



Poverty does not modify the association between perceived diet healthiness and adherence to nutritional guidelines in the Constances cohort (France)

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Poverty does not modify the association between perceived diet healthiness and adherence to nutritional guidelines in the Constances cohort

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Abstract

Poor individuals have less healthy diets and seem to benefit less from nutrition information campaigns. One may wonder if they are less aware of their diets' shortcomings. The aim of this paper is to assess whether the association between perceived diet healthiness and adherence to nutritional guidelines is weaker among poor people. Data were collected from 40,000 participants from the Constances study, a large population-based observational cohort in France. Adherence to French nutritional guidelines was measured by a validated score based on a 22 item food frequency questionnaire and poverty was defined as facing material deprivation. These variables and their interaction were the variables of interest of a linear regression predicting perceived diet healthiness, with controls for confounders and 95% CI. Poor participants had lower nutrition scores and diet healthiness perceptions. Among respondents who had never faced material deprivation, for each increase in the guideline adherence score there was a +0.21 change (95% CI [0.18,0.23]) in perceived diet healthiness for men (women: +0.19 [0.17,0.22]). The coefficients were not smaller among poor respondents. Our results do not support the assumption that people facing poverty might overestimate their diet healthiness. This suggests that information campaigns are not enough: policies or interventions making healthy eating easier and more manageable are necessary.

Keywords

Poverty ; Diet perception ; Nutritional guidelines ; Socioeconomic status; Prospective cohort; Qualitative food frequency questionnaire.

Short title: Poverty and diet perception

Introduction

Non-communicable diseases and the social gradient in health are major public health concerns (1). Over the last decades, in order to tackle the rising prevalence of lifestyle diseases, several countries have massively disseminated nutrition guidelines (2,3). Their impact was often limited by the “knowledge-behaviour gap” (4,5). Campaigns had inconsistent effects on diet quality and nutritional status (6–8). Some have proven successful. For example, when oriented towards a single message (8). However the main issue was to keep a sustained effect rather than a short-term change (6). Health promotion campaigns may also take time to change attitudes (7).

Launched in 2001, the Programme National Nutrition Santé (PNNS) was a major step in French nutrition policy. Besides many actions directed to (or negotiated with) health professionals and food industries, it produced nutritional guidelines for the general population. Since 2007 any advertisement for processed food or drink must include one of the following messages: ‘for a healthy life, eat at least five fruit and vegetables per day’, ‘for a healthy life, practice regular physical activity’, ‘for a healthy life, avoid eating too fat, too sweet, too salty’, ‘for a healthy life, avoid snacks between meals’ (9). These messages therefore appear in magazines, on billboards, the Internet, radio and television. By 2008 knowledge of the guidelines had significantly increased, but adherence to the guidelines had only mildly improved (10). Differences in knowledge across economic status were not reported.

While many factors contribute to the economic gradient in nutritional status, health education campaigns may increase this gradient because they benefit to poorer individuals less (5,11). In this perspective, a range of studies have examined whether nutritional knowledge and nutrition literacy mediated the association between higher income and healthier diets (12–15).

In a British sample of 1,040 adults, nutritional knowledge was positively associated with education, age and occupational group (income was not examined) (4). However, several studies have found that the association between knowledge and diet was weak or insignificant, or was positive only for a limited number of diet quality indicators, such as fruit and vegetable intake (16–18).

Other studies have focused on how people perceived the quality of their diet (nutritional awareness or perceived diet quality) as key points in making dietary choices because inaccurate perception of diet healthiness may be a barrier to adopting healthier dietary habits (19,20). In France, perceiving diet as balanced correlated with more adequate intakes of fruit and vegetables, fish and dairy but not animal protein. In US National health and nutrition survey (NHANES) perceiving diet as healthy was associated with a healthier diet but participants overestimated their diet healthiness. While the poorest participants perceived their diet as less healthy, the study did not report association between perception and intakes across income categories(20).

