

1 **Opposites don't attract: high spouse concordance** 2 **for dietary supplement use in the EPIC-Norfolk** 3 **Cohort Study**

4 **ABSTRACT**

5 Objective: Dietary supplements are commonly consumed but may not be beneficial for everyone. It
6 is known that supplement users have healthy behaviour characteristics but until now concordance
7 between spouses living in the same household has not been investigated and concordance may be an
8 important behavioural determinant.

9 Design: Prospective cohort study, cross-sectional data analysis.

10 Setting: European Prospective Investigation into Cancer in Norfolk (EPIC-Norfolk, UK),
11 recruitment between 1993 and 1998.

12 Subjects: Married (or living as married) participants sharing a household, who attended a health
13 examination and completed a 7-day diet diary, were included in the analysis (N= 11 060). The age
14 range was 39-79 years.

15 Results: Nearly 75% of the households in EPIC-Norfolk were concordant in their supplement use,
16 with 46.7% not using supplements and 27.0% using supplements. Concordance increased with age;
17 the percentage of concordant couples varied less by other socio-demographics. Participants who
18 had a spouse who used a supplement were nearly 9 times more likely to use a supplement
19 (unadjusted). Depending on participant's sex and type of supplement used, odds ratios for
20 'Supplement use by spouse' in the prediction of participant's supplement use, varied between 6.2-
21 11.7 adjusted for participant's age, smoking status, BMI, social class, education level and physical
22 activity.

23 Conclusions: 'Supplement use by spouse' is an independent and the strongest predictor of
24 participant's supplement use. This phenomenon can be useful in the design of studies and health
25 interventions; or, when assessing risk of excessive intake from dietary supplements.

26 **INTRODUCTION**

27 In EPIC-Norfolk, dietary supplements were reported by 44.8% of women and 31.7% of men in their
28 7 day Diet Diary (7dDD)⁽¹⁾, of which cod liver oil was the most commonly consumed supplement⁽²⁾.
29 Studies in the UK have identified the characteristics of supplement users (SU) and found that SU
30 are more likely to have a normal weight, a higher social class and show more health conscious
31 behaviour⁽³⁻⁵⁾. They have focussed on the SU as an individual; however people sharing a household
32 could influence each other's behaviour, as has been shown for other types of behaviours, such as
33 smoking⁽⁶⁾. Concordance in the choice of using a supplement might partly explain why not all SU
34 consistently show healthy behaviours; their spouse might have influenced them without the SU
35 showing the known characteristics of a SU.

36 A UK survey among health conscious women aged 33-72 years⁽⁴⁾, applied the theory of planned
37 behaviour to analyse why women took dietary supplements⁽⁷⁾. This study found that participants
38 rated family and health experts with the same intensity of normative beliefs regarding supplement
39 use, defined as "perception of whether specific significant others believe you should perform the
40 behaviour or not"⁽⁷⁾. A 'significant other' could be a spouse. A study investigating Complementary
41 Alternative Medicine (CAM) use amongst women with a median of four years since breast cancer
42 diagnosis, reported 15% more use of CAM (of which dietary supplement use is considered one)
43 among their spouses *vs.* women who were not using CAM themselves⁽⁸⁾.

44 There are two reasons why understanding more about spouse concordance is important. Firstly,
45 health interventions encouraging or discouraging supplement use in a specific group could affect
46 the nutritional status or risk of overdosing of people outside the intervention group. Conversely,
47 spouse concordance in supplement use could be useful in health interventions to strengthen a
48 message⁽⁶⁾.

49 In the Norfolk based European Prospective Investigation into Cancer (EPIC-Norfolk), we found
50 stronger associations for women than for men between supplement use and BMI and season, as well
51 as conflicting results between men and women for socio-demographic variables such as age,
52 education and marital status (unpublished results). Therefore, we set out to find what level of
53 concordance exists in SU in a large population of men and women. In this paper we hypothesise
54 that spouses influence each other's choices in using dietary supplements. We studied the existence
55 of concordance and discordance in supplement use and how this relates to other known socio-
56 demographic variables in order to understand the relative importance between spouse concordance,
57 other participants' characteristics and supplement use.

