Dietary predictors of early-onset ischaemic heart disease in a sample drawn from a Pakistani population

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ABSTRACT

Objective A relationship between dietary pattern and ischaemic heart disease (IHD) has long been established through empirical research. It is well documented that an unhealthy diet—rich in animal products (eggs and meat), salt, fried and salty food, ghee and butter and low in fruit, vegetables and fish—is associated with a risk of IHD. However, limited empirical evidence exists from studies conducted in Pakistan, so this study was designed to explore the association of dietary pattern with risk of IHD in this country.

Design Case–control study.

Setting 190 cases with a diagnosis of first onset of angina and myocardial infarction and 380 age- and gender-matched community controls were recruited from five major hospitals in the city of Lahore, Pakistan.

Method A Food Frequency Questionnaire was used to gather information on dietary patterns from the study sample (age 35–55), who provided written consent to participate.

Results Binary logistic regression analysis revealed that eggs, sweets, butter, desi ghee, desserts and beef were significant risk factors for IHD, and fish and fruit were significant protective dietary predictors of IHD.

Conclusions 50–73% of variance in IHD due to dietary pattern can be predicted with 91.8% accuracy within the study sample. The study lays ground for future research, as well as providing help in planning preventive dietary strategies to counter the escalating burden of IHD in Pakistan.

INTRODUCTION

Ischaemic heart disease (IHD) is estimated to be the leading cause of death in developing countries such as Pakistan. However, evidence on the association of dietary pattern with the risk of IHD is mostly available from studies carried out in the West. Choice of dietary items and cooking styles tend to vary from country to country, so the question arises about whether evidence on association of dietary pattern with IHD gathered from countries in the West is applicable to Pakistan. However, the INTERHEART Study has provided evidence on risk and protective effects of dietary patterns for 52 countries, including Pakistan. This research has established that 30% of population-attributable risk of acute myocardial infarction (AMI) can be inferred from consumption of unhealthy diets rich in fried foods, salty snacks, eggs and meat. Moreover, consumption of fatty foods and Western dietary patterns was found to be associated with risk of IHD.[1] Some evidence on association of dietary pattern with IHD exists from case–control studies carried out in the South Asian city of Tehran. Hamideh *et al*[2] found that low consumption of fish, fruit and vegetables was associated with a risk of IHD, a finding that is consistent with already available empirical evidence.[1]

Nishtar *et al*[3] investigated the association of dietary pattern with risk of IHD in a Pakistani population. They found that consumption of desi ghee was not significantly associated with the risk of IHD, although the cases reported greater long-term consumption of desi ghee and overall higher daily use of fats than the controls. Contrary to earlier evidence,[1] adding salt to food was not found to be significantly associated with the risk of IHD. However, consumption of fried foods and cooked breakfast was found to be associated with IHD. Greater consumption of vegetable curry was reported to be a significant risk factor for IHD.

Rapid industrialisation and a shift towards a Western lifestyle—associated with a low level of physical activity and higher intake of a Western diet—in Pakistan can be held responsible for the increasing burden of IHD. So there is a need to investigate common dietary items and their association with IHD in a developing country such as Pakistan, where, by the year 2020, the burden of IHD is expected to rise to epidemic proportions.[4]

METHOD

Food Frequency Questionnaire (FFQ)

The intake of dietary items was assessed using a 14-item qualitative food group frequency generic questionnaire designed by INTERHEART Study researchers[5] for use in a number of countries with diverse dietary patterns. This similarity signifies the global impact of this study. Information was sought on food items that have been found to have a risk (meat, eggs, sweets, fried foods, salty snacks) or a protective (fish, fruits and vegetables) effect.[3–6] Information on the number of times a specific food item was consumed per day, per week or per month was gathered. Later, all frequency variables were standardised to consumption of food items per week. A frequency of consumption of less than once a month was considered to be non-consumption.

As the frequency of consumption of eggs and fish varies with summer and winter season in Pakistan, respondents were asked to mark the consumption of these two food items separately for the two seasons. The rest of the list included meat (chicken, beef, fish and mutton), fried snacks,

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added salt, desserts, butter, desi ghee, oil, fruit, vegetables and sweets.

