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Association of Healthy Food Intake with Psychiatric Distress in Children and Adolescents: the CASPIAN-IV study

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Abstract

Background: Healthy dietary habits are known as a key factor for improving brain functions and cognitive ability in children and adolescents. The goal of this study was to evaluate the association of healthy food consumption with mental health in Iranian children and adolescents.

Materials and Methods: Data were obtained from the fourth national school-based surveillance survey entitled CASPIAN-IV study. In this study, 14880 children and adolescents aged 6-18 years were selected by multistage, cluster sampling method from rural and urban areas. The students and their parents completed two sets of questionnaires. The psychiatric distress included depression, worry, insomnia, anxiety, aggression, confusion, and worthless and the violent behaviors comprised of physical fight, victim and bully. The healthy foods included fresh fruits, dried fruits, vegetables and dairy products.

Results: The participants include 13,486 students from elementary, intermediate and high school degree. The prevalence of psychiatric distress was significantly higher among high school students, while violent behaviors were more prevalent in the middle school students. According to the multivariate model (model IV), the risk of psychiatric distress was significantly lower in students with daily consumption of fresh fruits, vegetables and milk. In addition, those with daily consumption of vegetables and milk had significantly lower risk for violent behaviors.

Conclusion: Consumption of healthy foods may reduce the risk of psychiatric distress and violent behaviors. Therefore, in addition to its benefits, increasing healthy food consumption among children and adolescents can be useful in preventing mental health disorders.

***Key Words*:** Healthy food, Iran, Psychiatric distress, Students, Violent behaviors.

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1- INTRODUCTION

Mental disorders are considered as a neglected global health problem with growing prevalence among children and adolescents especially in Low and Middle Income Countries(1). It is reported that up to 20% of this age group suffer from some kind of mental illness, so that about half of mental health problems in adulthood begin from adolescence (2). These problems often develop before the age of 14 years (3). In addition, psychiatric disorders are more common among adolescents than the young children (4-6). The World Health Organization (WHO) has anticipated that by 2020, mental disorders will be a critical global issue (7).

While consumption of foods with low nutritional content as unhealthy snacks and sweetened beverages is suggested to be in association with poorer mental health (8-16), healthy dietary habits, which are known as a key factor for improving brain functions and cognitive ability in children and adolescents, are associated with better psychological functioning (17, 18). For instance, a Western dietary pattern including fast foods, red meat and sweets are in association with higher frequency of mental health problem, in contrast, a diet nutrient–rich diet containing vegetables and fruits may be associated with better mental health (8, 19).

Most relevant previous studies have investigated the effects of a single nutrient or meal on mental health (10, 20, 21). Recently, dietary pattern have been considered as a substantial predictor of mental health rather than isolated nutrients (22, 23). It is suggested that diet quality can be approximated by simple markers as consumption of vegetables and fruits (24). A growing numbers of studies indicated that intake of fruits, vegetables and low fat dairy product is a main component of a healthy dietary pattern (14, 22, 25, 26).

In recent years, the prevalence of non-communicable diseases including obesity, metabolic syndrome and cardiovascular diseases is notably increasing in Iran (27, 28). Also, Burden of nutritional disorders has increased among children and adolescents due to rapid changes in lifestyle and increased tendency to consume low nutritional value foods (29).

On the other hand, with regards to the considerably high prevalence, and the increasing burden of mental disorders and given the potential for preventive actions early in life span, it is necessary to identify and investigate the role of environmental factors particularly diet quality in this regard. To the best of our knowledge, there is a gap in the knowledge about this issue in Iran. We have previously reported the association of junk food consumption with mental health in Iranian students (30) and in the current study we investigated the association of the intakes of fruits, vegetables and low fat dairy, as primary components of a healthy dietary pattern with mental health in a national sample of Iranian children and adolescents.

2- MATERIALS AND METHODS

2-1. Study Design and Population

This study used data from the fourth survey of the school-based surveillance system entitled "Childhood and Adolescence Surveillance and PreventIon of Adult Non-communicable Disease" (CASPIAN) study in 2011-2012. The objective of this study was to evaluate nationally-representative high risk behaviors in school students in Iran and its procedure have been described in details previously (31).

2-2. Sampling Method

The sampling was proportionate to size by considering equal sex ratio; so that the numbers of selected boys and girls were equal in each province. Moreover, the ratios of living area (urban and rural), were

considered. Therefore, the maximum sample size was determined based on an appropriate estimate of all desired risk factors. The sample size was calculated using a proportion estimation formula. In order to calculate the maximum sample size, the prevalence, precision and type I error were considered as 0.5, 0.1 and 0.05 respectively. The estimated sample size was 100 subjects multiplied by sex grouping (boy and girl), living area (urban and rural), and an attrition rate of 20%. Therefore, 480 students (48 clusters with 10 students in each province of country) were selected. Overall 14,880 school students aged 6-18 years, were selected by multistage, cluster sampling method from 30 provinces of Iran. They were stratified based on the grade of school and residential area (urban or rural).

2-3. Measuring tool

To assess the psychiatric distress, the questionnaire of the World Health Organization- Global school-based Student Health survey (WHO-GSHS) was used (http://www.who.int/chp/gshs/datasets/en/index.htm). The validity and reliability of this questionnaire has been approved in previous study in Iran (32).