58 **METHODS**

59 **Study design**

60 EPIC-Norfolk is a prospective cohort study based in East-Anglia (UK) which started recruitment in
61 1993 (up to 1998) to investigate risk factors for chronic diseases, such as cancer and cardio-vascular
62 diseases⁽⁹⁾. Men and women, recruited from 35 general practitioners' clinics, aged between 39-79
63 years, completed an informed consent and a health and lifestyle questionnaire. This questionnaire
64 provided information on marital status ('single', 'married or living as married', 'widowed',
65 'separated', 'divorced'); current or past occupation, from which social class was derived according
66 to the Registrar General's occupation-based classification scheme; highest education level obtained
67 (categorised into: no qualifications, A-level, O-level or Degree/equivalent); smoking status (current,
68 former or never; derived from two questions: "Have you ever smoked as much as one cigarette a
69 day for as long as a year?" and "Do you smoke cigarettes now?") and self-reported physical
70 activity, from which a validated four point score of work-related and leisure time activity was
71 compiled⁽¹⁰⁾. A health examination was attended by 25639 participants at their general
72 practitioner's clinic. A trained nurse measured height (cm) and weight (kg), with participants
73 wearing light clothing and no shoes.

74 **Supplement use**

75 Dietary supplements were defined according to the EU directive 2002/46/EC: "foodstuffs the
76 purpose of which is to supplement the normal diet and which are concentrated sources of nutrients
77 or other substances with a nutritional or physiological effect, alone or in combination, marketed in
78 dose form..." During the health examination, participants were given a 7dDD which measured
79 dietary supplement use by asking "Please name any vitamins, minerals or other food supplements
80 taken on each day of last week"⁽²⁾. Participants recording one or more supplements taken on at least
81 one diary day were considered supplement users (SU). Participants who mentioned medication, *e.g.*
82 ferrous sulphate or prescribed calcium, without further use of dietary supplements, were defined as
83 non-supplement users (NSU). Since cod liver oil (CLO) is the most commonly consumed
84 supplement in the UK and nearly 25% in EPIC-Norfolk consumes CLO⁽²⁾, participants who
85 consumed CLO or fish oil supplements, with or without other types of supplements, were grouped
86 as a separate category of SU (SU+CLO) to partly account for heterogeneity among SU^(11,12).

87 **Household identification**

88 Participants sharing the same address were identified by their surname and postal address at the
89 time of recruitment; the same addresses were given the same household-ID, leaving 15 956
90 participants eligible (7978 households). Participants who (a) both attended a health examination

91 (86.7% of 15 956), (b) were living in a household where both EPIC-participants were married (or
92 living as married) (98.3%), and (c) went on to complete their 7dDD including the supplement
93 question (92.3%), were included for this analysis (N=11 060). The age range of this sample was
94 39-79 years; mean (SD) age among men was 61.1 (8.4) years and among women 58.5 (8.3) years.

95 **Statistical analysis**

96 Analyses were sex-stratified for observations to be uncorrelated, unless households rather than
97 participants were the denominator. We use the term ‘spouse concordance’ to refer to agreement in
98 supplement use, although not all couples were married. The percentages of participants that were
99 concordant in supplement use, *i.e.* where both members took supplements or both did not take
100 supplements, are given for each stratum of the socio-demographic variables for which we wanted to
101 test the associations with supplement use. For equal presentation purposes, continuous variables,
102 such as age, body mass index (BMI, kg/m²) and month of 7dDD completion were grouped.
103 Differences in socio-demographic variables between SU+CLO, SU-CLO and NSU, as well as
104 spouse concordance, were tested using the Chi-squared statistic. Supplement use, as a categorical
105 variable with three categories (NSU, SU+CLO, SU-CLO), was then used as the dependent variable
106 in multinomial logistic regression with ‘Supplement use by spouse’ as a predictor, including all the
107 socio-demographic variables from Table 1. Participants for whom one or more variables were
108 missing were removed from the regression analysis (2%). Statistical analysis was performed using
109 SPSS v21. P-values below 0.05 were considered statistically significant.

110 **RESULTS**

111 Of the 11 060 participants, 4445 (40.2%) were SU; 34.6% among men and 45.7% among women.
112 In the 5530 households, nearly 75% were concordant in their supplement use, with 46.7% not using
113 supplements, *i.e.* both NSU, and 27.0% using supplements, *i.e.* both SU.