Is misperception of diet healthiness a factor that explains why poor people have less healthy eating habits in so many societies? People facing poverty may misperceive their diet healthiness because they have poorer nutritional knowledge (12,13). They may also have nutritional knowledge but have adapted their standards to their living circumstances (21), or they may react to health promotion campaigns differently compared to non-poor participants. In a qualitative study in New Zealand, such campaigns met resistance and denial, potentially reinforcing stigmatisation and the social gradient in health (22). Some studies have tried to assess the association between perceived diet quality and adherence to nutritional guidelines, taking economic status into account. An American study compared perceived diet quality with the Healthy Eating Index: 40% of the respondents were “optimistic”, perceiving their diet quality to be better than it actually was, but being optimistic was not associated with income

or education (23). This study, however, only included people in charge with meal preparation in their homes and dated from 1989-90. A recent study in Luxembourg showed a significant association between perceiving diet as important for health and diet quality independently of education and income (19). This study did not target specifically poor participants and was performed on a sample of 1,351 participants.

There is evidence that the poor are at greater risk of suboptimal diet and derive less nutritional knowledge from information campaigns, but it is still unclear whether they perceive their diet healthiness less consistently with nutritional recommendations. The aim of this study is to assess whether the association between perceived diet healthiness and adherence to nutritional guidelines is weaker among poor participants in Constances, a large, population-based epidemiologic cohort in France.

Methods

Study design

Constances is a general-purpose, population-based epidemiologic cohort. It is designed as a representative sample of French adults aged 18–69 years at inception (24). The random sampling protocol over-represents individuals with a higher probability of non-volunteering according to age, gender and SES, relying on the French national inter-scheme registry of health insurance beneficiaries (RNIAM). Self-employed workers have a different health insurance scheme and cannot be sampled, therefore the cohort covers 85% of the French population aged 18-69. Inclusion criteria include a health examination in one of the 19 participating Health centres scattered across the French metropolitan territory, and completion of a series of questionnaires. The data used in this paper are drawn from the ‘Health and lifestyle’ questionnaire, which is self-completed at home upon inclusion. The study has

obtained the authorisation of the National Data Protection Authority (*Commission nationale de l'informatique et des libertés*-CNIL, #910486).

Population

This study included participants who were invited between January, 2012 and June, 2015, who had returned the 'Health and lifestyle' questionnaire (n=41,705) and had completed the material deprivation question (n=841 excluded) and at least 11 out of the 22 Food frequency questionnaire (FFQ) items (n=849 excluded). This resulted in the inclusion of 40,015 participants, including 25,507 complete cases.

Variables

Perceived diet healthiness were measured through the question 'Do you consider that your diet is balanced?'. Possible answers ranged from 1 (not at all) to 8 (perfectly). The question was used in another French nutrition survey where it correlated with more appropriate intakes of various food groups (25,26). A 'balanced diet' (*alimentation équilibrée*) is a good French translation of a 'healthy diet' as it is frequently used in daily life and in nutrition information campaigns (27). 'In general, how healthy is your overall diet?' was used in NHANES where it was associated with higher diet quality (20). It was recently validated as a synthetic measure of dietary quality (28).

Adherence to nutrition guidelines (PNNS score) is adapted from the PNNS-GS score (29,30). In another nutritional survey, PNNS-GS score has been validated for monitoring adherence to French nutritional guidelines. It was associated with healthier nutrient intakes and biomarkers (29), and lower incidence of metabolic syndrome (31). Our version of the PNNS score is adapted to Constances questionnaire. Habitual food intakes were collected thanks to a self-completed FFQ designed by nutritionists and food sociologists. These experts intended to make it understandable by French adults of any sociocultural background and age; the FFQ

was not validated. It included usual intake frequency for 22 food groups, without quantities (32). When respondents consumed the item on a daily basis, they declared how many times or servings per day. Otherwise, the answers were translated into frequency of consumption per day (Nearly never: 0 time/day; About once a week: 0.15; 2 or 3 times a week: 0.36; 4 to 6 times a week: 0.71). We also used questions on modifiable physical activity, alcohol consumption (never, less than once a week, weekly frequency), and use of fats and spreads. Our PNNS score included 11 components: fruit and vegetables, bread cereals potatoes and legumes, milk and dairy, meat poultry seafood and eggs, seafood, added fat, sweetened foods, non-alcoholic beverages, alcohol, salt, physical activity (Online Resource Table A1). Wholegrain cereals, added fat and water intakes, which are measured in the PNNS-GS score, could not be assessed. The maximum score is 12.5 because the score gives supplementary points for physical activity, fruit and vegetable, and salt consumption when habits are more satisfactory than current recommendations (29).