The students completed two sets of questionnaires obtained from GSHS translated in Persian. The questionnaire of students was comprised of several components including demographic data (age, gender, living area, family size, parental occupation and education), life style questions (screen time, socioeconomic status and physical activity), psychiatric distress (depression, worry, confusion, anxiety, aggression, insomnia and worthless) and violent behaviors (bully victim and physical fight) were assessed by following questions. It is necessary to mention that the questionnaire was read for the students without literacy (first grade students).

Depression: During the past 12 months, did you ever feel so sad or hopeless? (Responses were "Yes or No).

Worry: During the past 12 months, how often have you been so worried about something that you could not sleep at night? (Responses were ranged from never to always).

Confusion: During the past 6 months, how often did you experience confusion so that you cannot do your daily activity? (Responses were ranged from almost every day to or never).

Anxiety: During the past 6 months, how often did you experience anxiety so that you cannot do your daily activity? (Responses were ranged from almost every day to or never).

Aggression: During the past 6 months, how often did you experience aggression so that you cannot do your daily activity? (Responses were ranged from almost every day to or never).

Insomnia: During the past 6 months, how often did you experience insomnia so that you cannot do your daily activity? (Responses were ranged from almost every day to or never).

Worthless: During the past 6 months, how often did you experience worthless so that you cannot do your daily activity? (Responses were ranged from almost every day to or never).

Bully: During the past 3 months, how many times you bully at school? (Responses ranged from 0 time to 4 times or more).

Victim: During the past 3 months, how many times you got bullied at school? (Responses ranged from 0 time to 4 times or more).

Physical fight: During the past 12 months, how many times you had physical fight? (Responses ranged from 0 time to 4 times or more).

The questions, response items and scoring of psychiatric distress and violent behaviors questions are presented in **Appendix 1.**

Weight and height were measured by trained health care experts under standard protocol and by using calibrated instruments. Weight was recorded with lightly dressed condition with 0.1 kg accuracy and standing height was measured without shoes with 0.1 cm accuracy. To calculate body mass index (BMI), weight (kg) was divided by height (m^2).

To assess the physical activity (PA), the students were asked "How many days in the last week, have you had a 30 minutes physical activity?". Responses were included 0- 1 day (considered as mild), 2-4 days (considered as moderate) and 5-7 days (considered as severe) (33).

To evaluate the socio-economic status (SES), using principle component analysis (PCA) variables including parent's education, parent's job, possessing private car, type of home (public or private), school type (public or private) and having personal computer in home were summarized in one main component. This main component was categorized into tertile. The first tertile was defined as a low SES, and last tertile as a high (34).

As suggested by other studies (14, 22, 25, 26), four groups of foods were considered as healthy foods, including fruits (fresh and dried), vegetables and dairy products. The students were asked "How often do you consume healthy foods". The responses were included of seldom or weekly or daily consumption.

The questionnaire of parents consisted of demographic information such as their occupation and education, family history and family size; they were completed by trained researchers in a convenient place. In addition, the procedure was controlled by a skilled team. A workshop was organized for the project team and a manual was given to them. The Data and Safety Monitoring Board of the project supervised the uniformity in all assessments, the quality control and quality assurance of the survey at the national level.

2-4. Inclusion and exclusion criteria

All 6-18 years school students with Iranian nationality (having Iranian identity card) were eligible to participate in this study. Exclusion criteria included having a chronic disease, history of chronic medication consumption and obtaining from a special diet. Moreover, subjects with full missing data were excluded.

2-5. Ethical considerations

This nationwide study was evaluated and approved by ethical committee of Tehran and Isfahan university of Medical Sciences. The project code is 188092. There were no obligation for participation in this study and all of the participants were volunteers. After receiving explanation about the study protocols, the verbal and written informed consent were obtained from students and their parents respectively.

2-6. Statistical analysis

Continuous variables were expressed as mean and standard deviation (SD) and quantitative variables as number and percentage. Pearson Chi-square test were used to analysis of categorical variables. The association of mental health with healthy food intake was assessed with four models of logistic regression to control potential confounders. *Model.1* is a crude association between healthy food intake and psychiatric distress and violent behavior without adjustment. In *model.2*,

these associations were adjusted for age, gender, and region. In *model.3*, additional adjustment was done for family history of chronic diseases, mother's education, screen time, physical activity, and socioeconomic status. Finally in *model.4*, BMI was adjusted in addition to *Model.3*. Results of logistic regression are presented as odds ratio (OR) and 95% confidence interval (95% CI). Data were analyzed using survey data analysis methods in the Statacrop.2011 (Stata Statistical Software: Release 11. College Station, TX: Stata crop LP. Package).P-value<0.05 was considered as statistically significant.

3- RESULTS

Among 14,880 invited students and one of their parents, 13,486 students (participation rate of 90.6%) with mean age of 12.47±3.36 years participated in this study. Demographic data of the study population and the prevalence of psychiatric distress and violent behaviors are presented in **Table.1** and **Table.2** respectively. The prevalence of psychiatric distress was significantly higher among high school students, while violent behaviors were more prevalent in the middle school students. Overall, angriness and physical fight are the most reported ones (**Table.2**).

Table.3 presents the association of psychiatric distress with consumption of healthy foods. As presented, psychiatric distress was in association with consumption of fresh fruits, vegetables and milk significantly (P<0.05). Therefore, those with daily intake of fresh fruits, vegetables and milk had significantly lower risk of all psychiatric distress but in case of dried fruits, this association was significant only for angriness.

