

Psychological distress, gender and dietary factors in South Asians: a cross-sectional survey

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Submitted 12 September 2012: Final revision received 25 March 2013: Accepted 19 April 2013: First published online 17 June 2013

Abstract

Objective: Psychological distress, defined as symptoms of depression and anxiety, is an increasingly important public health issue in developing countries. Little is known about the extent to which adverse dietary factors are associated with psychological distress in South Asians. Our aim was to compare the associations of diet and psychological distress in men and women in Goa, India.

Design: Cross-sectional study of consecutive attendees in nine urban and rural general practices in Goa, India in 2004–2005. All participants completed an FFQ on their dietary intake in a typical week. Psychological distress was measured using the Kessler Psychological Distress Scale (K10), a WHO-validated screening instrument.

Results: Consecutive attendees (*n* 1512; 601 men and 911 women) aged 30 to 75 years participated. Moderate and high scores of psychological distress were detected in significantly more women than men (eighty-eight men *v.* 264 women, unadjusted OR = 0.39; 95% CI 0.29, 0.52). Those who ate one or more portions of fish weekly had nearly half the prevalence of distress in both sexes (women, OR = 0.52; 95% CI 0.29, 0.91; men, OR = 0.50; 95% CI 0.25, 0.99) and this was independent of age, marital status, education, income, religion and living alone.

Conclusions: Psychological distress is significantly lower with fish intake in both sexes. Further longitudinal work is needed to establish temporal relationships. Addressing psychological distress is becoming an increasingly significant public health priority in both high- and low-income countries.

Keywords
Psychological distress
Diet
Women
South Asian
India
General practice

Mental health is an increasingly important global public health issue with a high lifetime prevalence of 2–15% and is associated with long-term disability⁽¹⁾. Findings from India and other developing countries show a prevalence of psychological distress exceeding 30% in adults attending general out-patient medical clinics⁽²⁾ and among primary care attendees in low-income countries. Common mental disorders produce the greatest detriment in health compared with other chronic diseases such as angina, asthma and diabetes⁽³⁾. Non-communicable disease is rapidly becoming the dominant cause of ill health for all developing regions other than sub-Saharan Africa⁽⁴⁾, overtaking infectious diseases as the major cause of morbidity and mortality. The WHO report on the global burden of disease emphasised that mental health must be a high priority in health and social policy, and in delivery of primary and secondary care, in order to improve general health and well-being⁽³⁾.

Psychological distress is defined as symptoms of depression and anxiety. The importance of psychological distress cannot be underestimated. It is associated with an

increased risk of mortality from several causes in a dose–response pattern, with mortality risk shown to be raised at even lower levels of distress⁽⁵⁾. The Kessler Psychological Distress Scale (K10) measures psychological distress (specifically symptoms of depression and anxiety) in the previous 30 d.

Within India, prevalence of depression in a community sample of elders varies from 6% in south India within which Goa is situated⁽⁶⁾ to more than 50% in rural West Bengal⁽⁷⁾. In Goa, 41% of the population lives in urban areas compared with 26% for India⁽⁸⁾. Urbanisation has adverse effects on mental health in developing countries, namely increased rates of depression/anxiety⁽⁹⁾. Women and those of lower socio-economic status are also more prone to depression in developing countries⁽¹⁰⁾.

A number of research studies in high-income countries have explored links between Western diets and psychological distress, but little work has been reported in low- to middle-income countries, such as India. Psychological distress is associated with an adverse dietary profile.

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Evidence from several cross-sectional and prospective cohort studies, mostly in high-income countries, has shown an association between high fruit and vegetable intake and reduced depression^(11,12). Psychological distress and its associated adverse dietary risk factors are all increased in women. Cook and Benton⁽¹³⁾ demonstrated that fruit and vegetable intake (fresh fruit in summer and in winter, pure fruit juice, dried fruit, root vegetables, peas, beans, potatoes and other cooked vegetables) was more likely to be associated with better mental health (less anxiety and depression as measured by the twelve-item General Health Questionnaire (GHQ)) in women rather than men and this was independent of age and social background. A more recent cross-sectional study of 1046 Australian women also demonstrated an association between a diet consisting of vegetables, fruit, beef, lamb, fish and wholegrain foods and a lower likelihood of depressive and anxiety disorder⁽¹⁴⁾.