If the respondent had recorded the frequency of consumption of a food item on a daily basis, it was multiplied by 7 to convert to a weekly basis; frequency of consumption of food items obtained on a weekly basis was kept as recorded. If the respondent had given the frequency in months, then the data were divided by 4 to convert to a weekly basis. For two items (eggs and fish), the frequency was recorded separately for summer and winter and later converted into weeks according to the season. Winter season was calculated over a span of 16 weeks and summer was calculated as lasting for 44 weeks as per scientifically accepted season length for Pakistan. Many studies such as the INTERHEART[7] and Risk Corn Study,[3] as well as research conducted in the West,[2 6] have measured dietary items in a similar manner with a few adaptations according to the differences in consumption of food items prevalent across countries. For conducting binary logistic regression analyses to ascertain association of dietary items with IHD, food items were categorised and reference values were determined to compute OR in a similar procedure to that adopted in the Risk Corn Study.[3]

Meat (beef, mutton, chicken and fish): weekly serving of a size equal to a deck of cards.

Vegetables: weekly serving in cooked (curry) and raw form (salads).

Fruits: weekly serving of any sort of seasonal fruit.

Deep fried foods: weekly serving as somosas, indian fritters, fries, nammak parray etc.

Desserts: weekly servings of items commonly used in Pakistani households such as rice pudding, sweet confections served across the South Asia etc.

Sweets: different types of confectionary etc.

Salt: weekly intake of added salt at the table.

Eggs: weekly use of whole eggs at breakfast, used in cooking or added to curry.

Butter, desi ghee (a type of home-made cooking fat derived from clarification of butter traditionally used for cooking curries), banaspati ghee: a rough estimate of weekly consumption of saturated (ghee and butter) versus unsaturated (oils) consumed in curry and for cooking of breakfast (eg, paratha).

Sample size calculation

Sample size calculation for unmatched case–control studies was used[8] and is shown in table 1.

Table 1 Sample size for unmatched case–control study, calculated on the following assumptions

Assumption	Size		
Two-sided confidence level (1−α)	95		
Power (% chance of detecting)	80		
Ratio of controls to cases	2		
Hypothetical proportion of controls with exposure	40		
Hypothetical proportion of cases with exposure	53.13		
Least extreme OR to be detected	1.70		
	Kelsey	**Fleiss**	**Fleiss (with continuity correction)**
Sample size for cases	169	169	180
Sample size for controls	338	338	360
Total sample size	507	507	540

Note: a slightly larger sample size (total of 570 cases and controls) was recruited.

Sample

To investigate the association of dietary pattern with IHD and to determine whether these factors differ between cases and controls, we solicited a sample of 190 patients with a confirmed diagnosis of IHD, and 380 controls, who had no IHD before or at the time of testing. The cases recruited were patients with a first onset of IHD (angina and myocardial infarction) presenting within 24 h of symptoms, admitted to the coronary care unit or the equivalent cardiology ward of the hospitals. Likewise, two age- and gender-matched community controls (up to 5 years older or younger, aged 35–55 years) were drawn directly from special subgroups in the community: eligible control subjects were community based (visitor or relative of a patient from another ward, or an unrelated visitor of a cardiac patient). A number of case–control studies have used similar criteria extensively for selection of cases and community-based controls to investigate risk and protective factors for IHD[7 9–12] Community controls had particular characteristics like the cases (age and gender), but had not yet developed the disease under investigation.

We recruited cases if they had suffered one episode of angina with chest pain as determined by cardiologists. Patients with chest pain established as angina through exercise, ECG or cardiologist's summary and symptom scores were also recruited. In addition, patients with a first onset of AMI whose diagnosis had been confirmed by a cardiologist on the basis of clinical symptoms or changes in ECG or raised concentration of troponin were included in the study.

Inclusion/exclusion criteria

Patients experiencing the following signs and symptoms were not included in the study sample: cardiogenic shock or chest pain due to non-cardiac reasons; a significant chronic medical illness such as liver disease, hyperthyroidism or hypothyroidism, renal disease, malignant disease; pregnancy; a psychiatric diagnosis or use of antipsychotic medication; previous treatment for heart disease such as percutaneous transluminal coronary angioplasty or coronary artery bypass graft surgery. Potential participants who failed to provide informed consent (as these conditions modify the risk factors in IHD and might have an impact on behaviour and lifestyle) and patients who were unable to read or write Urdu (the national language) were also not included in the study.

Community-based controls recruited to the study were attendants, visitors or relatives of the cardiac patient, unrelated (not first-degree blood relatives) having no previous diagnosis of heart disease or history of exertional chest pain. Exclusion criteria for community controls were the same as for the cases.