114 Concordance in supplement use was significantly higher among daily SU *vs.* non-daily SU (women
115 only) and for those consuming multiple supplements *vs.* single SU (Table 1). Concordance in
116 supplement use significantly increased with age in both sexes. A higher BMI among women was
117 associated with increased concordance in supplement use, but less concordance among men. The
118 column marked ‘sole SU’, shows the percentage of men/women who used a supplement, when their
119 spouse did not. For all participants’ characteristics, in all strata, this percentage was higher among
120 women. For age and social class the trends for men and women were opposite. For example,
121 where among women sole supplement use increased with increasing social class, for men, this
122 percentage decreased. And where for men physical activity had no association with sole
123 supplement use, for women, more physical activity was associated with more sole supplement use.

124 The odds of the participant being a SU were higher among women than men, irrespective whether
125 the spouse was a SU or NSU (Figure 1). The odds of using a supplement were higher among
126 participants whose spouses were SU. The OR was 8.86 (95% CI: 7.78-10.09), indicating that
127 participants with a spouse who used supplements were nearly 9 times more likely to be a SU than
128 participants whose spouse was a NSU.

129 All socio-demographic variables from Table 1 were entered one by one into a multinomial logistic
130 regression model (SU+CLO vs. NSU; SU-CLO vs. NSU); sex stratified results are presented in
131 Table 2. The OR for 'Supplement use by spouse' attenuated only slightly after inclusion of all other
132 socio-demographic variables. Having a spouse who used supplements was the strongest predictor
133 for both SU+CLO and SU-CLO groups in both sexes, followed at some distance by current
134 smoking. Binary logistic regression, where only SU+CLO and SU-CLO were included, confirmed
135 these differences between the two SU-groups and also found 'supplement use by spouse' to be
136 significantly different.

137 The model without 'supplement use by spouse' (data not shown) showed small differences for age
138 among women (OR SU+CLO 1.08, 95% CI 1.04-1.13; OR SU-CLO 0.94, 95% CI 0.90-0.98), a
139 stronger association with social class in men (OR SU-CLO 0.66, 95% CI 0.53-0.81) and a stronger
140 association for education in women (OR SU-CLO 0.76; 95% CI 0.65-0.89) compared to Table 2.
141 This indicates that 'partner supplement use' was not a strong confounder for these variables that are
142 known to be associated with supplement use.

143 **DISCUSSION**

144 Spouse concordance in supplement use was 73.7%, with increased age being strongly associated
145 with increased concordance. The strongest predictor for dietary supplement use was supplement
146 use of a spouse. This factor was stronger for participants consuming CLO supplements vs. non-
147 CLO supplements.

148 The associations between dietary supplement use and socio-demographics found in studies in the
149 UK^(3,4) and other countries⁽¹²⁻¹⁴⁾, were also found in this sub-cohort of spouses in the EPIC-Norfolk
150 study. This study was able to include 'supplement use by spouse' and found it to have the strongest
151 association with dietary supplement use compared to known characteristics of SU, while minimally
152 changing the association between the other socio-demographic variables and supplement use.

153 The positive association found for increased age and spouse concordance has been described by
154 others as concordance due to cohabitation⁽⁶⁾. In our study, being older independently increased
155 supplement use among men (more strongly for CLO than for non-CLO supplements), and decreased

156 the odds for non-CLO use in women. Assuming that age is correlated with the number of years of
157 marriage, and hence length of cohabitation, we assumed the correlation between age and
158 supplement use to increase after ‘supplement use by spouse’ was excluded from the model;
159 however, the ORs for age were minimally affected. Positive assortative mating, defined as ‘the
160 tendency of individuals to choose a spouse with similar characteristics’⁽⁶⁾, could explain the slight
161 attenuation seen for social class and education level with inclusion of ‘supplement use by spouse’.
162 Although even in the fully adjusted model ‘supplement use by spouse’ remained the strongest
163 predictor, we cannot rule out residual confounding.

164 Strengths of this analysis included the detailed recording of supplement use⁽²⁾, as well as detailed
165 assessment of socio-demographic characteristics⁽⁹⁾. We were able to identify over 5500 households
166 in this free living UK cohort, which apart from a lower smoking prevalence, represents the UK
167 population between 40-79 years old reasonably well⁽⁹⁾. The analysis described here, was -by
168 design- restricted to a sub-cohort which can be considered a selective group of participants,
169 considering both participants were willing to participate in a long-term prospective study.
170 Compared to the cohort, the mean age among men in this subset increased by 2 years (Supplement
171 Table 1), which might explain the 3% increase in supplement use. The proportion of SU among
172 women was only 1% higher compared to the whole cohort. Smoking was approximately 3% less
173 prevalent in both men and women, and might be indicative of more similar health related
174 behaviours among these spouses overall and hence could have overestimated the spouse
175 concordance for supplement use found in this study. Weaknesses of this analysis include that only
176 ‘supplement use by spouse’ in EPIC-Norfolk could be assessed; however, other relations/resources
177 (such as magazines, health professionals and friends) exist that can influence beliefs relating to
178 supplement use⁽⁷⁾. Alternatively, other motives for using supplements, such as prevalent illness or
179 health concerns, were not taken into account in this analysis, but are known to influence specific
180 types of supplements^(15,16).