Moreover, the association between violent behaviors and healthy foods consumption has been illustrated in **Table.4**. As this table shows, there was a significant association between violent behaviors and vegetable consumption (P<0.05). Among violent behaviors, significant association existed between physical fight and consumption of fresh fruits, vegetables, and milk. In other words, those with daily consumption of all food groups except dried fruits had lower physical fight.

The associations of healthy food consumption with psychiatric distress are presented in **Table.5.** The risk of all psychiatric distress was significantly lower in students with daily consumption of fresh fruits and milk (compared with seldom eaters) except in case of the association between fresh fruits and depression. Also, those with daily consumption of vegetables had 28% lower risk for worthless (OR: 0.72; 95% CI 0.68-0.87), 20% lower risk for angriness (OR: 0.80; 95% CI 0.71-0.91), 36% lower risk for confusion (OR: 0.64; 95% CI 0.53-0.78) and 16% lower risk of depression (OR: 0.84; 95% CI 0.74-0.96).

The association parameters of healthy foods consumption with violent behaviors from logistic regression models have been shown in **Table.6**. In the multivariate model (model IV), those with daily consumption of vegetables and milk (compared with seldom eaters) had significantly lower risk for violent behaviors except in case of the association between milk and victim (OR: 0.9; 95% CI 0.79-1.02).

4- DISCUSSION

The findings of the present study show that there is a significant association between healthy foods consumption and mental health with regarding to the confounder factors, so that daily eaters of healthy foods were less likely to have mental health disorders. These results are notably in line with previous studies implying that those with higher consumption of healthy foods are less susceptible to be affected by depression or

depressive symptom (15, 22, 35-37). Mc-Martin et al., suggested that consumption of fruits and vegetables, as a part of a healthy dietary pattern, play an important role in the prevention of mental health problems (26). Also, it has been found that individuals with a diverse diet rich in fruits and vegetables, dairy products and other healthy foods are less likely to suffer from depression, while a higher consumption of nutrient-poor diets such as processed foods are in association with mental health disorders including anxiety and depression (38, 39). In addition, adherence to a high quality diet such as Mediterranean diet is associated with better mental health (40).

The results of a recent study indicate that there is an association between high intake of vegetables and fruits and higher mood. Furthermore, the same findings have been observed regarding to the isolated nutrients such as magnesium, fiber, ascorbic acids, tryptophan and selenium found abundantly in healthy foods such as fruits and vegetables(41). In addition, there is an association between meal skipping and mental problems and violent behaviors in children and adolescents (42). Likewise, O'Neil et al., showed a relationship between unhealthy diet patterns and poorer mental health among children and adolescents (43). In a recent study, a cross-sectional association is documented between high quality diet and lower levels of depression during adolescence (44).

Possible mechanism for association between healthy foods and mental health disorders remains to be clarified. One study demonstrated the relationship of fruits and leafy green vegetables with lower mental health problems associated with micronutrient content of them specifically folate concentration which is required for neurotransmitters (8, 45, 46). In animal models, it is shown that high fat diet can induced anxiety and depressive signs in mice, whereas healthy diet containing fresh fruits and vegetables rich in anti-oxidant may be beneficial for preventing inflammation and oxidative stress known as detrimental factors for mental health (47, 48). There were both strengths and limitations which must be considered to interpret the findings of this study. The major strength was the large sample size drawn from 30 provinces of Iran with diverse ethnically population. To our knowledge, this is the first study to explore the association between healthy food consumption and mental health in Iranian children and adolescents. However, the cross sectional design of this study was the main limitation.

5- CONCLUSIONS

In summary, we have concluded that consumption of healthy foods may reduce the risk of psychiatric distress and violent behaviors in a population of children and adolescents. Moreover, the results of a recent study indicate that there is an association between high intake of vegetables and fruits and higher mood. Hence, adherence to a healthy dietary intake can be suggested as a protective approach related to mental health.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENT

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Appendix.1: List of questions to screen psychiatric distress and violent behaviors according to Global School-based student Health Survey (GSHS) questionnaires

Question	Response
Psychiatric distress	
During the past 12 months, did you ever feel so sad or hopeless?	1.Yes 2. No
During the past 12 months, how often have you been so worried about something that you could not sleep at night?	1. Never (considered as No) 2. Rarely (considered as No) 3. Sometimes (considered as No) 4. Most of the time (considered as Yes) 5. Always (considered as Yes)
During the past 6 months, how often did you experience confusion so that you cannot do your daily activity?	1. Almost every day (considered as Yes) 2. More than once a week (considered as Yes) 3. Almost every week (considered as Yes) 4. Almost every month (considered as No) 5. Rarely or never (considered as No)
During the past 6 months, how often did you experience anxiety so that you cannot do your daily activity?	
During the past 6 months, how often did you experience aggression so that you cannot do your daily activity?	
During the past 6 months, how often did you experience insomnia so that you cannot do your daily activity?	
During the past 6 months, how often did you experience worthless so that you cannot do your daily activity?	

