 (2.2, 5.6)	7.2 (4.4, 11.6)	3.4 (2.1, 5.4)
Food security status of province				
Secure	–	–	–	–
Semi secure	1.3 (1.1, 1.4)	1.1 (0.9, 1.2)	1.37 (1.2, 1.54)	1.2 (1.07, 1.33)
Deprived	1.2 (1.1, 1.4)	1.4 (1.2, 1.6)	1.86 (1.6, 2.1)	1.3 (1.2, 1.47)

The households from deprived provinces, compared with those residing in secure provinces, were 20%, 40%, 86% and 30% more likely to decrease their weekly consumption of red meat, white meat, eggs and rice/bread, respectively. There was a significant association between household head's educational level and changes in weekly consumption pattern of the selected food items during the epidemic.

It is noteworthy that in the subgroup of households that had decreased their weekly consumption of animal protein rich foods and cereals, about 34% (11.2% of total population), 19% (4.7% of total population), 12% (1.7% of total population) and 6% (0.5% of total population) completely omitted red meat, white meat, egg and rice/bread, respectively (Table 4).

The ordinal regression analysis was performed in the subgroup of the households that decreased their dietary intake to identify factors that were associated with the amount of reduction in red and white meats, eggs and rice/bread consumption. The analysis confirmed that the assumption of parallel odds was not violate ($p = 0.133$). Therefore, results are reported for the ordered logistic models in Table 5. The analysis revealed that living in rural areas was associated with more reduction in weekly consumption of red and white meats, eggs and rice/bread intake. Also, people who were living in semi-secure or deprived provinces were more likely to omit their red meat from their food basket (OR, 1.33, 95%CI: 1.14, 1.54, OR, 1.39, 95%CI: 1.17, 1.65, respectively). Occupation but being teacher was not a significant predictor of more reduction in the food items. Interestingly, households whose income was decreased to half or less were more likely to omit their red and white meats, eggs and rice/bread intake.

Figures 1 and 2 display the stacked par charts for the reasons of decrease or increase of weekly consumption of the selected food items during the epidemic. The main reason for reduced consumption was income decrement and job loss.

A total of 20.1% of households had decreased weekly consumption of both red and white meats and 8.6% had reduced all three major dietary sources of animal protein, i.e., red and white meats and eggs. Close to half of the households (46.9%) who decreased their intake of the three protein sources had increased their intake of rice or bread.

Discussion

This is the first nationwide report of the coronavirus epidemic-induced dietary changes of the Iranian households during lockdown period. The mean household size and the ratio of urban to rural households well correspond the report from latest population census in Iran [16] indicating that the study population was representative (~1%) of the whole country households.

We found a considerable decrease in consumption frequency of animal protein rich foods notably red meat followed by white meat and eggs during coronavirus epidemic lockdown. The main reason for this change in dietary pattern in our study was reduced income which inevitably affects purchasing power and hence food access. Fear of exposure to asymptomatic carriers of the coronavirus may also adversely affect food choices of the households [17]. On the other hand, reduced demand for certain food items, including animal source proteins, may lead to a substantial decrement in vendors' and retailers' income [17]. Consequently, COVID-19-induced changes of dietary pattern of Iranian households have been, so far, due to decreased economic and physical access. Inaccessibility of food due to costs may result in socioeconomic disparities in healthy diet [7]. Obviously, poor people and those households with bigger size are more vulnerable. Decreased food access, one of the impacts of the epidemic on food security of the households [18], may be accompanied by less healthy eating pattern and poor diet quality [19].

Our findings demonstrated that female headed-households were more vulnerable and more likely to decrease their animal source proteins in their food baskets. Recent studies have addressed this issue that female-headed households confronting several challenges might be more vulnerable than male-headed [20] and strategies imposed by governments to combat coronavirus epidemic may adversely affect food security of the vulnerable subgroups including female-headed households [21].

We found that the likelihood of decrement of animal source proteins from food basket in deprived (food insecure), as compared with secure, provinces is higher. Furthermore, the quality of foods purchased could be very different, usually worse, when the household income

Table 4 The descriptive amount of decrease in consumption of red and white meats, eggs and rice/bread in the subgroup of households that had decreased their weekly consumption frequency during COVID-19 epidemic lockdown

Food item	Changes status*	*n* (%)	Of total population (%)
Red meat	Little	2296 (32.5)	10.7
	Half	2401 (33.2)	10.9
	Omitted	2653 (34.1)	11.2
White meat	Little	2093 (38.3)	9.3
	Half	2339 (42.2)	10.3
	Omitted	1036 (19.4)	4.7
Egg	Little	1422 (42.5)	6.0
	Half	1521 (45)	6.3
	omitted	399 (12.4)	1.7
Bread and rice	Little	670 (42.8)	2.9
	Half	844 (50.8)	3.5
	Omitted	98 (6.2)	0.5