Setting

The sample was recruited from five hospitals in the city of Lahore, Pakistan that were either specialised cardiology hospitals or hospitals running a cardiology unit or an equivalent coronary care unit catering for patients diagnosed with IHD.

Procedures

Approval from the regulatory and ethics committees of all five hospitals was sought before initiation of the research. A consent form was prepared in Urdu and given to participants for signature before they could take part in this study. All participants were briefed about the purpose of the study and were assured about the confidentiality and privacy of their responses. Participants were told that they were free to leave the study at

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any time if they felt uncomfortable and that this would not incur any prejudice or penalty to them. A similar set of procedures was carried out for the controls. For every case, two age- and gender-matched community controls were recruited either on the same day or within a week at the most. Once the participants had filled out the FFQ, the researcher thanked and debriefed them about the nature of the study. If any participant asked a question about the study, the researcher answered it briefly. However, if the question required in-depth answers or understanding, the participant was invited by the researcher to attend at a different time for a more detailed discussion. For this purpose, the participants were given the mailing address of the researcher.

Statistical analysis

Unconditional binary logistic regression analysis was conducted using the forward conditional method to verify the association between intake of dietary items and risk of IHD. Multivariate ORs and 95% CIs were calculated. ORs represented the excess risk of exposure to a dietary factor in cases compared with controls, without exposure. Perfect matching was not possible in all cases and controls. Therefore, to increase study power, unconditional logistic regression with adjustment for matching factors was used to estimate the independent effect of each factor on the risk of IHD. This approach allows the inclusion of unmatched cases in the analysis, and the results are comparable to those from conditional logistic regression. Estimated ORs and CIs calculated with both methods were within 5% of each other. Reported frequency of dietary items consumed per month, per week or daily was converted into weekly consumption of dietary items. New categorical variables were generated for dietary variables and a reference category with minimal risk was taken to compute ORs (see Risk Corn Study methodology[3]). Only cases with IHD diagnosed for the very first time were recruited, minimising the chance of lifestyle alteration. Moreover, analysis of dietary variables was carried out for cases and controls who reported having no prior diagnosis of diabetes or hypertension. Cases and controls who reported a diagnosis of hypertension or diabetes were excluded from the analyses, as there was the possibility that these individuals might have altered their dietary habits because of their medical condition. Moreover, cases and controls who reported that they had altered their dietary habits because of some other medical concern or otherwise were also excluded from the analysis.[2 4 9]

Binary logistic regression analysis was conducted to assess the association between weekly consumption of each dietary item and AMI, after adjustment of the model for the effects of age, gender, smoking status and body mass index.

RESULTS

Demographic characteristics of cases and controls (both men and women) are shown in table 2.

Dietary factors independently associated with the risk of IHD are shown in table 3.

The results of the binary logistic regression analysis support the belief that an unhealthy diet (high in animal products (eggs, milk and meat), added salt, salty snacks, fried food, ghee and butter and low in fruit, vegetables and fish) is significantly associated with the risk of IHD. The values of the coefficients reveal that eating eggs six or more times a week is associated with increased odds of IHD by a factor of 15.33 (95% CI 2.66 to 88.51), whereas eating sweets six or more times a week is associated with increased odds of IHD by a factor of 8.12 (95% CI 2.42 to 27.34). Eating butter six or more times a week is associated with increased odds of IHD by a factor of 6.00 (95% CI 1.34 to 26.86). Use of desi ghee 3–5 times a week is associated with increased odds of IHD by a factor 9.49 (95% CI 1.14 to 79.04), whereas use of desi ghee six or more times a week was found to be associated with increased odds of IHD by a factor 17.96 (95% CI 3.02 to 106.97). Fruit intake 3–5 times a week is associated with a decrease in odds of IHD by a factor of 0.01 (95% CI 0.001 to 0.11). Fruit consumption six times or more a week is associated with a decrease in odds of IHD by a factor of 0.01 (95% CI 0.00 1 to 0.10). Consumption of desserts 1–2 times weekly is associated with a decrease in odds of IHD by a factor 0.07 (95% CI 0.01 to 0.50). Beef consumption once a week is associated with increased odds of IHD by a factor of 7.47 (95% CI 1.85 to 30.12). Fish consumption once or twice a week is associated with a decrease in odds of IHD by a factor of 0.09 (95% CI 0.03 to 0.31), and a further increase in its consumption to 3–5 times a week is associated with a decrease in odds of IHD by a factor of 0.004 (95% CI 0.00 to 0.23). However, consumption of vegetables was not found to be significantly associated with a reduced risk of IHD.