Poverty can be defined in relative terms (usually as 60% of median income) or in absolute terms as material deprivation. In this study we define it as material deprivation (33) measured through the question: ‘Are there times when you experience difficulties meeting your financial needs (food, rent, electricity, loans etc.)?’. Possible answers were: Never, No but it has happened in the past, Yes less than a year ago, Yes for the past several years. We checked that material deprivation was associated with lower income by computing the monthly income per consumption unit from declared household monthly income (6 classes), household composition and the OECD equivalence scale (34). We did not derive our measure of poverty from this income variable because it had a lot of missing values (as is often the case with declared income) and did not account for the fact that the same income may allow for different standards of living according to the cost of living in the area.

Covariates Educational level was coded in 4 categories (incomplete secondary, completed secondary, bachelor level, masters and more) and age in 10-year groups. We also included variables indicating whether the respondent lived with a partner and followed a diet prescribed by a doctor (11).

Auxiliary variables were used when imputing the missing values. Body mass index was computed as weight in kilograms divided by height in meters squared, with weight and height measured during a standardised health examination (35). The social disadvantage index of the area of residence was computed from official statistics on income, educational level, occupational groups and unemployment (36). It varied from -5.7 (strongest disadvantage) to 3.5. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression scale (CESD). A score above 16 indicated depression. We also used region of residence, smoking status and whether participants had foregone healthcare for financial reasons over the last 12 months.

Statistical analysis

Descriptive statistics compared the distribution of all variables across categories of material deprivation, with either chi-square or Kruskal-Wallis tests (as relevant). We also report the number of missing data for each variable and a correlation matrix for all continuous variables.

We ran linear regressions with perceived diet healthiness as the dependent variable. The variables of interest were the PNNS score as a continuous variable, material deprivation categories and their interaction. We controlled for education, age, and partnership and dieting status. Diet perception and poverty risk both differ across sex, hence the analyses were separated for men and women. We reported unstandardized regression coefficients with 95% confidence intervals.

168 Perceived diet healthiness, material deprivation and each FFQ food item had a limited number
169 of missing values. The PNNS score, being a combination of many variables, had 68%
170 complete observations. Respondents in poverty have more missing values. In order to limit
171 the possible bias, we ran multiple, multinormal imputations with 50 imputed files.
172 Imputations were run separately according to sex and material deprivation category, to allow
173 for different associations in these groups of participants. Multinormal imputations assume that
174 imputed variables follow a normal distribution. In order to get closer to this assumption, we
175 imputed the square-root of the variables recording frequency of consumption for each food
176 group. To improve the quality of the imputation and account as best as possible for the
177 plausible sources of non-response bias, we used current smoking status, body mass index,
178 foregone health care, depressive symptoms, region, and the local socioeconomic deprivation
179 index as auxiliary variables. Models of interest were then estimated on the 50 completed
180 files and combined according to Rubin's rules (37,38). Perceived diet healthiness is measured
181 on an 8-level scale, with one third of respondents answering 7 or 8. There is a risk that the
182 linearity assumption involved in linear regressions biases our results. For this reason, we also
183 estimated the odds-ratios of perceiving diet as very healthy (answers 7 or 8) according to
184 PNNS score, material deprivation, their interaction and the covariates (Online Resource table
185 A2). We also estimated the linear regression models with continuous measurement of age
186 (and age squared) as a sensitivity analysis (results very similar to Table 3, not shown). All
187 analyses were performed using the Stata software (version 15, Stata Corp., College Station,
188 TX).

Results

Descriptive statistics

We excluded 1,690 cases because material deprivation was missing or because the FFQ was insufficiently completed (Figure 1). The final sample thus included 40,015 participants. Among them, 14,508 participants had at least one missing variable, while 25,507 were complete cases.

Figure 1 about here

Table 1 shows descriptive statistics according to material deprivation, among the available cases. Nearly two thirds of the participants had never experienced material deprivation; 7.1% (n=2,845) reported material deprivation only this year and 6.3% (n=2,530) for several years.