Much has been published on the importance of dietary essential *n*-3 fatty acids (FA), especially in relation to mood. These include EPA and DHA and are derived from fish and seafood, both of which are found in abundance in Goa, a coastal state in the west of India. Dietary intake is the only source of *n*-3 FA, the lack of which has been thought to be of aetiological significance in depression^(15–17). There also appears to be evidence for gender differences in the association between dietary fish intake and depression risk^(18,19). In a cross-sectional study in Finland⁽²⁰⁾, a significant relationship between infrequent fish intake and depression was found only in women (OR = 1.4; 95% CI 1.1, 1.8).

The cross-sectional studies exploring diet and mood were based largely in high-income countries from Europe including Scandinavia, America and Australasia, with none, to our knowledge, based in low- to middle-income countries from South Asia, such as India, where cultural and dietary practices differ significantly.

We hypothesised that, in a South Asian population recruited in India:

1. Psychological distress is associated with an adverse dietary profile, i.e. psychological distress is associated with reduced intakes of fish, fruit and vegetables and increased intake of saturated fats.
2. The prevalence of psychological distress differs between men and women. Psychological distress and its associated adverse dietary risk factors are all increased in women compared with men.

We aimed to compare the association of psychological distress and known dietary risk factors in men and women.

Methods

Study setting/population

The study sample was drawn from nine urban and rural private general practitioners that had at least twenty

people from a spectrum of socio-economic circumstances consulting daily in Goa, India. Although there is a government system of free public health, there are no publicly funded family practices in India. Primary medical care is provided through a combination of private general practices and government-funded community public health services. At least 80% of people in India use private medical services as their first point of contact^(21,22). Further details on the selection of the study sample are given elsewhere⁽²³⁾.

Study participants

Consecutive attendees (which included new and regular patients) aged 30 to 75 years were approached and given a study information sheet, which was read out and explained to illiterate participants. The age range of 30 to 75 years was used as the original aim of the study was to calculate a Framingham risk score on all participants without CVD with a view to assessing their risk of CVD⁽²³⁾. For illiterate participants the questionnaire was completed as an assisted questionnaire, i.e. items on the questionnaire were read out to participants and they were taken through each item in the language they spoke. We excluded pregnant women and those judged by the researcher and/or the doctor to be too unwell to participate (patients with terminal illnesses or who had acute emergencies requiring hospital admission). We excluded forty-four (2.8% of the whole sample) participants who were not Roman Catholic or Hindu. These forty-four were from a variety of religious backgrounds such as Islam, Jainism and Buddhism, with different dietary practices. It was felt that including this very small heterogeneous group of people would lead to spurious results. The majority of the population in Goa is either Roman Catholic or Hindu. The study was conducted from April 2004 to January 2005. The Independent Ethics Committee in Mumbai approved the study.

Measurements

Outcome

Psychological distress was measured by the Kessler score (K10), a WHO-validated psychological distress screening instrument⁽²⁴⁾. The Kessler Psychological Distress Scale (K10) measures psychological distress, and specifically symptoms of depression and anxiety, in the previous 30 d. It has ten questions with response options ranging from 'none of the time' to 'all of the time' on a five-point Likert-style scale that is scored from 1 to 5 and is intended to yield a global measure of distress based on questions about anxiety and depressive symptoms experienced in the most recent 4-week period.

Moderate distress and high distress are defined as total score greater than 6 and 9, respectively, out of a maximum possible score of 40. No distress and low distress are defined as scores of 0–2 and 3–6, respectively, out of a

maximum score of 40. This questionnaire has been validated in a Goan general practice population against criteria for both depression and anxiety from the International Classification of Diseases, 10th revision. K10 was found to be highly sensitive and specific, with an estimated area under the curve of 0.88⁽²⁵⁾. There is a significant association between scores measured by K10 and scores on the twelve-item GHQ used to measure psychological distress⁽²⁶⁾.

Exposures

These were assessed using a self-completed food questionnaire about the frequency of intake of carbohydrates, high-fat food, low-fat food, vegetables, fruit, red meat, fish and cooking oils (polyunsaturated and saturated). This instrument was derived from the standardised, rater-administered questionnaire Dine⁽²⁷⁾ that covers a wide range of foodstuffs. There was a comprehensive food list, representative of the eating habits of participants in the Goa area. The number of food items on the FFQ was sixty-three. The reference period was a typical week. The authors added local foods to the questionnaire and local terms were added for fish, meats and snacks (e.g. *batata wadas*, Goan *chourico*, *lados*, *burfi*). Local researchers who were involved in designing the questionnaire had a similar cultural background to the participants, which reduced the chance of miscommunication.