DISCUSSION

It is now well documented that the choice of dietary items increases or decreases the risk of cardiovascular disease.[1 2 5 13] Studies determining the role of dietary items in the onset of cardiovascular diseases have mostly been carried out in Western and European countries. Dietary patterns of people living in these countries tend to differ from those living in countries such as Pakistan; furthermore, methods of cooking and food preparation also vary between cultures and countries. Bearing these diversities in mind, an FFQ (a well-known measure used to assess risk of IHD associated with diet) was used in this research with slight modifications.

The FFQ has been used extensively to measure dietary habits worldwide. The INTERHEART Study[5] conducted in 52 countries including Pakistan used the same questionnaire. Despite cultural and social variations throughout the world in the consumption of food items, the results of our study revealed that atherogenic, as well as protective, effects of certain food items (eg, eggs, beef, butter, fish) are comparable with the rest of the world. The comparability of our study results to those from Western and European countries points to the scientific originality and global significance of the study. Most of our empirical knowledge on dietary factors associated with IHD in developing countries, including Pakistan, has been gained from the INTERHEART Study.[1 5] This study acknowledged the prevalence of three dietary patterns worldwide—Western, Oriental and prudent—and found a strong association of IHD with the Western diet pattern. The typical Western diet has been defined as one rich in meat, salty snack, eggs and fried foods. Moreover, INTERHEART Study researchers[5] found a prudent diet rich in raw and cooked vegetables and fruit to be linked with reduced odds of IHD. On the other hand, the Oriental diet, rich in tofu and soy as well as other sauces, was found to have no association with IHD.[7] The present study has produced somewhat similar findings: a diet rich in eggs, butter, desi ghee, beef, desserts and sweets was found to be significantly associated with an increased risk of IHD in the indigenous population. Moreover, consumption of fruit and fish was found to be a protective predictor of IHD in this Pakistani population.

This study found a high weekly consumption of eggs to be associated with a risk of IHD. These findings are consistent with earlier global findings in which high consumption of

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Table 2 Demographic characteristics of study sample depicted as frequency (%)