* Little: slight reduction in consumption compared to before COVID-19 epidemic, Half: reduce of consumption by half, Omitted: removed from household food basket

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Table 5 Ordered logistic regression models of factors contributed to the amount of reduction in intake of red meat during COVID-19 epidemic lockdown

Variables	Red meat OR (95% CI)	White meat OR (95% CI)	Egg OR (95% CI)	Bread and rice OR (95% CI)
Sex of household head				
Male	–	–	–	–
female	1.01 (0.82, 1.24)	1.07 (0.8, 1.4)	1.02 (0.8, 1.4)	1.09 (0.81, 1.5)
Urban/Rural				
Urban	–	–	–	–
Rural	1.38 (1.21, 1.57)	1.23 (1.1, 1.4)	1.3 (1.1, 1.6)	1.7 (1.3, 2.2)
Household size				
1–2	–	–	–	–
3–5	0.9 (0.77, 1.17)	0.9 (0.7, 1,1)	0.9 (0.7, 1.2)	0.8 (0.6, 1.03)
>6	1.07 (0.81, 1.41)	0.8 (0.6, 1.1)	1.04 (0.7, 1.5)	0.6 (0.4, 0.9)
High risk members				
No	–	–	–	–
<5 years old	1.16 (1.0, 1.33)	1.1 (0.9, 1.3)	0.9 (0.7, 1.2)	0.9 (0.7, 1.2)
Pregnant/lactating mothers	1.38 (0.97, 1.96)	1.3 (0.9, 1.9)	0.6 (0.4, 1.01)	0.9 (0.5, 1.4)
Elder	0.84 (0.67, 1.04)	0.9 (0.8, 1.3)	1.1 (0.8, 1.5)	0.8 (0.5, 1.1)
More than one	1.25 (1.04, 1.5)	1.3 (1.0, 1.6)	0.98 (0.8, 1.3)	1.1 (0.8, 1.5)
Occupation				
Employee	–	–	–	–
Freelance	0.9 (0.72, 1.12)	0.9 (0.6, 1.2)	0.8 (0.6, 1.2)	0.6 (0.4, 0.9)
Retired	0.97 (0.72, 1.25)	1.2 (0.9,1.7)	0.8 (0.5, 1.3)	1.07 (0.6, 1.8)
Health workers	0.9 (0.6, 1.35)	1.0 (0.6, 1.7)	0.9 (0.5, 1.6)	0.7 (0.3, 1.6)
Teacher	1.41 (1.01, 1.96)	1.5 (0.9, 2.3)	0.6 (0.3, 0.9)	1.3 (0.6, 2.9)
Driver	1.12 (0.82, 1.53)	0.9 (0.6, 1.3)	0.6 (0.4, 0.9)	0.7 (0.4, 1.2)
Other	1.21 (0.97, 1.52)	1.2 (0.9, 1.6)	0.8 (0.6, 1.2)	0.9 (0.6, 1.4)
Change in income				
No changes	–	–	–	–
Small decrease	0.92 (0.79, 1.01)	0.9 (0.7, 1.1)	1.2 (0.9, 1.7)	0.7 (0.5, 1.04)
Half	1.29 (1.08, 1.53)	1.7 (1.3, 2.1)	1.7 (1.3, 2.2)	1.7 (1.2, 2.5)
Cut	2.87 (2.36, 3.49)	3.5 (2.7, 4.4)	2.5 (1.9, 3.7)	2.6 (1.8, 3.7)
COVID-19 in family				
No	–	–	–	–
Yes	1.54 (1.09, 2.17)	1.3 (0.8, 1.9)	0.9 (0.6, 1.5)	1.2 (0.7, 2.2)
Education				
Master./ higher	–	–	–	–
Bachelor	1.21 (0.94, 1.56)	1.6 (1.1, 2.2)	1.3 (0.9, 2.0)	1.5 (0.9, 2.5)
Associate	1.3 (0.97, 1.74)	1.7 (1.2, 2.6)	1.4 (0.9, 2.4)	1.7 (0.9, 3.0)
Diploma	1.33 (1.03, 1.73)	1.6 (1.1, 2.2)	1.4 (0.9, 2.1)	1.6 (1.01, 2.6)
High school	1.85 (1.41, 2.41)	2.0 (1.4, 2.8)	1.3 (0.9, 2.0)	2.1 (1.3, 3.3)
Theological education	2.22 (1.3, 3.8)	1.7 (0.8,3.3)	1.02 (0.5, 2.1)	2.9 (1.3, 6.4)
Food security status of province				
Secure	–	–	–	–
Semi secure	1.33 (1.14, 1.54)	1.0 (0.8, 1.2)	0.8 (0.6, 1.1)	0.7 (0.5, 0.9)
Deprived	1.39 (1.17, 1.65)	1.1 (0.9, 1.3)	1.04 (0.8, 1.4)	1.08 (0.8, 1.5)