For foods listed as rice or pasta, potatoes, peas, dried beans, lentils, channa, vegetables (any type) and fruit (fresh, frozen, canned), the participants stated the frequency they consumed the items from the following options: (i) <1 time/week or never; (ii) 1–2 times/week; (iii) 3–5 times/week; (iv) 6–7 times/week; and (v) >7 times/week. For foods listed as fish (not fried), white meat, red meat, any fried food (including fish), pastries, snacks and cheese, the participants stated the frequency they consumed the items from the following options: (i) <1 time/week or never; (ii) 1–2 times/week; (iii) 3–5 times/week; and (iv) ≥ 6 times/week. More specific questions were asked concerning the type and amount of breakfast cereals, bread, margarine and milk consumed, as well as types of oils (polyunsaturated/saturated fats) used in cooking.

Broad dietary categories were examined and dichotomised by summing the responses to various foods. Dietary factors were categorised as follows: vegetables and/or fruit (none or 1 portion/week *v.* >1 portion/week), fish (none or <1 portion/week *v.* ≥ 1 portion/week), unsaturated oils (groundnut, sunflower or soya: no/yes), saturated oils (animal, ghee, palm or coconut oil: no/yes), red meat (burgers, beef, lamb, pork: none or <1 portion/week *v.* ≥ 1 portion/week). The participants were specifically asked about carbohydrate intake (differing types of breads, rice, pasta and potatoes). The languages that the FFQ were presented in were English, Konkani

or Hindi. The questionnaires were translated but not back-translated on account of budgetary restraints. For illiterate participants the questionnaire was completed as an assisted questionnaire, i.e. items on the questionnaire were read out to participants and they were taken through each item in the language they spoke.

Other factors

Age, marital status, religion, living alone and highest qualification were the sociodemographic factors chosen *a priori* as they were believed to be related to both distress and diet based on previous literature^(28–33). No information was collected on diagnosis or treatments for psychological disorders.

Statistical methods

The χ^2 test or the *t* test was calculated as appropriate to explore the association of sociodemographic factors and psychological distress. There were few missing data, with most variables having complete data; those with missing data were all missing fewer than ten responses. Therefore we conducted a complete case analysis. All analyses were undertaken using the statistical software package Stata version 11.1. There were no demographic differences between people with missing information and the rest of our sample.

The only variable that was continuous was age, which was approximately normally distributed. There was some evidence of age heaping: the phenomenon of reporting age to the nearest round number. This phenomenon is common when studying developing world demography.

From univariate analysis and the published literature^(28–31,34), age, marital status, education, annual family income, religion and living alone were identified as possible confounders.

For multivariable analysis, multilevel modelling was carried out to take into account clustering within the nine general practices in which the intra-class coefficient was 0.1 for prevalence of medium/high psychological distress. We used random-effects modelling to determine which dietary factors were associated with psychological distress, after adjustment for age, marital status, education, income, religion and living alone. We conducted a search for relevant interactions between the variables associated with depression on multivariable analyses in men and women.

Results

Response rates

In total 1556 (626 men and 930 women) general practice attendees were approached, all of whom agreed to participate. The majority of the participants were literate (86%). After exclusions, 1512 participants were included in the present analysis.

Table 1 Sex and age differences in the prevalence of psychological distress among men (*n* 601) and women (*n* 911) aged 30–75 years, Goa, India, 2004–2005

	No/low distress		Medium/high distress		Unadjusted OR	95% CI
	<i>n</i>	%	<i>n</i>	%		
Sex						
Female	647	55.8	264	75.0	1.00	Ref.
Male	513	44.2	88	25.0	0.39	0.29, 0.52
Age group						
30–45 years	402	34.7	77	21.9	1.00	Ref.
46–60 years	492	42.4	172	49.0	2.19	1.48, 3.26
61–75 years	266	22.9	102	29.1	3.37	2.15, 5.29

Ref., reference category.

Prevalence of psychological distress by age and sex

There were both sex and age differences in the prevalence of psychological distress (Table 1). Overall 352 participants had medium/high current distress (23%). Of these, 264 (75%) participants were women and eighty-eight (25%) were men (crude odds for distress in men *v.* women: OR = 0.39; 95% CI 0.29, 0.52).