Table 1 about here

Table 2 about here

Material deprivation was associated with other indicators of economic deprivation: lower income per consumption unit, worsened local deprivation index, slightly higher BMI. Participants reporting material deprivation for several years had foregone healthcare for themselves or their partner much more often (58.4% as against 5.2% among those never in material deprivation). They also had depressive symptoms and incomplete questionnaires more often. All these associations were highly significant ($p < 0.005$). There was a gradient in these associations: participants never deprived, deprived only in the past, currently deprived and deprived for several years had increasingly bad situations, (Kruskal-Wallis test $p < 0.0005$, p for trend < 0.001).

Participants who had never faced material deprivation were also older, lived with a partner more often and had a higher educational level. About 52% were women, against 59% of the participants who declared material deprivation only this year and 55% who had faced them for several years ($p < 0.005$ for all associations).

In the study population the PNNS score ranged from 0.5 to 12.5 with a mean of 6.33 (SD 1.54). Statistical tests indicated that it was significantly higher among women (6.53 against 6.11, $p < 0.0001$), non-smokers (6.48 against 5.76, $p < 0.0001$), older participants, and those with higher educational levels (Kruskal-wallis test $p = 0.001$), reflecting healthier diets in these population categories. In Table 2, PNNS score's correlation with social disadvantage index and BMI was close to 0, with income it was 0.11 and with age 0.27.

A third of the sample rated their diet healthiness 7 or 8 on the 1-8 scale (8 meaning a perfectly balanced diet). Mean perceived diet healthiness ranged from 5.9 for those never deprived to 4.9 for those deprived several years, while the mean PNNS score ranged from 6.43 to 5.94 ($p < 0.0005$ in both cases). Perceived diet healthiness correlated negatively with BMI and positively with age and perceived diet healthiness (0.27). This correlation did not vary much across material deprivation category (bottom line of Table 1, ranging from 0.25 among those currently deprived to 0.28 among those deprived in the past).

Models

In multivariate models for complete cases (Table 3, model 1), the association between PNNS score and perceived diet healthiness was similar for men and women who had never faced material deprivation: for each increase in PNNS score there was a +0.21 change (95% CI [0.18,0.23]) in perceived diet healthiness for men (+0.19 [0.17,0.22] for women). Among men, this increase was slightly stronger for participants who had faced material deprivation in the past, but was not significantly different for those currently facing material deprivation.

Among women who faced material deprivation, for each increase in PNNS score there was a stronger increase in perceived diet healthiness: the difference was 0.18 point and statistically significant [0.11,0.25].

Table 3 about here

When estimated on the full sample after imputation of the missing data (Table 3 model 2), the coefficients remained very close to those estimated on complete cases, with the same levels of statistical significance. Typically, the increase in PNNS score for women who have faced material deprivation for several years was 0.14 [0.09,0.20] point larger than for women who had never faced poverty.

Participants who had never faced material deprivation also had a higher intercept than the others. Figure 2 illustrates these results using predicted values from model 2 (imputed data): men who had never faced material deprivation rated their dietary habits as more balanced at every level of the PNNS score, with no difference in the slopes. Materially deprived women had lower perceived diet healthiness only if their PNNS score was low: among women with healthy diets material deprivation made no statistically significant difference.

Figure 2 about here

We estimated the odds-ratios of perceiving diet as very healthy (7 or 8 on the 1-8 scale) for men and women on the complete cases (Online Resource Table A2): none of the interaction terms were significant. Specifically, for women the changes in odds-ratios associated with each increase in PNNS score were not statistically different according to experience of material deprivation.

Discussion

Our results indicate that the association between perceived diet healthiness and adherence to national nutritional recommendations is not lower among participants facing or having faced poverty, measured as material deprivation. This result held after controlling for education and whether we imputed missing data or not.

Our results are consistent with the findings of other studies, conducted in Luxembourg (19) and in NHANES (39). The latter showed that materially deprived participants had less healthy diets (measured by the Healthy Eating Index) and lower perceptions of their diet healthiness which is in line with the results of this study. Our results are also consistent with another study (23) which found that overestimating diet healthiness was widespread across all levels of education and income. Nutritional knowledge is associated with higher SES but correlates weakly with food intake (4,12,13,17,18,40) although some studies found significant associations (41). This suggests that nutrition knowledge and diet perception are two different constructs. A lot of variables may mediate the link between nutritional knowledge and diet, including diet perception, home environment and access to food (42,43) and food-management skills (21).