181 The sequence of who in the household started with the use of supplements remains unknown.
182 Future studies would benefit from not only requesting supplement information from the participant,
183 but also establishing whether any of the other household members used supplements; as well as
184 asking who first commenced use, since this additional information will help to identify different
185 motivations and characteristics of SU and could aid the development of health interventions and
186 risk assessment.

187 **CONCLUSION**

188 'Supplement use by spouse' was the strongest predictor of participant's supplement use and hence
189 can be of importance when developing public health messages to encourage or discourage
190 supplement use since the nutritional status of people beyond the SU could be affected.

191 **REFERENCES**

- 192 1. Lentjes MAH, Welch AA, Luben RN, et al. (2013) Differences in dietary supplement use and secular and
193 seasonal trends assessed using three different instruments in the EPIC-Norfolk population study. *J. Diet. Suppl.*
194 **10**, 142–51.
- 195 2. Lentjes MAH, Bhaniani A, Mulligan AA, et al. (2011) Developing a database of vitamin and mineral
196 supplements (ViMiS) for the Norfolk arm of the European Prospective Investigation into Cancer (EPIC-
197 Norfolk). *Public Health Nutr.* **14**, 459–71.
- 198 3. Harrison RA, Holt D, Pattison DJ, et al. (2004) Are those in need taking dietary supplements? A survey of 21
199 923 adults. *Br. J. Nutr.* **91**, 617–23.
- 200 4. Kirk SF, Cade JE, Barrett JH, et al. (1999) Diet and lifestyle characteristics associated with dietary supplement
201 use in women. *Public Health Nutr.* **2**, 69–73.
- 202 5. McNaughton SA, Mishra GD, Paul AA, et al. (2005) Supplement use is associated with health status and
203 health-related behaviors in the 1946 British birth cohort. *J. Nutr.*, 1782–1789.
- 204 6. Di Castelnuovo A, Quacquarello G, Donati MB, et al. (2009) Spousal concordance for major coronary risk
205 factors: a systematic review and meta-analysis. *Am. J. Epidemiol.* **169**, 1–8.
- 206 7. Conner M, Kirk SF, Cade JE, et al. (2001) Why do women use dietary supplements? The use of the theory of
207 planned behaviour to explore beliefs about their use. *Soc. Sci. Med.*, 621–33.
- 208 8. McLay JS, Stewart D, George J, et al. (2012) Complementary and alternative medicines use by Scottish women
209 with breast cancer. What, why and the potential for drug interactions? *Eur. J. Clin. Pharmacol.* **68**, 811–9.
- 210 9. Day N, Oakes S, Luben R, et al. (1999) EPIC-Norfolk: study design and characteristics of the cohort. European
211 Prospective Investigation of Cancer. *Br. J. Cancer* **80 Suppl 1**, 95–103.
- 212 10. Wareham NJ, Jakes RW, Rennie KL, et al. (2003) Validity and repeatability of a simple index derived from the
213 short physical activity questionnaire used in the European Prospective Investigation into Cancer and Nutrition
214 (EPIC) study. *Public Health Nutr.* **6**, 407–13.
- 215 11. Denison HJ, Jameson KA, Syddall HE, et al. (2012) Patterns of dietary supplement use among older men and
216 women in the UK: findings from the Hertfordshire Cohort Study. *J. Nutr. Health Aging* **16**, 307–11.
- 217 12. Radimer K, Bindewald B, Hughes J, et al. (2004) Dietary supplement use by US adults: data from the National
218 Health and Nutrition Examination Survey, 1999-2000. *Am. J. Epidemiol.* **160**, 339–49.
- 219 13. Bailey RL, Gahche JJ, Lentino C V, et al. (2011) Dietary supplement use in the United States, 2003-2006. *J.*
220 *Nutr.* **141**, 261–6.
- 221 14. Touvier M, Kesse E, Volatier J-L, et al. (2006) Dietary and cancer-related behaviors of vitamin/mineral dietary
222 supplement users in a large cohort of French women. *Eur. J. Nutr.* **45**, 205–14.
- 223 15. Satia-Abouta J, Kristal AR, Patterson RE, et al. (2003) Dietary supplement use and medical conditions: the
224 VITAL study. *Am. J. Prev. Med.* **24**, 43–51.
- 225 16. Bailey RL, Gahche JJ, Miller PE, et al. (2013) Why US adults use dietary supplements. *JAMA Intern. Med.* **173**,
226 355–61.