Violent behaviors	
During the past 3 months, how many times you bully at school?	1. None (considered as No) 2. 1-2 times (considered as Yes) 3. 2-3 times (considered as Yes) 4. 4 times or more (considered as Yes)
During the past 3 months, how many times you got bullied at school?	1. None (considered as No) 2. 1-2 times (considered as Yes 3. 2-3 times (considered as Yes) 4. 4 times or more (considered as Yes)
During the past 12 months, how many times you had physical fight?	1. None (considered as No) 2. 1 times (considered as Yes) 3. 2 times (considered as Yes) 4. 3 times (considered as Yes) 5. 4 times (considered as Yes)

Table-1: Characteristics of participants according to school level: The CASPIAN-IV study

Variables	Primary school Number (%)	Middle school Number (%)	High school Number (%)	Total Number (%)	P- value*
Family size					
Less than 4 persons	3394(56%)	1598(46%)	1499(40%)	6491(49%)	<0.001
More than 4 persons	2987(44%)	1847(54%)	2244(60%)	6778(51%)	
Father's occupation					
Unemployed or died	277(4%)	195(6%)	185(5%)	657(5%)	0.15
Worker or Government Employee	2858(47%)	1544(46%)	1672(46%)	6074(47%)	
Farmer	517(8%)	360(11%)	358(10%)	1235(9%)	
Self- employed	2399(40%)	1261(37%)	1402(39%)	5062(39%)	
Mother's occupation					
Housekeeper or died	5488(89%)	3052(88%)	3343(89%)	11883(89%)	0.59
Worker or Government Employee	467(7%)	295(8%)	298(8%)	1060(8%)	
Other	184(3%)	118(3%)	107(2%)	409(3%)	
Father's education					
Illiterate/Elementary school	594(10%)	404(12%)	473(13%)	1471(11%)	0.03
Secondary school/ High school	4613(76%)	2522(75%)	2653(73%)	9788(75%)	
University	872(14%)	446(13%)	513(14%)	1831(14%)	
Mother's education					
Illiterate/Elementary school	916(15%)	601(17%)	753(20%)	2270(17%)	<0.001
Secondary school/ High school	4616(75%)	2589(75%)	2720(72%)	9925(74%)	
University	611(10%)	279(8%)	277(7%)	1167(9%)	
Sedentary lifestyle					
Watching TV					
≤ 2h/day	3486(57%)	1531(44%)	1568(42%)	6585(49%)	<0.001
> 2h/day	2638(43%)	1935(56%)	2187(58%)	6760(51%)	
Working with computer					
≤ 2h/day	5686(95%)	3037(89%)	3097(83%)	11820(90%)	<0.001
> 2h/day	293(5%)	353(10%)	614(16%)	1260(10%)	
Screen time					
≤ 4 h/day	5477(89%)	758(78%)	2708(72%)	10899(81%)	<0.001
> 4h/day	674(11%)	758(22%)	1062(28%)	2494(19%)	

Physical activity					
Mild	1653(27%)	1169(34%)	1731(46%)	4553(34%)	<0.001
Moderate	2376(39%)	1316(38%)	1218(32%)	4910(37%)	
Severe	2105(34%)	969(28%)	812(21%)	3886(29%)	
Socio- Economic Status (SES)					
Low	2035(35%)	1066(33%)	1046(30%)	4147(33%)	0.004
Medium	1963(34%)	1029(32%)	1108(32%)	4100(33%)	
High	1753(30%)	1085(34%)	1305(38%)	4143(33%)	
Family history					
HTN	3236(53%)	1838(53%)	2090(55%)	7146(54%)	0.10
Dyslipidemia	2583(42%)	1534(44%)	1771(47%)	5888(44%)	<0.001
DM	2166(36%)	1266(37%)	1425(38%)	4857(37%)	0.19
Obesity	2676(43%)	1599(46%)	1804(48%)	6079(45%)	0.006
BMI					
Underweight	824(13%)	452(13%)	345(9%)	1621(12%)	<0.001
Normal	4048(67%)	2137(62%)	2609(69%)	8830(66%)	
Overweight	491(8%)	368(11%)	428(11%)	1287(9%)	
Obese	720(12%)	476(14%)	388(10%)	1584(12%)	
Body Image					
Thin	2526(41%)	1011(29%)	1059(28%)	4596(34%)	<0.001
Normal	2787(45%)	1639(47%)	1833(48%)	6259(46%)	
Obese	868(14%)	822(24%)	888(23%)	2578(19%)	
Passive smoking					
Yes	2540(42%)	1509(44%)	1753(47%)	5802(44%)	<0.001
No	3525(58%)	1929(56%)	1970(53%)	7424(56%)	
Current Smoking					
Yes	6158(99%)	3441(98%)	3538(93%)	13137(97%)	<0.001
No	40(0.6%)	51(1%)	258(6%)	349(2%)	

* Comparisons based on $\chi 2$ test.

Table-2: Prevalence of psychiatric distress and violence behavior according to school level: The CASPIAN -IV study

Variables	Primary Number (%)	Guidance Number (%)	High school Number (%)	Total Number (%)	P- value*
Psychiatric Distress					
Worthless	358(6%)	494(14%)	530(14%)	1382(10%)	<0.001
Angriness	1749(28%)	1481(43%)	1806(48%)	5036(38%)	<0.001
Anxiety	930(15%)	1041(30%)	1399(37%)	3370(25%)	<0.001
Insomnia	620(10%)	670(19%)	850(23%)	2140(16%)	<0.001
Confusion	319(5%)	347(10%)	486(13%)	1152(8%)	<0.001
Depression	796(13%)	789(23%)	1209(37%)	2794(25%)	<0.001
Worried	1037(17%)	1290(37%)	1595(42%)	3922(29%)	<0.001
Violence behavior					
Bully	925(15%)	735(21%)	687(18%)	2347(17%)	<0.001
Victim	1751(28%)	1037(30%)	882(23%)	3670(27%)	<0.001
Physical fight	2393(39%)	1557(45%)	1402(37%)	5352(40%)	<0.001

* Comparisons based on $\chi 2$ test.