We found that the association between perceived diet healthiness and adherence to guidelines was stronger for women who had experienced material deprivation for a long period of time. It has been shown that following nutritional guidelines is difficult for low-income people because nutritious foods are more expensive (44,45). Poor women (with similar levels of education) may perceive better their diets' shortcomings (or qualities) because maintaining a healthy diet with a smaller budget requires more reflexivity, time and energy (21,44,46). This result, however, was not statistically significant when we modelled odds-ratios of perceiving one's diet as very healthy.

We measured poverty in terms of material deprivation, through a question regarding budget restrictions in basic needs (rent, food, energy) experienced over the last 12 months or earlier in life. We did not use income for several reasons: the collection in broad classes does not allow for precise measurement, income declarations are prone to biased or missing responses (47), computing income per consumption unit from household income and household composition generates even more missing responses, and the same income may allow different standards of living according to the cost of living in the area. However, we validated this measure by checking that individuals who claimed they faced material deprivation had lower declared incomes and higher chances to forego healthcare and lived in more deprived areas.

A major strength of this study is its sample. Data were collected from over 40,000 adults sampled randomly from the French population from 2012 to 2015. Low-SES adults were over-sampled in order to compensate for higher non-participation rates. The study addressed many aspects of health, and included a comprehensive and free health examination which may have lowered the overall participation rate but attracted low-income participants. We were also able to control for the most plausible confounders, to impute missing data with a comprehensive set of auxiliary variables (including depressive symptoms, smoking status and local deprivation index), and to relax the linear assumption of the first models, in order to deliver robust conclusions.

Our study has some limitations. First, as in any survey based on voluntary participation, it remains possible that the most economically deprived and hard-to-reach populations did not participate in the Constances cohort. If these populations are those for whom the association between adherence to recommendations and perception of diet healthiness is lowest, not including them may bias our results. While we could not address non-participation bias, we

303 treated item non-response, which was associated with material deprivation. Estimating our
304 model on complete cases or after imputation of item non-responses gave very similar results.

305 Second, the downside of using a general-purpose cohort rather than a nutrition survey is that
306 adherence to nutritional guidelines is based on a 22-item FFQ. We did not measure quantities
307 nor controlled for total energy intake. While our PNNS score is adapted from the validated
308 PNNS-GS score, the FFQ was not validated. We found the expected associations between
309 PNNS score and age, sex and education, as well as with material deprivation (44). Nutrition
310 recommendations addressed to the French population usually refer to frequency of
311 consumption (five a day, twice a week), or simply advise to ‘eat less salty’. Our questionnaire
312 design is coherent with the wording of these messages, making it a relevant tool to confront
313 with perception of diet healthiness.

314 Third, perceived diet healthiness was collected on an 8-point scale and treated as a continuous
315 variable. Since assuming a linear relationship between adherence and dietary balance may
316 induce bias, we also estimated odds-ratios of perceiving diet as very healthy: results were
317 consistent except that the positive difference between women having faced material
318 deprivation for several years and those never poor was no longer significant.

319 **Conclusions**

320 Diet contributes to the social gradient in health (1). Why do poor people keep eating such
321 unhealthy diets, despite all the nutritional information that has been massively disseminated
322 towards them over the last years? One possible explanation is that they misuse the
323 information, overestimate their diet healthiness, and don’t see any reason to change (20). This
324 is an important rationale for a variety of health education campaigns. Some researchers argue
325 that such an assumption means “blaming the victims” (48,49), making them responsible for

exposing themselves to well-identified health risk factors. Our results indicate that this assumption is not only ethically disputable, it is also misleading: in our study diet misperception is not stronger among poor participants. Disseminating nutritional information may improve nutritional knowledge in the whole population, but it is not sufficient to improve poor people's diets. On the contrary it may generate anxiety among the most vulnerable (50,51): in our study they were equally aware of their diet healthiness, but they had less resources to improve it.