There was an association of medium/high distress with increasing age in all participants (crude odds for distress *v.* people aged 30–45 years: OR = 2.19; 95% CI 1.48, 3.26 for age 46–60 years; OR = 3.37; 95% CI 2.15, 5.29 for age 61–75 years; Table 1) and this finding was stronger in women.

Univariate analysis

Demographic factors associated with psychological distress

In women, there were significant associations between being widowed/divorced/separated, having no qualifications, very low annual income and medium/high levels of psychological distress. There were no significant associations in men (Tables 2 and 3).

Dietary risk factors associated with psychological distress

In a crude analysis in men, distress was inversely associated with fish consumption only: twenty-one men (24%) with medium/high levels of distress ate <1 portion fish/week compared with sixty-seven men (13%) with no/low levels of distress ($P = 0.008$). No significant associations were found between prevalence of distress and vegetable and/or fruit intake, meat consumption or intake of saturated fats in cooking oil (Table 4). In women, medium/high levels of distress were significantly associated with reduced red meat intake: seventy-six women (29%) who had medium/high levels of distress ate red meat at least once weekly compared with 235 women (36%) who had no/low distress ($P = 0.03$). Medium/high levels of distress were also more prevalent in women who ate fish less than once weekly: thirty-four women (13%) who had medium/high levels of distress ate fish less than once weekly compared with fifty women (8%) who had no or low distress ($P = 0.02$). There were

no significant associations with vegetable and/or fruit intake or cooking oils (Table 4).

Multivariable analysis

Significant associations were found between psychological distress and sex. Based on this and the published literature^(28–31,34,35), analyses were conducted separately for males and females.

In the multivariable analysis (adjusting for age, marital status, education, income, religion and living alone) for women, the odds of psychological distress in those who consumed fish at least once weekly were half that of women who ate no fish/less frequently (OR = 0.52; 95% CI 0.29, 0.92) and were also reduced in those who consumed red meat at least once weekly compared with those not eating meat/less regularly (OR = 0.61; 95% CI 0.41, 0.88; Table 4). For men, the odds of psychological distress in those eating fish regularly were also half that of men who ate no fish/less than once weekly (OR = 0.50; 95% CI 0.25, 0.99; Table 4). There were no significant associations found with vegetables, fruit or unsaturated oils with either sex. A sensitivity analysis showed that results were similar in terms of magnitude of the odds ratio if educational attainment and living alone were taken out of the model, although female fish consumption just failed to make statistical significance (OR = 0.59; 95% CI 0.34, 1.03; $P = 0.06$), indicating a trend towards psychological distress in females who eat little fish.

Discussion

Main findings

Women in Goa, India were more than twice as likely as men to have medium/high levels of psychological distress. After adjusting for demographic confounders, fish consumption was found to be significantly associated with reduced odds of medium or high psychological distress by approximately half in both sexes and meat consumption was also associated with reduced distress in women. No significant associations were found with vegetables, fruit or unsaturated oils in either sex.

Table 2 Demographic features of women (*n* 911) aged 30–75 years with no/low psychological distress and medium/high psychological distress, Goa, India, 2004–2005

	No/low distress		Medium/high distress		Total	<i>P</i> value*
	Mean or <i>n</i>	SD or %	Mean or <i>n</i>	SD or %		
Mean age (years)	51.1	11.4	55.3	10.6	911	<0.001
Marital status (%)						
Married	451	70	153	5	604	
Single, never married	23	4	10	4	33	
Widowed, divorced or separated	173	27	101	38	274	0.002
Religion (%)						
Hindu	172	27	57	22	229	
Roman Catholic	475	73	207	78	682	0.115
Living alone (%)						
No	606	94	251	95	857	
Yes	41	6	13	5	54	0.413
Highest qualification† (%)						
None	181	28	98	37	279	
Up to Standard 4	150	23	71	27	221	
Up to Standard 10	231	36	70	27	301	
Up to Standard 12	41	6	10	4	51	
Professional qualification	44	7	15	6	59	0.009
Annual income‡ (%)						
<Rs 10 000	35	5	32	12	67	
Rs 10 000–50 000	362	56	148	56	510	
Rs >50 000–100 000	210	32	75	28	285	
Rs >100 000–500 000	40	6	9	3	49	0.002

*Age tested using an unpaired *t* test; other variables tested using χ^2 tests.

