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

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

3 **Word count (main text): 4,101**

4 **Abstract**

5 Poor individuals have less healthy diets and seem to benefit less from nutrition information
6 campaigns. One may wonder if they are less aware of their diets' shortcomings. The aim of
7 this paper is to assess whether the association between perceived diet healthiness and
8 adherence to nutritional guidelines is weaker among poor people. Data were collected from
9 40,000 participants from the Constances study, a large population-based observational cohort
10 in France. Adherence to French nutritional guidelines was measured by a validated score
11 based on a 22 item food frequency questionnaire and poverty was defined as facing material
12 deprivation. These variables and their interaction were the variables of interest of a linear
13 regression predicting perceived diet healthiness, with controls for confounders and 95% CI.
14 Poor participants had lower nutrition scores and diet healthiness perceptions. Among
15 respondents who had never faced material deprivation, for each increase in the guideline
16 adherence score there was a +0.21 change (95% CI [0.18,0.23]) in perceived diet healthiness
17 for men (women: +0.19 [0.17,0.22]). The coefficients were not smaller among poor
18 respondents. Our results do not support the assumption that people facing poverty might
19 overestimate their diet healthiness. This suggests that information campaigns are not enough:
20 policies or interventions making healthy eating easier and more manageable are necessary.

21 **Keywords**

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

24 Short title: Poverty and diet perception

25 **Introduction**

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

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

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

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

54 Other studies have focused on how people perceived the quality of their diet (nutritional
55 awareness or perceived diet quality) as key points in making dietary choices because
56 inaccurate perception of diet healthiness may be a barrier to adopting healthier dietary habits
57 (19,20). In France, perceiving diet as balanced correlated with more adequate intakes of fruit
58 and vegetables, fish and dairy but not animal protein. In US National health and nutrition
59 survey (NHANES) perceiving diet as healthy was associated with a healthier diet but
60 participants overestimated their diet healthiness. While the poorest participants perceived their
61 diet as less healthy, the study did not report association between perception and intakes across
62 income categories(20).

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

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

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

85 **Methods**

86 **Study design**

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

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

99 **Population**

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

105 **Variables**

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

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

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

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

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

149 *Auxiliary variables* were used when imputing the missing values. Body mass index was
150 computed as weight in kilograms divided by height in meters squared, with weight and height
151 measured during a standardised health examination (35). The social disadvantage index of the
152 area of residence was computed from official statistics on income, educational level,
153 occupational groups and unemployment (36). It varied from -5.7 (strongest disadvantage) to
154 3.5. Depressive symptoms were assessed using the Center for Epidemiologic Studies
155 Depression scale (CESD). A score above 16 indicated depression. We also used region of
156 residence, smoking status and whether participants had foregone healthcare for financial
157 reasons over the last 12 months.

158 **Statistical analysis**

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

162 We ran linear regressions with perceived diet healthiness as the dependent variable. The
163 variables of interest were the PNNS score as a continuous variable, material deprivation
164 categories and their interaction. We controlled for education, age, and partnership and dieting
165 status. Diet perception and poverty risk both differ across sex, hence the analyses were
166 separated for men and women. We reported unstandardized regression coefficients with 95%
167 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).

189 **Results**

190 **Descriptive statistics**

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

195 Figure 1 about here

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

199 Table 1 about here

200 Table 2 about here

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

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

214 In the study population the PNNS score ranged from 0.5 to 12.5 with a mean of 6.33 (SD
215 1.54). Statistical tests indicated that it was significantly higher among women (6.53 against
216 6.11, $p < 0.0001$), non-smokers (6.48 against 5.76, $p < 0.0001$), older participants, and those
217 with higher educational levels (Kruskal-wallis test $p = 0.001$), reflecting healthier diets in these
218 population categories. In Table 2, PNNS score's correlation with social disadvantage index
219 and BMI was close to 0, with income it was 0.11 and with age 0.27.

220 A third of the sample rated their diet healthiness 7 or 8 on the 1-8 scale (8 meaning a perfectly
221 balanced diet). Mean perceived diet healthiness ranged from 5.9 for those never deprived to
222 4.9 for those deprived several years, while the mean PNNS score ranged from 6.43 to 5.94
223 ($p < 0.0005$ in both cases). Perceived diet healthiness correlated negatively with BMI and
224 positively with age and perceived diet healthiness (0.27). This correlation did not vary much
225 across material deprivation category (bottom line of Table 1, ranging from 0.25 among those
226 currently deprived to 0.28 among those deprived in the past).

227 **Models**

228 In multivariate models for complete cases (Table 3, model 1), the association between PNNS
229 score and perceived diet healthiness was similar for men and women who had never faced
230 material deprivation: for each increase in PNNS score there was a +0.21 change (95% CI
231 [0.18,0.23]) in perceived diet healthiness for men (+0.19 [0.17,0.22] for women). Among
232 men, this increase was slightly stronger for participants who had faced material deprivation in
233 the past, but was not significantly different for those currently facing material deprivation.