In order to make healthy eating more accessible to poor households, it is necessary to act not only on knowledge but also on the context of eating practices (9,52,53) and on the food supply, so that healthier options become easier, or even unconscious for all. Research and policies developed along the perspective of the theories of practices offer promising avenues in this respect (52,54,55). Many existing policies are in fact consistent with this 'practice' approach (55). Improving the nutritional content of processed foods (without rising prices) (59), offering healthy snacks in vending machines (56), supplying balanced meals in schools and workplace canteens (57) or reducing portion size in restaurants and fast-foods (58) may improve diets without requiring the adoption of new behaviours. Is not clear to what extent such policies may benefit to households facing material deprivation but at least, they do not blame or stigmatize them for the shortcomings of their diets.

Declarations

Ethics approval and consent to participate

The study has obtained the authorisation of the National Data Protection Authority (*Commission nationale de l'informatique et des libertés*-CNIL, #910486). Participants'

informed consent signature validates the collection of these data and authorises their use for research purposes.

Availability of data and material

The data that support the findings of this study are available from Constances principal investigators (Marie Zins, Marcel Goldberg, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the principal investigators.

Competing interests

SC, JM, MP, EKG and MZ declared no conflict of interest.

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Authors' contributions

MP conceived the hypothesis, conducted the statistical analyses and drafted the manuscript. MZ is co-principal investigator of the Constances cohort. SC and EKG contributed to the elaboration of the nutrition guideline score. JM critically revised the drafted manuscript. All authors were involved in writing the paper and had final approval of the submitted and published versions.

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535

536 **Tables and figures**

537

538 **Fig1**

539 Caption: Flowchart of study population

540 Notes:

541 FFQ: food frequency questionnaire

542

543

Table 1

Sample characteristics according to declared material deprivation in the Constances cohort
(column percentages unless otherwise specified)

	Material deprivation				Total	Missing	P-value
	Never	Past only	This year	Several years			
Material deprivation: row % (n)	62.2 (24,868)	24.4 (9,772)	7.1 (2,845)	6.3 (2,530)	100 (40,015)	0	
Complete case ^a	64.6	63.3	61.6	60	63.7	0	<0.0005
Woman	51.8	56.6	58.9	55.4	53.7	0	<0.0005
Age						0	<0.0005
18-29 years	12.1	10.2	18.4	12	12.1		
30-39 years	16.9	16.9	21.1	19.9	17.4		
40-49 years	21.3	22.6	26.9	29.2	22.5		
50-59 years	22.2	27.2	20.5	24.8	23.5		
60+ years	27.5	23.1	13.1	14.1	24.6		
Educational level						591	<0.0005
Incomplete secondary	19.3	30.7	33.1	37.8	24.1		
Completed secondary	15.5	18.6	21.3	23.5	17.1		
Bachelor level	26.7	25.9	27.2	22.5	26.3		
Masters level	38.5	24.8	18.4	16.2	32.5		
No partner	22.9	28.1	41.3	44.2	26.7	469	<0.0005
Depressive symptoms (CESD>16)	13.9	24.4	37	43.8	19.8	0	<0.0005
Foregone healthcare	5.2	17.9	44.7	58.4	14.1	310	<0.0005
Prescribed diet	3.8	5.5	4.7	6.7	4.5	554	<0.0005
Diet perceived as very healthy (7-8/8)	36.1	28.7	20.8	17.7	32.2	412	<0.0005
Continuous variables: mean (sd)							
Age	48.2 (13.8)	48.3 (12.8)	43.4 (12.9)	45.6 (12.1)	47.8 (13.5)	0	<0.0005
Income ^b	2649 (1285)	2134 (1147)	1448 (890)	1306 (758)	2358 (1278)	12,604	<0.0005
Local social disadvantage index ^c	-0.9 (1.7)	-0.7 (1.6)	-0.6 (1.7)	-0.5 (1.7)	-0.8 (1.7)	19	<0.0005
BMI (kg/m ²)	24.6 (4.2)	25.5 (4.7)	25.9 (5.1)	26.4 (5.5)	25 (4.5)	2,090	<0.0005
Perceived diet healthiness	5.9 (1.4)	5.6 (1.5)	5.2 (1.7)	4.9 (1.8)	5.7 (1.5)	412	<0.0005
PNNS score	6.43 (1.54)	6.27 (1.55)	5.98 (1.51)	5.94 (1.51)	6.33 (1.54)	12,810	<0.0005
Correlation PNNS x Perceived diet	0.26	0.28	0.25	0.27	0.27	12,951	

Difference between material deprivation groups has been compared by chi-square or Kruskal-Wallis tests as relevant.