			Disease status			
			Men		Women	
Variable	Cases	Controls	Cases	Controls	Cases	Controls
Age						
35–40	52 (27.4)	99 (26.1)	27 (22.7)	56 (23.4)	25 (35.2)	43 (30.5)
41–45	38 (20.0)	74 (19.5)	29 (24.4)	45 (18.8)	9 (12.7)	29 (20.6)
46–50	52 (27.4)	114 (30.0)	32 (26.9)	84 (35.1)	20 (28.2)	30 (21.3)
51–50	48 (25.3)	98 (24.5)	31 (26.1)	54 (22.6)	17 (23.9)	39 (27.7)
Mean age	(46.19)	(46.06)	(46.47)	(46.24)	(45.73)	(45.74)
Education						
10 or less years	126 (66.3)	160 (42.1)	79 (66.4)	94 (39.3)	47 (66.2)	66 (46.8)
12–14 years	57 (30.0)	173 (45.5)	34 (28.6)	113 (47.3)	23 (32.4)	60 (42.6)
16 or more years	7 (3.7)	36 (18.9)	6 (5.0)	32 (13.4)	1 (1.4)	15 (10.6)
Occupation						
Business	6 (3.2)	47 (12.4)	6 (5.0)	46 (19.2)	3 (4.2)	1 (0.7)
Government	36 (18.9)	94 (24.7)	33 (27.7)	81 (33.9)	–	13 (9.2)
Private	36 (18.9)	66 (17.4)	31 (26.1)	51 (21.3)	5 (7.0)	15 (10.6)
Self-employed	36 (18.9)	43 (11.3)	34 (28.6)	39 (16.3)	2 (2.8)	4 (2.8)
Agriculture	10 (5.3)	13 (3.4)	10 (8.4)	12 (5.0)	–	1 (0.7)
Not working	4 (2.1)	5 (1.3)	2 (1.7)	4 (1.7)	2 (2.8)	1 (0.7)
Retired	3 (1.6)	4 (1.1)	3 (2.5)	4 (1.7)	–	–
Housewife	59 (31.1)	108 (28.4)	–	2 (0.8)	59 (83.1)	106 (75.2)
Monthly income*						
12000 and less	67 (35.3)	80 (21.1)	40 (33.6)	55 (23.0)	27 (38.0)	25 (17.7)
12000–20000	67 (35.3)	107 (28.2)	43 (36.1)	66 (27.6)	24 (33.8)	41 (29.1)
20000–35000	27 (14.2)	98 (25.8)	18 (15.1)	63 (26.4)	9 (12.7)	35 (24.8)
35000 and above	29 (15.3)	95 (25.0)	18 (15.1)	55 (23.0)	11 (15.5)	40 (28.4)
Mean income**	21519.47	30565.19	22001.68	31348.40	20711.26	29237.58
Median income	15000.00	21561.50	15000.00	20000.00	15000.00	25000.00
Personal property						
Owned	87 (45.8)	218 (57.4)	66 (55.5)	151 (63.2)	21 (29.6)	67 (47.5)
Not owned	103 (54.2)	162 (42.6)	53 (44.5)	88 (36.8)	50 (70.4)	74 (52.5)
Marital status						
Married	174 (91.6)	333 (87.6)	113 (95.0)	216 (90.4)	61 (85.9)	117 (83.0)
Not married	10 (5.3)	26 (6.8)	4 (3.4)	15 (6.3)	6 (8.5)	11 (7.8)
Engaged	–	4 (1.1)	–	3 (1.3)	–	1 (0.7)
Divorced	1 (0.5)	5 (1.3)	1 (0.8)	4 (1.7)	–	1 (0.7)
Widowed	5 (2.6)	12 (3.2)	1 (0.8)	1 (.4)	4 (5.6)	11 (7.8)
Family system						
Nuclear	107 (56.3)	202 (53.2)	68 (57.1)	124 (51.9)	39 (54.9)	78 (55.3)
Joint	83 (43.7)	178 (46.8)	51 (42.9)	115 (48.1)	32 (45.1)	63 (44.7)
Living						
Rural	50 (26.3)	95 (25.0)	31 (26.1)	59 (24.7)	19 (26.8)	36 (25.5)
Urban	140 (73.7)	285 (75.0)	88 (73.9)	180 (75.3)	52 (73.2)	105 (74.5)
Household size						
<5	29 (15.3)	59 (15.5)	19 (16.0)	40 (16.7)	10 (14.1)	19 (13.5)
5–7	75 (39.5)	167 (43.9)	48 (40.3)	112 (46.9)	27 (38.0)	55 (39.0)
8–9	39 (20.5)	85 (22.4)	25 (21.0)	51 (21.3)	14 (19.7)	34 (24.1)
>9	47 (24.7)	69 (18.2)	27 (22.7)	36 (15.1)	20 (28.2)	33 (23.4)

*Monthly income is expressed in Pakistani currency (Rupees).
**Mean income is the average income of the family. Besides the mean income the median income was considered as it is a better indicator than the mean household income as it is not dramatically affected by unusually high or low values as found in our data collected for monthly income.

dairy products, especially eggs, was found to be associated with the risk of IHD.[1–3 14–17]

Besides eggs, consumption of other animal products such as butter and desi ghee were also found to be associated with the risk of IHD. These results are in line with previous findings that consumption of a diet rich in saturated fat, total fat, sugar, sodium and animal products such as meat, eggs and whole cream milk results in weight gain, raising levels of serum cholesterol, thereby enhancing the risk of IHD and type II diabetes.[18] In the present study, saturated fats such as desi ghee, butter, animal products including eggs and beef, and intake of sweets made from sugar were found to be significantly associated with a risk of IHD.