†Qualification: Standard 4, equivalent to age 11 plus; Standard 10, equivalent to GCSE (General Certificate of Secondary Education); Standard 12, equivalent to A-level.

‡Currency exchange rate (11 March 2013): \$US 1 = 54.40 Rs.

Table 3 Demographic features of men (*n* 601) aged 30–75 years with no/low psychological distress and medium/high psychological distress, Goa, India, 2004–2005

	No/low distress		Medium/high distress		Total	<i>P</i> value*
	Mean or <i>n</i>	SD or %	Mean or <i>n</i>	SD or %		
Mean age (years)	51.5	11.7	52.5	11.8	600	0.418
Marital status (%)						
Married	469	91	77	88	546	
Single, never married	26	5	9	10	35	
Widowed, divorced or separated	18	4	2	2	20	0.142
Religion (%)						
Hindu	210	41	28	32	238	
Roman Catholic	303	59	60	68	363	0.106
Living alone (%)						
No	502	98	86	98	588	
Yes	11	2	2	2	13	0.939
Highest qualification† (%)						
None	63	12	13	15	76	
Up to Standard 4	110	21	14	16	124	
Up to Standard 10	241	47	37	42	278	
Up to Standard 12	27	5	6	7	33	
Professional qualification	72	14	18	20	90	0.370
Annual income‡ (%)						
<Rs 10 000	27	5	8	9	35	
Rs 10 000–50 000	249	49	48	55	297	
Rs >50 000–100 000	178	35	20	23	198	
Rs >100 000–500 000	59	12	12	14	71	0.112

*Age tested using an unpaired *t* test; other variables tested using χ^2 tests.

†Qualification: Standard 4, equivalent to age 11 plus; Standard 10, equivalent to GCSE (General Certificate of Secondary Education); Standard 12, equivalent to A-level.

‡Currency exchange rate (11 March 2013): \$US 1 = 54.40 Rs.

Fish and common mental disorder

Goa is a coastal state of India that has a significant fishing industry where the local fish consumption is high, even in lower-income groups. There was a low proportion eating

fish less than once weekly in our sample. Weekly fish eating has previously been found to be associated with lower psychological distress/depression^(19,20), therefore we chose to dichotomise the FFQ data for fish at

Table 4 Dietary features of men (*n* 601) and women (*n* 911) aged 30–75 years with no/low and medium/high psychological distress risk, Goa, India, 2004–2005

	No/low distress		Medium/high distress		Total	<i>P</i> value*	Adjusted OR†	95 % CI
	<i>n</i>	%	<i>n</i>	%				
Males								
Vegetables and/or fruit								
None or <1 portion/week	195	38	34	39	229		1.00	Ref.
≥2 portions/week	318	62	54	61	372	0.911	0.81	0.46, 1.42
Fish								
None or <1 portion/week	67	13	21	24	88		1.00	Ref.
≥1 portion/week	446	87	67	76	513	0.008	0.50	0.25, 0.99
Cooking oil								
Polyunsaturated (groundnut, sunflower or soya oil)								
No	284	55	42	48	326		1.00	Ref.
Yes	229	45	46	52	275	0.184	0.81	0.43, 1.5
Saturated (animal, ghee, palm or coconut oil)								
No	132	25	28	32	160		1.00	Ref.
Yes	381	75	60	68	441	0.236	1.23	0.69, 2.20
Red meat (burgers, beef, lamb, pork)								
None or <1 portion/week	336	66	60	68	396		1.00	Ref.
≥1 portion/week	177	35	28	32	205	0.624	0.59	0.32, 1.06
Females								
Vegetables and/or fruit								
None or <1 portion/week	260	40	105	40	365		1.00	Ref.
≥2 portions/week	387	60	159	60	546	0.908	0.94	0.65, 1.35
Fish								
None or <1 portion/week	50	8	34	13	84		1.00	Ref.
≥1 portion/week	597	92	230	87	827	0.015	0.52	0.29, 0.92
Cooking oil								
Polyunsaturated (groundnut, sunflower or soya oil)								
No	389	60	150	57	539		1.00	Ref.
Yes	258	40	114	43	372	0.357	0.80	0.54, 1.17
Saturated (animal, ghee, palm or coconut oil)								
No	164	25	77	29	241		1.00	Ref.
Yes	483	75	187	71	670	0.233	1.38	0.92, 2.08
Red meat (burgers, beef, lamb, pork)								
None or <1 portion/week	412	64	188	71	600		1.00	Ref.
≥1 portion/week	235	36	76	29	311	0.030	0.61	0.41, 0.88

Ref., reference category.