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

237 Table 3 about here

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

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

249 Figure 2 about here

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

255 **Discussion**

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

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

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

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

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

298 Our study has some limitations. First, as in any survey based on voluntary participation, it
299 remains possible that the most economically deprived and hard-to-reach populations did not
300 participate in the Constances cohort. If these populations are those for whom the association
301 between adherence to recommendations and perception of diet healthiness is lowest, not
302 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

326 exposing themselves to well-identified health risk factors. Our results indicate that this
327 assumption is not only ethically disputable, it is also misleading: in our study diet
328 misperception is not stronger among poor participants. Disseminating nutritional information
329 may improve nutritional knowledge in the whole population, but it is not sufficient to improve
330 poor people's diets. On the contrary it may generate anxiety among the most vulnerable
331 (50,51): in our study they were equally aware of their diet healthiness, but they had less
332 resources to improve it.

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

344 **Declarations**

345 **Ethics approval and consent to participate**

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

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

350 **Availability of data and material**

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

356 **Competing interests**

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

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359 No funding was received.

360 **Authors' contributions**

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

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369

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536 **Tables and figures**

537

538 **Fig1**

539 Caption: Flowchart of study population

540 Notes:

541 FFQ: food frequency questionnaire

542

543

544 **Table 1**

545 Sample characteristics according to declared material deprivation in the Constances cohort
 546 (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	

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

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

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

552 ^c Disadvantaged areas have a lower index. Computed from median income and the
 553 percentages of blue-collar workers, unemployed and adults with less than completed
 554 secondary education in the area of residence.
 555

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

1 **Table 3**

2 Association between perceived diet healthiness and PNNS score according to material deprivation for men and women in the Constances cohort:
 3 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	.

4 95% confidence intervals in brackets. Models adjusted on age (baseline 18-29 years), education (incomplete secondary), partnership status (single), and dieting status (no
 5 prescribed diet).

6 ^a CC: complete cases only.

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

8 ^c MD: Material deprivation.

1 **Fig2**

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

4

5 Notes:

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

9 MD: material deprivation

10

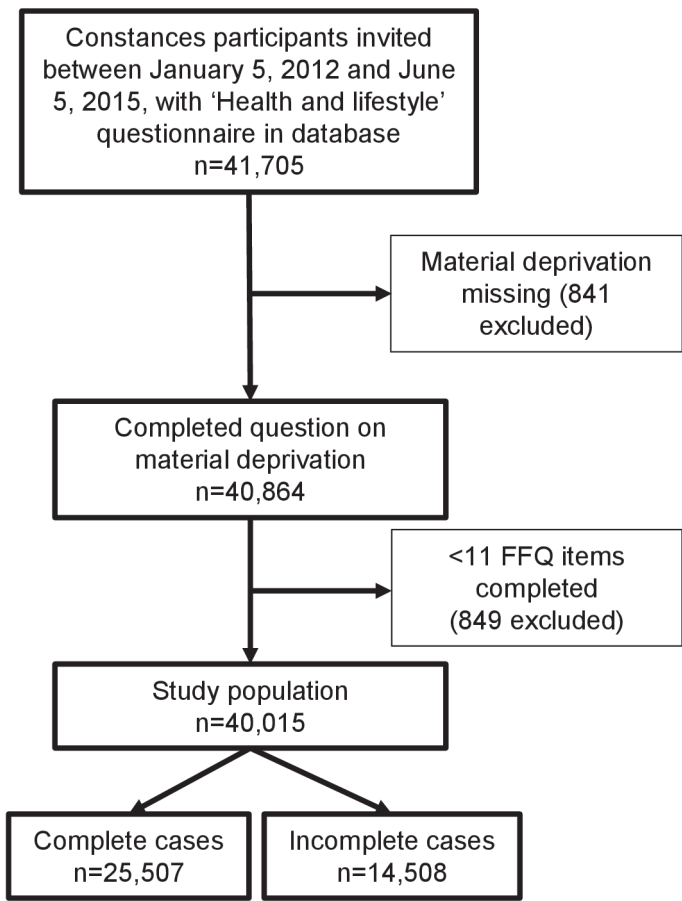
11 **Additional files: Online resources**

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

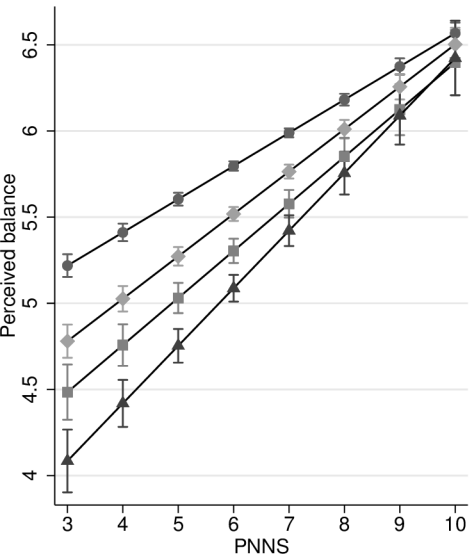
13

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

18



Women



Men