Desi ghee is often used for cooking curry in Pakistan as well as in a few other South Asian countries. Hence, empirical research evidence linking the association of desi ghee with risk of IHD has only been obtained from research conducted in South Asia. It is high in cost homemade ghee, made from clarified butter, extremely rich in cholesterol oxides, and is hardly ever accessible commercially. Research literature confirms that the consumption of desi ghee is associated with the atherogenic process, which has been found to increase the odds of premature IHD in

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Table 3 Dietary factors independently associated with ischaemic heart disease in cases and controls

Variable	B (SE)	Exp (B) OR (95% CI)
Final model	−0.97 (1.17)	0.38
Constant		
Eggs		
Never		1
1–2 times weekly	−0.11 (1.09)	0.89 (0.11 to 7.57)
3–5 times weekly	1.38 (0.91)	3.98 (0.67 to 23.53)
6 or more times weekly	2.73** (0.89)	15.33 (2.66 to 88.51)
Sweets		
Never		1
1–2 times weekly	0.19 (1.58)	1.21 (0.06 to 26.76)
3–5 times weekly	0.43 (1.49)	1.54 (0.08 to 28.39)
6 or more times weekly	2.09** (0.62)	8.13 (2.42 to 27.34)
Butter		
Never		1
1–2 times weekly	−0.73 (0.98)	0.48 (0.07 to 3.31)
3–5 times weekly	−0.63 (1.17)	0.53 (0.05 to 5.27)
6 or more times weekly	1.79* (0.76)	6.00 (1.34 to 26.86)
Desi ghee		
Never		1
1–2 times weekly	1.22 (0.71)	3.39 (0.85 to 13.63)
3–5 times weekly	2.25* (1.08)	9.49 (1.14 to 79.04)
6 or more times weekly	2.89** (0.91)	17.97 (3.02 to 106.97)
Fruits		
Never		1
1–2 times weekly	−1.05 (1.02)	0.34 (0.04 to 2.58)
3–5 times weekly	−4.59*** (1.22)	0.01 (0.001 to 0.11)
6 or more times weekly	−4.53*** (1.16)	0.011 (0.001 to 0.103)
Desserts		
Never		1
1–2 times weekly	−2.61** (0.98)	0.07 (0.01 to 0.50)
3–5 times weekly	0.24 (0.83)	1.27 (0.25 to 6.45)
6 or more times weekly	0.79 (0.68)	2.22 (0.58 to 8.47)
Beef		
Never		1
1–2 times weekly	2.01** (0.71)	7.47 (1.85 to 30.12)
3 or more times weekly	−0.42 (1.02)	0.66 (0.09 to 4.81)
Fish		
Never		1
1–2 times weekly	−2.41*** (0.63)	0.09 (0.03 to 0.31)
3–5 times weekly	−4.76** (1.68)	0.009 (0.00 to 0.23)

Overall data adjusted for age, gender, smoking and body mass index. The analysis was performed only on cases and controls who reported that they had never been diagnosed with diabetes or hypertension. Considering the length of the output for this analysis, only the final model was included in the table.
*p<0.05, **p<0.01, ***p<0.001.

South Asians.[2 19 20] However, inconsistent findings already exist in this regard: Risk Corn Study researchers did not find a significant association between type of fat used for cooking, including desi ghee, and risk of IHD within the indigenous population. However, the cases in their study were found to consume larger amounts of visible fat on a daily basis than the controls,[3] but no statistically significant association of desi ghee with risk of IHD was found when binary logistic regression analysis was conducted to determine the association.

The results of this study reveal that sweets, desserts, indigenous food items made from milk, cream and sugar in Pakistan are associated with a risk of IHD. These results are consistent with research literature: consumption of milk and its products has been documented to be associated with morbidity as well as mortality of IHD.[2 21]

Similarly, these researchers found that high intake of dairy fat and consumption of fried foods increased the risk of IHD.[2] In the present study, greater weekly consumption of indigenous forms of desserts and sweets made from milk and sugar were found to be significantly associated with the risk of IHD. The desserts most commonly consumed in Pakistan (eg, kheer, gajjar ka halwa, saiwianyan and firni) are extremely rich in milk proteins and have high fat content. Fat and cholesterol present in dairy products, along with animal protein and milk carbohydrates, have been found to be associated with the risk of IHD, as intake of these products tends to clog the arteries supplying blood to the heart.[22 23]

Evidence from a survey conducted in 19 Western countries has documented that increased intake of milk and its products raises levels of proteins linked with heart disease.[23] Desserts and sweets are made from whole milk, cream and sugar, and these items have been found to increase the risk of IHD.[22]

Protective effects of fruit and fish consumption are significantly associated with IHD within the indigenous population. These study results are very much in line with earlier research conducted globally.[1 2 7 13 24–26] However, unlike the evidence provided by many previous studies, no protective effect was found to be associated with greater vegetable consumption in our study. Although empirical evidence supports the fact that reduced consumption of omega-3 occurs in people who consume vegetables and fruit, this has a cardioprotective effect. Protective effects of fish consumption are also well documented by international studies: it has been shown that even one or two weekly servings of fish reduces coronary heart disease (CHD) mortality by more than 50% in those who consume 30 g or less of fish every day compared with those who do not eat fish at all.[27]