*Using χ^2 tests.

†Adjusted for demographic variables age, marital status, education, income, religion and living alone using random-effects models.

<1 portion/week *v.* ≥1 portion/week. In our study, fish consumption was found to be significantly associated with reduced distress by approximately 50% in both men and women. Gender differences in rates of depressive disorder have long been recognised and, consistent with our study, women have been found to be twice as likely to suffer from a depressive disorder as men (21% of women and 13% of men)⁽³⁵⁾. The women in our sample had significantly less education and income.

Some cross-sectional studies published previously produced similar findings to us, for example a study in Finland⁽²⁰⁾ in which infrequent fish consumption, defined as fish intake less than once weekly, was significantly associated with depression in women (OR = 1.4; 95% CI 1.1, 1.8). Other studies in Crete and Finland respectively have shown a stronger association in women than men^(18,19).

However, one study did not show any significant associations between frequency of fish intake and depression⁽³⁶⁾, but this study was limited by a small sample size. To our knowledge there are no studies conducted in

low- to middle-income countries which have examined the association between diet and psychological distress.

The participants of the present study were from Goa and may not be representative of the wider Indian population. Goa is the smallest state in west India, with better health and development than most other Indian states with respect to infant mortality and literacy rates⁽³⁷⁾. Forty-one per cent of the population lives in urban areas compared with 26% for the rest of India, and there is a higher proportion of persons aged over 60 years and a higher number of doctors for the population size compared with the rest of India⁽⁸⁾. The diet of Goans is particularly high in fish, as Goa is a coastal region and with a large proportion of people who are Roman Catholic in comparison to other states in India where vegetarianism is more common due to cultural, family traditions and religious beliefs (those practising Jainism, Buddhism and Hinduism). Fish is however consumed in significant quantities in a number of states which has implications for the sustainability of fish stocks for the

future, should dietary guidelines be devised in response to results of studies with similar findings to ours. The National Sample Survey (NSS)⁽³⁸⁾ reported that 42% of households are vegetarian, in that they never eat fish, meat or eggs. The remaining 58% of households are less strict vegetarians or non-vegetarians. Over time there has been a slow shift from strict vegetarianism to less strict vegetarianism, with changes being more visible in rural areas.

Strengths and limitations of the study

The present study is, to our knowledge, the first one published on the prevalence of psychological distress and dietary risk factors among general practice attendees in a low- to middle-income country such as India. The study practices covered socio-economically diverse rural and urban communities in Goa, India and achieved high rates of participation. We had data on more than 1500 people and adjusted for a range of possible socio-economic confounding factors that might impact on both diet and distress, such as education, income and living circumstances. The study uniquely adds to the existing research by examining the association between psychological symptoms and a South Asian diet in men and women.

The study was limited by its cross-sectional nature and hence our analyses were not able to ascertain a causal relationship between distress and dietary factors. As an observational study, there may have been unmeasured confounding; in particular the effects of deprivation, rural/urban differences and access to certain foods may not have been fully accounted for by measures of income and education. We used the K10, a WHO-validated screening tool for psychological distress, that has (unlike many instruments) been validated for use in Indian populations. The study participants were attending private general practices and the results may not be generalisable to other settings. A higher prevalence of psychological distress in a population seeking health care may be expected⁽²⁾. No information was collected on diagnosis or treatments for psychological disorders. We estimated the intake of food groups including fish with an FFQ and not with a food diary, which would have been a more accurate reflection of intake. The FFQ was employed to provide descriptive information about food consumption patterns and included supplementary questions as to cooking methods, detailing a variety of cooking oils among a comprehensive food list. The advantages of using the FFQ as opposed to a food diary were that it was easy to administer with a low respondent burden and high completion rates. The standardisation of responses enabled the questionnaire to be analysed easily. It was ethnically modified appropriately for foods consumed particular to the region. However, due to lack of resources we were unable to conduct validation or reliability testing, and therefore this modified version has not been validated in an Indian setting. Further limitations of the questionnaire included the