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Table 1: Characteristics of supplement users and spouse concordance among married (or living as married) participants sharing a household in EPIC-Norfolk (N=11 060).

Participant's characteristic	Men				Concordant SU/NSU N/N (%)	Women				Concordant SU/NSU N/N (%)
	NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)		NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)	
Frequency supplement										
Daily	n/a	1250 (73.2)	458 (26.8)	370 (21.7)	1338/0 (78.3)	n/a	1354 (61.4)	853 (38.6)	880 (39.9)	1327/0 (60.1)
Non daily	n/a	130 (62.5)	78 (37.5)	51 (24.5)	157/0 (75.5)	n/a	170 (52.8)	152 (47.2)	154 (47.8)	168/0 (52.2)
			<i>P</i> <0.001 ^a		<i>P</i> <0.348 ^b			<i>P</i> <0.003		<i>P</i> <0.001
Number of supplements										
Single (one)	n/a	859 (69.4)	379 (30.6)	334 (27.0)	904/0 (73.0)	n/a	804 (55.4)	646 (44.6)	681 (47.0)	769/0 (53.0)
Multiple	n/a	521 (76.8)	157 (23.2)	87 (12.8)	591/0 (87.2)	n/a	720 (66.7)	359 (33.3)	353 (32.7)	726/0 (67.3)
			<i>P</i> <0.001		<i>P</i> <0.001			<i>P</i> <0.001		<i>P</i> <0.001
Age										
<=50 years	561 (75.4)	105 (14.1)	78 (10.5)	44 (5.9)	139/382 (70.0)	694 (57.5)	247 (20.5)	266 (22.0)	279 (23.1)	234/614 (70.3)
>50-60 years	1210 (67.9)	400 (22.4)	172 (9.7)	135 (7.6)	437/808 (69.9)	1048 (52.9)	559 (28.2)	374 (18.9)	414 (20.9)	519/892 (71.2)
>60-70 years	1335 (61.9)	614 (28.5)	208 (9.6)	162 (7.5)	660/995 (76.7)	1024 (53.7)	583 (30.6)	300 (15.7)	282 (14.8)	601/872 (77.2)
>70 years	508 (60.0)	261 (30.8)	78 (9.2)	80 (9.4)	259/395 (77.2)	235 (54.0)	135 (31.0)	65 (14.9)	59 (13.6)	141/202 (78.9)
			<i>P</i> <0.001		<i>P</i> <0.001			<i>P</i> <0.001		<i>P</i> <0.001
Social class^c										
Professional	290 (67.4)	93 (21.6)	47 (10.9)	25 (5.8)	115/196 (72.3)	210 (51.9)	104 (25.7)	91 (22.5)	86 (21.2)	109/186 (72.8)
Managerial	1360 (63.7)	529 (24.8)	247 (11.6)	168 (7.9)	608/973 (74.0)	1075 (53.9)	526 (26.4)	393 (19.7)	360 (18.1)	559/933 (74.8)
Skilled non-manual	456 (63.3)	188 (26.1)	76 (10.6)	45 (6.3)	219/306 (72.9)	465 (50.5)	294 (31.9)	162 (17.6)	179 (19.4)	277/390 (72.4)