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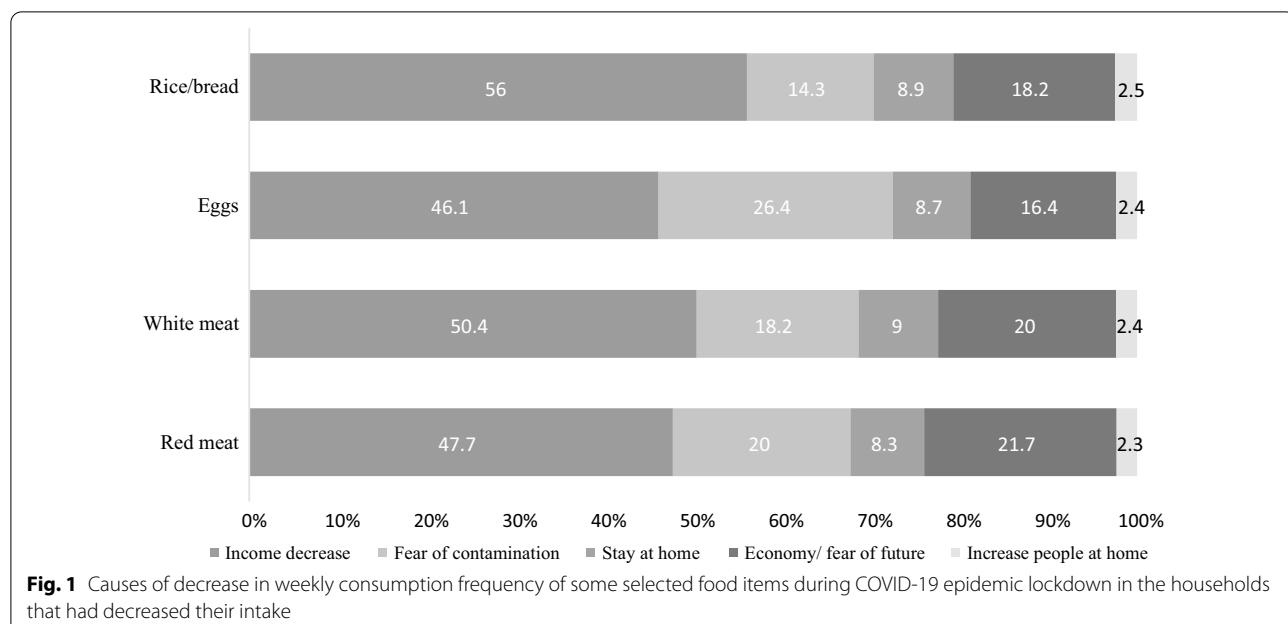
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Fig. 1 Causes of decrease in weekly consumption frequency of some selected food items during COVID-19 epidemic lockdown in the households that had decreased their intake
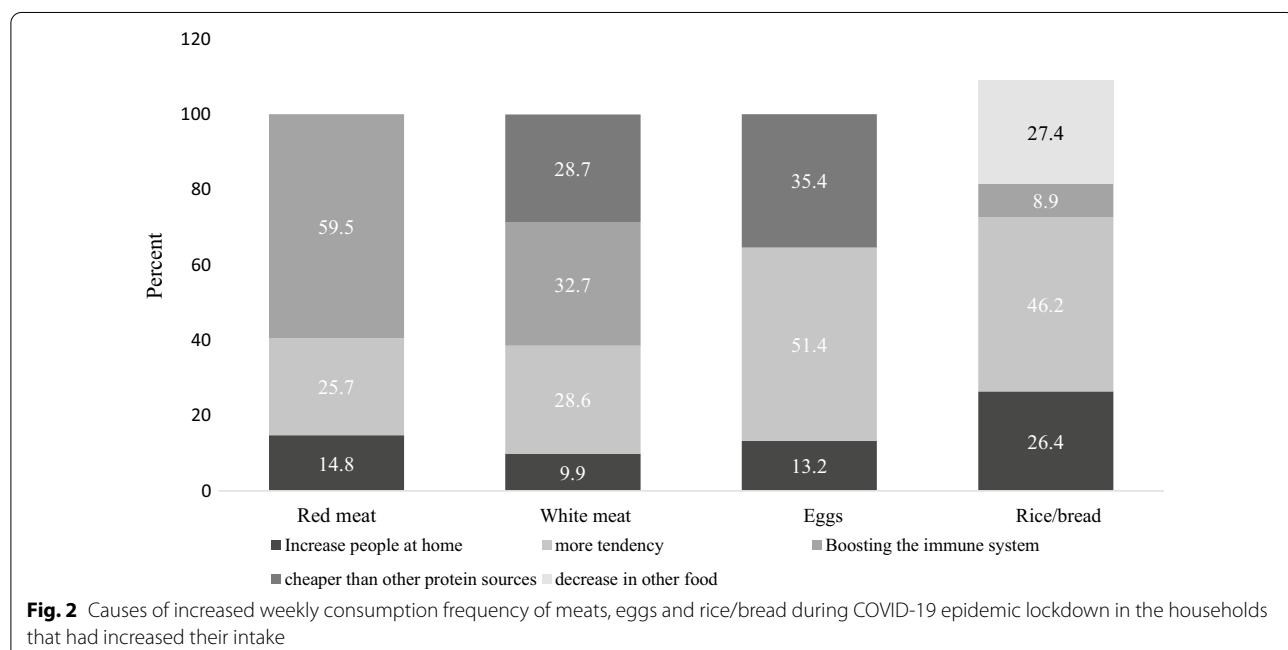
Fig. 2 Causes of increased weekly consumption frequency of meats, eggs and rice/bread during COVID-19 epidemic lockdown in the households that had increased their intake