Table-3: Association between psychiatric distress and healthy foods: The CASPIAN IV study

Variables	Fresh Fruits			Dried Fruits			Vegetables			Milk		
	Seldom	Weekly	Daily	Seldom	Weekly	Daily	Seldom	Weekly	Daily	seldom	Weekly	Daily
Worthless												
Yes	201 (15%)	481 (36%)	668 (49%)	547 (44%)	456 (36%)	246 (20%)	319 (23%)	590 (43%)	466 (34%)	442 (32%)	446 (32%)	488 (36%)
No	1139 (10%)	3956 (34%)	6627 (56%)	4383 (41%)	4044 (37%)	2392 (22%)	2055 (17%)	5544 (47%)	4275 (36%)	2328 (20%)	3946 (33%)	5609 (47%)
P- value	<0.001			0.06			<0.001			<0.001		
Angriness												
Yes	568 (11%)	1663 (34%)	2713 (55%)	1937 (43%)	1648 (36%)	949 (21%)	997 (20%)	2308 (46%)	1714 (34%)	1343 (27%)	1719 (34%)	1956 (39%)
No	776 (10%)	2792 (34%)	4598 (56%)	3004 (40%)	2860 (38%)	1700 (22%)	1387 (17%)	3837 (46%)	3044 (37%)	1435 (17%)	2686 (33%)	4160 (50%)
P- value	0.005			0.008			<0.001			<0.001		
Anxiety												
Yes	419 (13%)	1155 (35%)	1725 (52%)	1230 (41%)	1098 (36%)	686 (23%)	660 (20%)	1511 (45%)	1184 (35%)	967 (29%)	1101 (33%)	1286 (38%)
No	927 (9%)	3306 (34%)	5603 (57%)	3716 (41%)	3414 (37%)	1967 (22%)	1729 (17%)	4644 (47%)	3589 (36%)	1815 (18%)	3310 (33%)	4851 (49%)
P- value	<0.001			0.40			0.01			<0.001		
Insomnia												
Yes	266 (13%)	717 (34%)	1110 (53%)	791 (41%)	704 (37%)	412 (22%)	430 (20%)	954 (45%)	744 (35%)	624 (29%)	694 (33%)	813 (38%)
No	1075 (10%)	3738 (34%)	6198 (56%)	4150 (41%)	3806 (37%)	2233 (22%)	1950 (17%)	5189 (47%)	4011 (36%)	2147 (19%)	3710 (33%)	5301 (48%)

P- value	<0.001			0.84			0.01			<0.001		
Confusion												
Yes	171 (15%)	417 (37%)	536 (48%)	450 (43%)	370 (36%)	221 (21%)	277 (24%)	520 (45%)	353 (31%)	368 (32%)	381 (33%)	401 (35%)
No	1172 (10%)	4030 (34%)	6762 (56%)	4489 (41%)	4137 (37%)	2417 (22%)	2104 (18%)	5614 (46%)	4401 (36%)	2404 (20%)	4019 (33%)	5705 (47%)
P- value	0.001			0.32			<0.001			<0.001		
Depression												
Yes	320 (12%)	936 (34%)	1481 (54%)	1055 (42%)	918 (36%)	554 (22%)	568 (20%)	1239 (45%)	975 (35%)	828 (30%)	919 (33%)	1038 (37%)
No	1021 (10%)	3504 (34%)	5809 (56%)	3874 (41%)	3579 (37%)	2085 (22%)	1808 (17%)	4888 (47%)	3772 (36%)	1939 (19%)	3483 (33%)	5054 (48%)
P- value	0.02			0.55			<0.001			<0.001		
Worried												
Yes	453 (12%)	1250 (32%)	2150 (56%)	1502 (42%)	1297 (37%)	745 (21%)	755 (19%)	1729 (44%)	1425 (37%)	1152 (30%)	1303 (33%)	1459 (37%)
No	890 (10%)	3192 (34%)	5147 (56%)	3434 (40%)	3207 (38%)	1892 (22%)	1623 (17%)	4405 (47%)	3324 (36%)	1616 (17%)	3095 (33%)	4645 (50%)
P- value	0.002			0.11			0.008			<0.001		

*Comparisons based on $\chi 2$ test.

Table-4: Association between violent behavior and healthy foods: The CASPIAN IV study