fact that a comprehensive list of all possible foods could not be included. The languages that the FFQ were presented in were English, Konkani or Hindi. The questionnaires were translated but not back-translated on account of budgetary restraints. One week's intake of food may not represent all that is eaten habitually and questionnaires may be subject to bias with participants overestimating consumption of perceived 'good foods'. In addition, we did not ask about portion size as this has varying definitions for individuals. Grouping of foods into individual items may have made answering some questions difficult. Questions on fish intake were a discrete entity on their own, separate from questions on fried food which included fried fish, and thus may have diluted the relationship between fish consumption and distress. However, in Goa, fried fish is pan fried and never deep fried. Although pan-fried fish would have diluted the relationship between fish consumption and distress, this would have been less so than with deep-fried fish. Previous studies have shown that use of a self-completed FFQ is valid⁽³⁹⁾. Our study was on attendees to general practices in Goa and may not apply to populations that do not attend for care in this setting.

Possible biological mechanisms to account for association between fish intake and distress

There are several plausible biological mechanisms to explain the relationship between *n*-3 FA, derived from fish and seafood, and psychological distress.

There is epidemiological, biochemical and experimental evidence in Europe, North America and Australasia on the association between depression and *n*-3 FA, a potential natural antidepressant. Hibbeln *et al.*⁽¹⁷⁾ showed a strong negative association between fish intake and depression across thirteen predominantly high-income countries. One mechanism postulated is that *n*-3 FA are in high concentration in the brain and central nervous system and are associated with the regulation of important serotonergic neurotransmitter systems in the brain (dopamine and serotonin), which have a possible role in the aetiology of depression^(16,40). This is supported by both animal⁽⁴¹⁾ and human studies⁽⁴²⁾. Another theory is the 'macrophage theory of depression'⁽³⁵⁾ in which it is proposed that depression is accompanied by an overactivity of the inflammatory response of the immune system; an increase in secretions of inflammatory cytokines and eicosanoids, which are implicated in depression^(43–45). The *n*-3 FA from fish decrease production of these inflammatory eicosanoids. Alternatively, the 'cAMP signal transduction hypothesis' suggests depression to be caused by impaired phospholipid metabolism and impaired FA-related signal transduction (due to inadequate intake of fish and *n*-3 FA) and may also explain the association between depression and CVD⁽⁴⁶⁾. There have been small clinical trials based in developed countries (USA, Israel and

the UK) examining the impact on depressed patients of FA supplementation but results are varied, with some studies showing an improvement in depressive symptoms following FA supplementation^(47–49) and others not⁽⁵⁰⁾.

Future work

Current trial evidence on diet supplementation with fish oils (*n*-3 FA, DHA and EPA) is conflicting. There is a further need for clinical trials to determine the impact on distress of patients having an increased fish intake *v.* taking FA supplements. Furthermore, we found significantly lower distress in women who ate red meat regularly and this finding needs to be examined further. An extension of this would be to compare distress in a vegetarian population with a non-vegetarian group who consume the requisite amount of fish/meat.

Our finding of reduced odds of distress with higher fish consumption is consistent with previous studies in general populations in other countries. There are several plausible mechanisms to account for this. It is possible that distress itself could cause reduced intake of fish or that the low concentration of *n*-3 FA, by reduced intake of fish, contributes to a susceptibility to distress. Further longitudinal population data are required to ascertain the relationship between dietary risk factors and distress in India in both coastal and other areas.

Conclusions

Addressing psychological distress to reduce disease burden and disability is becoming an increasingly significant public health priority in low-income countries. Our study suggests that psychological distress is significantly associated with reduced fish intake in general practice attendees in Goa, India. Our study provides data on the relationship between mental health and diet in a low-income country for the first time. Further longitudinal research is needed to clarify this relationship.

Acknowledgements

Sources of funding: The research was funded through a grant given by University College London, UK. The funders had no direct role in the design or conduct of the study, interpretation of the data, or review of the manuscript. *Conflicts of interest:* None. *Authors' contributions:* M.B., K.W., G.C., M.K. and I.N. all contributed to the writing of the manuscript and L.M. additionally contributed to the statistical analysis and results section. *Acknowledgements:* The authors would like to thank the nine general practitioner doctors who took part in the study and the patients who undertook the research assessments. They also would like to thank the six researchers who conducted the research assessments and interviews.

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