^a Participant has valid answers on PNNS score, perceived dietary balance, material deprivation, age, education, partnership status, and dieting status.

^b Monthly income per consumption unit using the OECD scale, in euros.

^c Disadvantaged areas have a lower index. Computed from median income and the percentages of blue-collar workers, unemployed and adults with less than completed secondary education in the area of residence.

1 **Table 2**

2 Correlation matrix between continuous variables in Constances cohort (complete cases)

	Age	Income	Social disadv.	BMI (kg/m ²)	Perceived diet	PNNS score
Age	1					
Income ^a	0.25*	1				
Local social disadvantage index ^b	0.01	-0.26*	1			
BMI (kg/m ²)	0.21*	-0.05*	0.11*	1		
Perceived diet healthiness	0.15*	0.17*	-0.06*	-0.22*	1	
PNNS score	0.28*	0.11*	-0.02*	0.01	0.27*	1

3 ^a Monthly income per consumption unit using the OECD scale, in euros.

4 ^b Disadvantaged areas have a lower index. Computed from median income and the percentages of blue-collar workers, unemployed and adults
5 with less than completed secondary education in the area of residence.

6 * Correlation coefficient statistically significant at p<0.01.

7

Table 3

Association between perceived diet healthiness and PNNS score according to material deprivation for men and women in the Constances cohort: unstandardized linear regressions adjusted on age, education, dieting and partnership status, on complete cases and after imputation.

		Men		Women	
		CC ^a	MI ^b	CC	MI
MD ^c	MD never	0	0	0	0
	MD past	-0.56 [-0.81,-0.30]	-0.52 [-0.73,-0.31]	-0.55 [-0.79,-0.31]	-0.60 [-0.80,-0.40]
	MD now	-0.61 [-1.04,-0.18]	-0.55 [-0.90,-0.20]	-1.08 [-1.45,-0.70]	-0.98 [-1.29,-0.67]
	MD several years	-0.68 [-1.10,-0.26]	-0.66 [-1.01,-0.31]	-1.78 [-2.21,-1.36]	-1.56 [-1.91,-1.21]
PNNS score (1 point)		0.21 [0.18,0.23]	0.20 [0.18,0.22]	0.19 [0.17,0.22]	0.19 [0.18,0.21]
Interaction of PNNS with	MD Never	0	0	0	0
	MD past	0.05 [0.01,0.09]	0.04 [0.01,0.08]	0.05 [0.01,0.09]	0.05 [0.02,0.08]
	MD now	0.02 [-0.06,0.09]	0.02 [-0.04,0.08]	0.09 [0.03,0.15]	0.08 [0.03,0.13]
	MD several years	-0.00 [-0.07,0.07]	0.00 [-0.05,0.06]	0.18 [0.11,0.25]	0.14 [0.09,0.20]
Constant		3.92 [3.77,4.07]	3.93 [3.80,4.06]	4.00 [3.85,4.15]	3.91 [3.79,4.04]
n		12,036	18,539	13,471	21,476
Adjusted R-squared (for complete cases)		0.133	.	0.132	.

95% confidence intervals in brackets. Models adjusted on age (baseline 18-29 years), education (incomplete secondary), partnership status (single), and dieting status (no prescribed diet).

^a CC: complete cases only.

^b MI: Multiply imputed data (50 imputations).

^c MD: Material deprivation.

Fig2

Caption: Association between perceived diet healthiness and PNNS score according to material deprivation and sex: predicted values and 95% CI.