Variables	Fresh fruits			Dried fruits			Vegetables			Milk		
	Seldom	Weekly	Daily	Seldom	Weekly	Daily	Seldom	Weekly	Daily	seldom	Weekly	Daily
Physical fight												
Yes	544 (10%)	1893 (36%)	2809 (54%)	2014 (42%)	1818 (37%)	1026 (21%)	1018 (19%)	2517 (47%)	1793 (34%)	1151 (21%)	1848 (35%)	2330 (44%)
No	805 (10%)	2576 (33%)	4520 (57%)	2945 (41%)	2708 (37%)	1621 (22%)	1372 (17%)	3644 (46%)	2982 (37%)	1630 (20%)	2576 (32%)	3804 (48%)
P- value	<0.001			0.35			<0.001			<0.001		
Victim												
Yes	367 (10%)	1222 (34%)	2000 (56%)	1364 (41%)	1202 (37%)	733 (22%)	713 (20%)	1690 (46%)	1252 (34%)	767 (21%)	1188 (32%)	1705 (47%)
No	981 (10%)	3252 (34%)	5334 (56%)	3593 (41%)	3322 (37%)	1923 (22%)	1674 (17%)	4480 (46%)	3529 (37%)	2015 (21%)	3238 (33%0	4436 (46%)
P- value	0.99			0.56			0.007			0.61		
Bully												
Yes	239 (10%)	821 (36%)	1231 (54%)	861 (40%)	777 (37%)	484 (23%)	463 (20%)	1073 (46%)	800 (34%)	572 (25%0	777 (33%)	987 (42%)
No	1105 (10%)	3632 (34%)	6082 (56%)	4086 (41%)	3728 (37%)	2164 (22%)	1922 (18%)	5068 (46%)	3965 (36%)	2202 (20%)	3632 (33%)	5132 (47%)
P- value	0.09			0.56			0.02			<0.001		

*Comparisons based on $\chi 2$ test.

Table-5: Associations of healthy food consumption with psychiatric distress: The CASPIAN IV study

Variables		Worthless (OR, 95% CI)	Angriness (OR, 95% CI)	Anxiety (OR, 95% CI)	Insomnia (OR, 95% CI)	Confusion (OR, 95% CI)	Depression (OR, 95% CI)	Worried (OR, 95% CI)
Fresh fruits								
Model I[1]	Seldom	1	1	1	1	1	1	1
	Weekly	0.68 (0.57-0.82)*	0.81 (0.71-0.92)*	0.77 (0.66-0.89)*	0.77 (0.65-0.91)*	0.70 (0.58-0.86)*	0.85 (0.73-0.99)*	0.76 (0.66-0.88)*
	Daily	0.57 (0.47-0.68)*	0.80 (0.70-0.92)*	0.68 (0.58-0.78)*	0.72 (0.61-0.85)*	0.54 (0.44-0.66)*	0.81 (0.70-0.94)*	0.82 (0.71-0.94)*
Model II[2]	Seldom	1	1	1	1	1	1	1
	Weekly	0.72 (0.59-0.87)*	0.84 (0.73-0.96)*	0.81 (0.69-0.94)*	0.81 (0.67-0.96)*	0.74 (0.60-0.91)*	0.89 (0.76-1.05)	0.81 (0.69-0.94)*
	Daily	0.59 (0.49-0.71)*	0.84 (0.73-0.95)*	0.71 (0.61-0.82)*	0.76 (0.64-0.90)*	0.57 (0.46-0.69)*	0.86 (0.74-0.99)*	0.86 (0.74-0.99)*
Model III[3]	Seldom	1	1	1	1	1	1	1
	Weekly	0.79 (0.64-0.97)*	0.88 (0.76-1.02)	0.85 (0.72-0.99)*	0.84 (0.70-1.02)	0.83 (0.65-1.05)	0.97 (0.81-1.15)	0.84 (0.71-0.99)*
	Daily	0.59 (0.48-0.72)*	0.85 (0.74-0.99)*	0.74 (0.63-0.87)*	0.76 (0.63-0.92)*	0.65 (0.51-0.82)*	0.94 (0.80-1.12)	0.82 (0.71-0.96)*
Model IV[4]	Seldom	1	1	1	1	1	1	1
	Weekly	0.78 (0.63-0.95)*	0.88 (0.76-1.02)	0.84 (0.71-0.99)*	0.84 (0.69-1.02)	0.83 (0.66-1.06)	0.97 (0.81-1.16)	0.84 (0.71-0.99)*
	Daily	0.59 (0.48-0.71)*	0.85 (0.74-0.99)*	0.73 (0.62-0.86)*	0.76 (0.63-0.92)*	0.65 (0.52-0.82)*	0.94 (0.79-1.12)	0.82 (0.71-0.96)*
Dried fruits								
Model I[1]	Seldom	1	1	1	1	1	1	1
	Weekly	0.90 (0.78-1.04)	0.89 (0.81-0.97)*	0.97 (0.87-1.07)	0.97 (0.86-1.09)	0.89 (0.76-1.04)	0.94 (0.84-1.05)	0.92 (0.84-1.01)
	Daily	0.82 (0.69-0.97)*	0.86 (0.77-0.96)*	1.05 (0.93-1.18)	0.96 (0.84-1.10)	0.91 (0.76-1.09)	0.97 (0.86-1.10)	0.90 (0.80-1.01)