decreases [10, 22]. Though we did not really evaluate food security status of the households, decreased animal protein foods in the food basket usually accompanies food insecurity [23].

A very noticeable finding is increment of bread and rice consumption in almost half of the study population. Generally socio-economic status has a direct correlation with diet quality in terms of micronutrient content [24]. It should be noted that high animal protein intake is not generally recommended from both nutrition and environmental points of view [25, 26] and there is evidence for association between animal protein intake and all-cause as well as specific (notably general adiposity and cardiovascular disease) mortality [26–29]. Nevertheless, decreased or deletion of animal source proteins due to reduced access of the

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households together with consequent increased consumption of cereals, notably rice and bread, may bring about adverse health effects including obesity with its comorbidities such as diabetes, hypertension and cardiovascular disease, with concomitant micronutrient deficiencies, the so-called double burden of malnutrition [30, 31]. High occurrence of micronutrient deficiencies and related disorders including stunting in under 5 children has been partly attributed to insufficient or lack of animal source proteins in diet [32]. Findings from two recent studies confirmed the effect of animal source proteins intake by pregnant mother and growing child in prevention and treatment of different forms of child malnutrition notably underweight, wasting and stunting [33, 34].

Some limitations of this study must be acknowledged. The survey employed self-administered online questionnaire with the consequent exclusion of those people who had less or no access to the internet facilities for any reason. Nevertheless, this is a common limitation in online surveys [35–37]. Furthermore, we did not ask about the household fish consumption. Considering the high price of fish in Iran is one of the biggest obstacles to fish consumption [38], noticeable decrement and even omission of this nutritious food item from the food basket of many Iranian households during the epidemic is highly expectable. Notwithstanding, we do not think that this issue has affected seriously our findings as some studies showed that the contribution of fish to total protein intake of the Iranian households is minimal [39, 40].

Conclusions

The COVID-19 epidemic has affected different aspects of life including economy, food choices and also food access. Our findings revealed that the contribution of animal protein foods in a considerable proportion of Iranian household food baskets have decreased during epidemic lockdown mostly due to income and job loss but the amounts of rice and bread, as the major sources of dietary energy, have increased. These changes, if last long enough, can seriously affect micronutrient status of the whole population, especially children, and accelerate the occurrence rates of obesity and several chronic diseases in the future. Further research is thus warranted to determine if this trend is secular. Meanwhile, early nutritional interventions including subsidies, food basket aids, home gardening, home fortification and supplementation for needy families should be implemented.

Author contributions
This study was designed by TN with intellectual aids of BN, SR, MA, DG, HR, AD and ZA. ZA, MM and FS helped in data gathering through vice-chancellors in health affairs and the Community Nutrition Offices of the medical universities of the provinces. BN performed all statistical analyses and prepared the preliminary manuscript that was then finalized by TN. SR, MA, DG, HR, AD and ZA revised the manuscript critically. All authors have read and approved the final manuscript.

Availability of data and materials
Please contact author for data requests.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of the National Nutrition and Food Technology Research Institute (IR.SBMU.NNFTRI.REC.1399.066).

Consent for publication
All authors have given their consent for this publication.

Competing interests
The authors declare that they have no competing interests.

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