Notes:

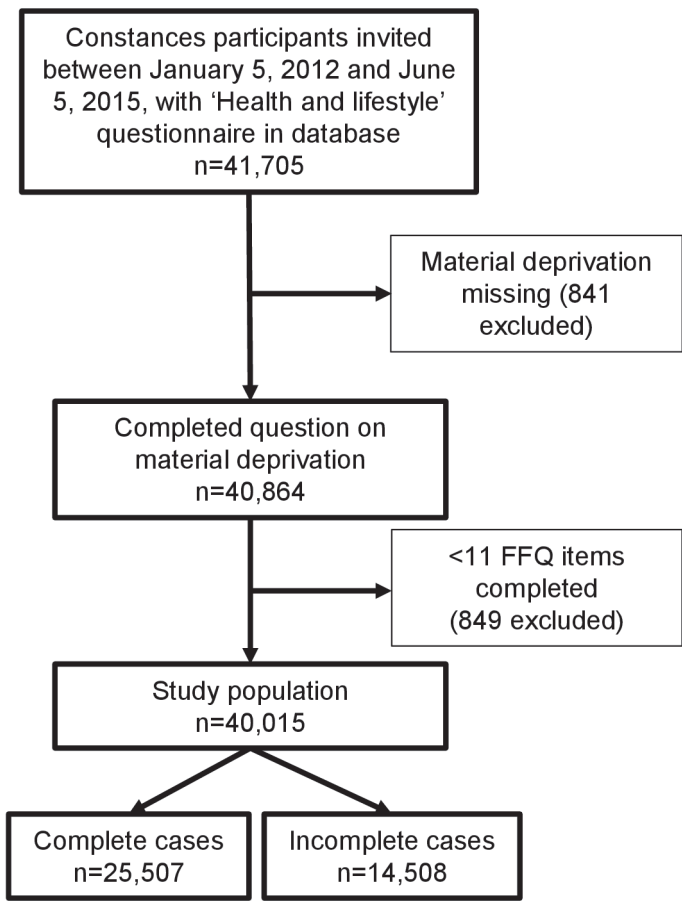
Linear predictions based on models in Table 3, adjusted on age (18-29 years), education (incomplete secondary), partnership status (single) and dieting status (no prescribed diet), estimated on multiply imputed data (50 imputations).

MD: material deprivation

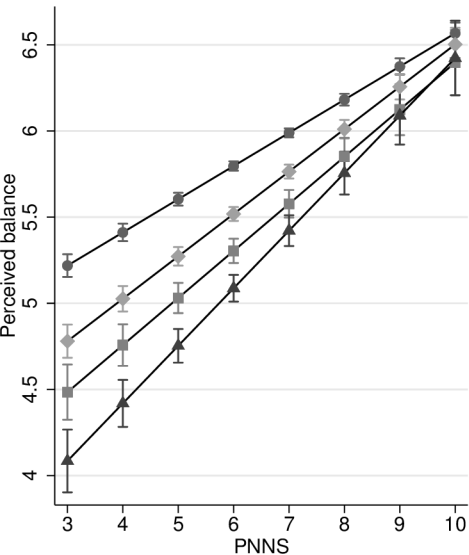
Additional files: Online resources

Table A1. Definition of PNNS score components and their implementation in Constances

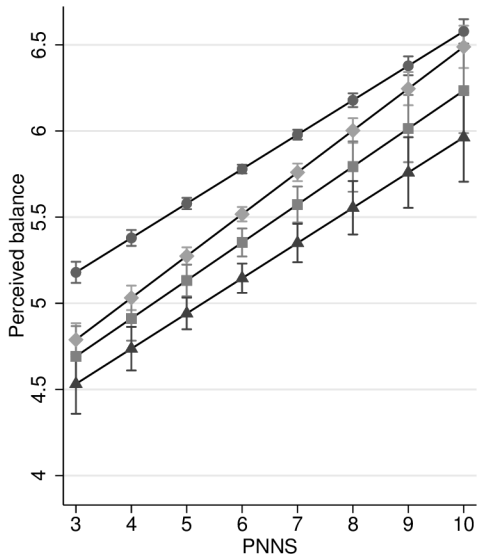
Table A2. Odds-ratios of perceiving diet as very healthy according to PNNS score, material deprivation and their interaction for men and women in the Constances cohort: logistic model adjusted on age (baseline 18-29 years), education (incomplete secondary), partnership status (single), and dieting status (no prescribed diet), complete cases.



Women



Men



—●— MD Never
—■— MD now

—◆— MD past
—▲— MD long