Model II[2]	Seldom	1	1	1	1	1	1	1
	Weekly	0.91 (0.79-1.06)	0.90 (0.82-0.98)*	0.99 (0.89-1.09)	0.98 (0.87-1.10)	0.90 (0.76-1.05)	0.95 (0.85-1.06)	0.94 (0.85-1.03)
	Daily	0.83 (0.70-0.99)*	0.87 (0.78-0.97)*	1.08 (0.95-1.22)	0.98 (0.85-1.13)	0.92 (0.77-1.11)	0.99 (0.87-1.13)	0.91 (0.81-1.03)
Model III[3]	Seldom	1	1	1	1	1	1	1
	Weekly	0.92 (0.79-1.08)	0.92 (0.83-1.01)	0.99 (0.89-1.11)	1.00 (0.87-1.14)	0.93 (0.77-1.10)	0.98 (0.87-1.10)	0.98 (0.88-1.08)
	Daily	0.82 (0.68-0.99)*	0.86 (0.76-0.97)*	1.08 (0.95-1.24)	0.94 (0.81-1.10)	0.93 (0.76-1.14)	1.02 (0.89-1.18)	0.94 (0.83-1.07)
Model IV[4]	Seldom	1	1	1	1	1	1	1
	Weekly	0.93 (0.80-1.09)	0.92 (0.84-1.02)	1.00 (0.89-1.11)	1.00 (0.88-1.14)	0.93 (0.78-1.11)	0.98 (0.87-1.11)	0.97 (0.88-1.08)
	Daily	0.83 (0.69-0.99)*	0.85 (0.76-0.97)*	1.09 (0.95-1.24)	0.95 (0.81-1.11)	0.92 (0.76-1.13)	1.02 (0.89-1.18)	0.94 (0.83-1.07)
Vegetables								
Model I[1]	Seldom	1	1	1	1	1	1	1
	Weekly	0.68 (0.59-0.79)*	0.83 (0.75-0.92)*	0.85 (0.76-0.95)*	0.83 (0.72-0.95)*	0.70 (0.59-0.82)*	0.80 (0.72-0.90)*	0.84 (0.75-0.94)*
	Daily	0.70 (0.59-0.82)*	0.78 (0.70-0.87)*	0.86 (0.76-0.97)*	0.84 (0.72-0.96)*	0.60 (0.51-0.72)*	0.82 (0.73-0.92)*	0.92 (0.81-1.03)
Model II[2]	Seldom	1	1	1	1	1	1	1
	Weekly	0.69 (0.59-0.80)*	0.85 (0.76-0.94)*	0.86 (0.87-0.97)*	0.85 (0.74-0.98)*	0.71 (0.60-0.84)*	0.82 (0.73-0.92)*	0.85 (0.76-0.95)*
	Daily	0.69 (0.58-0.81)	0.77 (0.68-0.86)	0.84 (0.75-0.95)	0.83 (0.72-0.97)	0.60 (0.50-0.72)	0.81 (0.72-0.91)	0.89 (0.79-1.01)
Model III[3]	Seldom	1	1	1	1	1	1	1
	Weekly	0.71 (0.60-0.84)*	0.89 (0.79-0.99)*	0.90 (0.80-1.02)	0.87 (0.75-1.12)	0.71 (0.59-0.85)*	0.82 (0.72-0.93)*	0.89 (0.79-1.01)
	Daily	0.72 (0.60-0.87)*	0.80 (0.71-0.90)*	0.91 (0.80-1.04)	0.86 (0.73-1.01)	0.64 (0.53-0.78)*	0.85 (0.74-0.97)*	0.92 (0.81-1.05)

Model IV[4]	Seldom	1	1	1	1	1	1	1
	Weekly	0.70 (0.59-0.83)*	0.89 (0.79-0.99)*	0.90 (0.80-1.02)	0.87 (0.74-1.01)	0.71 (0.59-0.85)*	0.81 (0.71-0.92)*	0.89 (0.78-1.01)
	Daily	0.72 (0.60-0.87)*	0.80 (0.71-0.91)*	0.90 (0.79-1.03)	0.86 (0.74-1.01)	0.64 (0.53-0.78)*	0.84 (0.74-0.96)*	0.92 (0.81-1.05)
Milk								
Model I[1]	seldom	1	1	1	1	1	1	1
	Weekly	0.59 (0.51-0.68)*	0.68 (0.61-0.75)*	0.62 (0.55-0.69)*	0.64 (0.56-0.73)*	0.61 (0.52-0.72)*	0.61 (0.55-0.69)*	0.59 (0.52-0.65)*
	Daily	0.45 (0.39-0.53)*	0.50 (0.45-0.55)*	0.49 (0.44-0.55)*	0.52 (0.46-0.60)*	0.45 (0.39-0.54)*	0.48 (0.42-0.53)*	0.44 (0.39-0.49)*
Model II[2]	seldom	1	1	1	1	1	1	1
	Weekly	0.73 (0.63-0.84)*	0.80 (0.72-0.89)*	0.79 (0.71-0.89)*	0.77 (0.67-0.88)*	0.73 (0.62-0.86)*	0.76 (0.67-0.85)*	0.77 (0.69-0.87)*
	Daily	0.65 (0.56-0.75)*	0.66 (0.60-0.73)*	0.76 (0.68-0.85)*	0.74 (0.64-0.84)*	0.63 (0.53-0.75)*	0.70 (0.62-0.79)*	0.70 (0.63-0.78)*
Model III[3]	seldom	1	1	1	1	1	1	1
	Weekly	0.75 (0.64-0.88)*	0.81 (0.72-0.91)*	0.80 (0.71-0.90)*	0.76 (0.65-0.88)*	0.72 (0.60-0.87)*	0.75 (0.66-0.86)*	0.76 (0.67-0.85)*
	Daily	0.72 (0.61-0.85)	0.71 (0.63-0.79)	0.79 (0.70-0.90)	0.78 (0.67-0.91)	0.70 (0.58-0.85)	0.75 (0.66-0.85)	0.71 (0.63-0.80)
Model IV[4]	seldom	1	1	1	1	1	1	1
	Weekly	0.76 (0.65-0.89)*	0.81 (0.72-0.91)*	0.80 (0.71-0.90)*	0.76 (0.65-0.88)*	0.72 (0.60-0.87)*	0.76 (0.67-0.86)*	0.75 (0.67-0.85)*
	Daily	0.72 (0.61-0.85)*	0.71 (0.63-0.79)*	0.79 (0.70-0.89)*	0.78 (0.67-0.90)*	0.69 (0.57-0.84)*	0.75 (0.66-0.85)*	0.71 (0.63-0.80)*

[1]Without adjustment (crude model),[2] Adjusted for age, sex and region,[3]Additionally adjusted for family history of chronic diseases, mother's education, screen time, physical activity, socioeconomic status,[4]Additionally adjusted for BMI.