In a meta-analysis conducted on cohort studies that included an ample sample of men and women, researchers found a (11%) decrease in risk of stroke in individuals who daily consumed an additional portion of fruit and a (5%) decrease when fruit and vegetables were consumed together, and a (3%) decrease in those who consumed vegetables only.[28] A joint analysis for fruit and vegetables was not carried out in this study, but it was found that greater weekly consumption of fruit was significantly associated with a decrease in the odds of IHD.

However, our study did not find any association of consumption of vegetables with reduced risk of IHD within the indigenous population. This finding is inconsistent with many of the earlier findings; globally, researchers have documented the protective role of greater vegetable consumption against IHD.[1 3 7 17 28–30] Contradictory results obtained by the present study may be attributable to the fact that cooking style in Pakistan is quite different from that adopted worldwide. In Pakistan, people eat vegetables in the form of cooked vegetable curry; cooking food for long periods can destroy the nutritional value.[22] Secondly, vegetables are cooked by adding lots of desi ghee, butter or other forms of trans-fatty cooking medium. Desi ghee and butter itself may destroy the nutrient value of vegetables by increasing the trans-fatty composition of the vegetables cooked in the form of curry. This may be the reason why greater consumption of vegetables did not turn out to be a significant protective factor against IHD within the national population.

Worldwide, an atherogenic diet rich in red meat has found to be associated with a risk of IHD. Our study findings are consistent with those from other studies carried out internationally that confirm an association between greater use of red meat and risk of IHD.[1 3 7 17 28–30] Consumption of large portions of red meat has been found to increase cholesterol levels associated with the risk of IHD.[31]

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It is important to keep in mind that the consumption of dietary items in developing countries such as Pakistan is contingent on the level of income as well as the household size. In Pakistan, certain food items (eg, fish, fruit) are expensive and are not within the easy procurement power of every household. Moreover, certain food items are consumed seasonally, and consumption of a few food items varies from province to province. Eggs and fish are consumed in greater quantity during the winter, especially in coastal areas of Pakistan. These differences in consumption of dietary items were kept in mind during the designing of this study protocol and hence information on consumption of eggs and fish was recorded separately for winter and summer season. Bearing in mind the regional, seasonal, sociocultural and economic disparities in the consumption of dietary items prevalent within the national population, it is recommended that further studies to confirm the associations of diet with the risk of IHD be designed. Besides desi ghee, there are other forms of fat used for cooking curry and breakfast—namely, banaspati ghee (ghee made for commercial use from hydrogenation of vegetable oils)—that were not assessed in this study, although as a cooking medium they should provide useful insight.

It is important to note that, previously in Pakistan, limited research effort has been made to investigate the association of red and white meat with the risk of IHD. The present study has an advantage over other studies conducted in Pakistan, as it investigated the association of IHD with four types of meat, both red and white (mutton, beef, chicken and fish). Furthermore, it can be said that, despite the wide disparities in the consumption of dietary items globally, the protective and risk effects of certain food items (ie, red meat, eggs, fruit and fish) seem to remain global. There is ample room for further studies in Pakistan to build on the evidence documented by our study. However, more accurate conclusions about the association of certain types of food items with IHD within the indigenous population can be drawn from studies using dietary interventions, as these interventions have proved to be effective in reducing the risk of IHD.[32]

Like any research, our study has certain limitations. The study used a self-report method to recall the frequency of food items, which might have resulted in recall bias leading to some inaccurate information: under- or over-reporting of certain types of food especially non-seasonal foods. This study did not investigate quantity, portion size and calorific content of foods.

CONCLUSION

Diet is a modifiable risk factor for IHD and can therefore serve as an important agent for primary and secondary prevention strategies. It is important that the general public should be educated about the atherogenic effects of certain dietary items, such as red meat and eggs. Moreover dietary items identified as protective factors against IHD in our study, such as fish and fruit, should be brought to the knowledge of the general mass.

Author note This paper is extracted from the PhD work of RR. Sample size calculation and demographic tables have been presented in another article, accepted for publication in the *International Journal of Psychology*.

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