Table-6: Associations of healthy food consumption with violent behaviors: The CASPIAN IV study

Variables		Physical Fight (OR, 95% CI)	Victim (OR, 95% CI)	Bully (OR, 95% CI)
Fresh fruits				
Model I[1]	Seldom	1	1	1
	Weekly	1.08(0.95-1.24)	1.00(0.86-1.16)	1.04(0.89-1.22)
	Daily	0.91(0.80-1.05)	1.00(0.86-1.15)	0.93(0.79-1.09)
Model II[2]	Seldom	1	1	1
	Weekly	1.08(0.93-1.24)	0.99(0.85-1.14)	1.05(0.89-1.22)
	Daily	0.94(0.82-1.08)	0.99(0.86-1.15)	0.96(0.82-1.13)
Model III[3]	Seldom	1	1	1
	Weekly	1.09(0.94-1.27)	1.02(0.87-1.20)	1.09(0.91-1.29)
	Daily	0.93(0.81-1.08)	1.00(0.85-1.17)	1.00(0.84-1.19)
Model IV[4]	Seldom	1	1	1
	Weekly	1.10(0.94-1.27)	1.02(0.87-1.20)	1.08(0.91-1.29)
	Daily	0.94(0.81-1.08)	1.00(0.85-1.17)	0.99(0.83-1.18)
Dried fruits				
Model I	Seldom	1	1	1
	Weekly	0.98(0.89-1.07)	0.95(0.86-1.05)	0.98(0.88-1.10)
	Daily	0.92(0.83-1.03)	1.00(0.89-1.12)	1.06(0.92-1.021)
Model II	Seldom	1	1	1
	Weekly	0.96(0.88-1.05)	0.94(0.85-1.04)	0.98(0.87-1.10)
	Daily	0.91(0.82-1.02)	0.99(0.88-1.12)	1.06(0.93-1.21)
Model III	Seldom	1	1	1
	Weekly	0.98(0.89-1.08)	0.94(0.85-1.05)	0.97(0.86-1.10)
	Daily	0.92(0.82-1.03)	1.00(0.88-1.13)	1.07(0.93-1.24)
Model IV	Seldom	1	1	1
	Weekly	0.98(0.89-1.08)	0.95(0.85-1.05)	0.98(0.86-1.11)
	Daily	0.91(0.81-1.02)	0.99(0.87-1.12)	1.06(0.92-1.23)
Vegetables				

Model I	Seldom	1	1	1
	Weekly	0.93(0.84-1.03)	0.88(0.79-0.98)*	0.87(0.77-0.99)*
	Daily	0.81(0.72-0.90)*	0.83(0.74-0.93)*	0.83(0.73-0.95)*
Model II	Seldom	1	1	1
	Weekly	0.95(0.86-1.06)	0.88(0.79-0.98)*	0.90(0.79-1.01)
	Daily	0.84(0.75-0.93)*	0.84(0.74-0.94)*	0.85(0.75-0.97)*
Model III	Seldom	1	1	1
	Weekly	0.97(0.86-1.09)	0.89(0.79-1.01)	0.88(0.77-1.01)
	Daily	0.86(0.76-0.98)*	0.86(0.76-0.98)*	0.86(0.75-0.99)*
Model IV	Seldom	1	1	1
	Weekly	0.96(0.86-1.08)	0.89(0.79-1.01)	0.88(0.77-1.01)
	Daily	0.87(0.77-0.99)*	0.86(0.76-0.98)*	0.87(0.75-0.99)*
Milk				
Model I	Seldom	1	1	1
	Weekly	1.01(0.91-1.12)	0.96(0.86-1.07)	0.82(0.72-0.93)*
	Daily	0.86(0.78-0.96)*	1.00(0.90-1.12)	0.74(0.65-0.83)*
Model II	Seldom	1	1	1
	Weekly	0.92(0.83-1.03)	0.90(0.80-1.01)	0.81(0.71-0.92)*
	Daily	0.79(0.71-0.88)*	0.91(0.81-1.02)	0.76(0.67-0.87)*
Model III	Seldom	1	1	1
	Weekly	0.89(0.79-0.99)*	0.87(0.77-0.99)*	0.81(0.70-0.93)*
	Daily	0.78(0.70-0.88)*	0.90(0.79-1.02)	0.78(0.68-0.90)*
Model IV	Seldom	1	1	1
	Weekly	0.89(0.79-0.99)*	0.88(0.77-0.99)*	0.81(0.70-0.93)*
	Daily	0.79(0.70-0.89)*	0.90(0.79-1.02)	0.79(0.68-0.90)*

[1]Without adjustment (crude model),[2] Adjusted for age, sex and region,[3]Additionally adjusted for family history of chronic diseases, mother's education, screen time, physical activity, socioeconomic status,[4]Additionally adjusted for BMI.