Participant's characteristic	Men				Concordant		Women			
	NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)	SU/NSU N/N (%)	NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)	Concordant SU/NSU N/N (%)
Skilled manual	912 (67.3)	343 (25.3)	101 (7.4)	114 (8.4)	330/668 (73.6)	719 (56.1)	356 (27.8)	207 (16.1)	242 (18.9)	321/614 (72.9)
Semi-skilled	464 (66.4)	181 (25.9)	54 (7.7)	53 (7.6)	182/345 (75.4)	400 (56.7)	190 (26.9)	116 (16.4)	128 (18.1)	178/343 (73.8)
Non-skilled	98 (69.0)	36 (25.4)	8 (5.6) <i>P</i> <0.003	14 (9.9)	30/68 (69.0) <i>P</i> <0.638	94 (60.6)	33 (21.3)	28 (18.1) <i>P</i> <0.003	27 (17.4)	34/80 (73.5) <i>P</i> <0.758
Level of education										
Degree	539 (66.9)	181 (22.5)	86 (10.7)	59 (7.3)	208/400 (75.4)	311 (58.1)	119 (22.2)	105 (19.6)	94 (17.6)	130/275 (75.7)
A-level	1632 (64.2)	643 (25.3)	267 (10.5)	195 (7.7)	715/1136 (72.8)	943 (50.0)	533 (28.3)	410 (21.7)	377 (20.0)	566/805 (72.7)
O-level	293 (64.8)	112 (24.8)	47 (10.4)	32 (7.1)	127/194 (71.0)	360 (55.2)	166 (25.5)	126 (19.3)	123 (18.9)	169/307 (73.0)
No qualifications	1150 (66.5)	444 (25.7)	136 (7.9) <i>P</i> <0.054	135 (7.8)	445/850 (74.6) <i>P</i> <0.162	1387 (56.5)	706 (28.7)	364 (14.8) <i>P</i> <0.001	440 (17.9)	630/1193 (74.2) <i>P</i> <0.464
Smoking^c										
Never	1170 (64.2)	456 (25.0)	197 (10.8)	133 (7.3)	520/812 (73.1)	1782 (53.3)	941 (28.1)	620 (18.5)	617 (18.5)	944/1537 (74.2)
Former	2030 (64.1)	833 (26.3)	302 (9.5)	263 (8.3)	872/1471 (74.0)	876 (52.4)	476 (28.5)	319 (19.1)	334 (20.0)	461/743 (72.1)
Current	395 (77.8)	82 (16.1)	31 (6.1) <i>P</i> <0.001	23 (4.5)	90/281 (73.0) <i>P</i> <0.722	319 (68.0)	91 (19.4)	59 (12.6) <i>P</i> <0.001	71 (15.1)	79/278 (76.1) <i>P</i> <0.122
Physical activity										
Inactive	1211 (69.4)	383 (21.9)	151 (8.7)	124 (7.1)	410/882 (74.0)	924 (61.2)	374 (24.8)	213 (14.1)	223 (14.8)	364/791 (76.4)
Moderately inactive	853 (62.1)	381 (27.7)	140 (10.2)	108 (7.9)	413/593 (73.2)	969 (51.7)	557 (29.7)	348 (18.6)	364 (19.4)	541/836 (73.5)
Moderately active	828 (64.2)	326 (25.3)	135	98 (7.6)	363/603 (74.9)	662 (51.4)	358 (27.8)	269	257	370/567 (72.7)

Participant's characteristic	Men NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)	Concordant SU/NSU N/N (%)	Women NSU N (%)	SU+CLO N (%)	SU-CLO N (%)	Sole SU N (%)	Concordant SU/NSU N/N (%)
Active	722 (64.3)	290 (25.8)	110 (9.8)	91 (8.1)	309/502 (72.2)	446 (52.1)	235 (27.5)	175 (20.4)	190 (22.2)	220/386 (70.8)
			(10.5)					(20.9)	(19.9)	
			<i>P</i> <0.002		<i>P</i> <0.483			<i>P</i> <0.001		<i>P</i> <0.016
Start 7dDD										
Spring (Mar-May)	930 (65.7)	355 (25.1)	130 (9.2)	96 (6.8)	389/692 (76.4)	778 (54.8)	415 (29.2)	228 (16.0)	252 (17.7)	391/671 (74.7)
Summer (Jun-Aug)	904 (65.4)	345 (25.0)	133 (9.6)	105 (7.6)	373/648 (73.9)	793 (56.0)	365 (25.8)	257 (18.2)	240 (17.0)	382/684 (75.3)
Autumn (Sep-Nov)	940 (66.9)	329 (23.4)	136 (9.7)	105 (7.5)	360/657 (72.4)	742 (53.0)	382 (27.3)	277 (19.8)	289 (20.6)	370/641 (72.2)
Winter (Dec-Feb)	840 (63.6)	351 (26.4)	137 (10.3)	115 (8.7)	373/583 (72.0)	688 (53.2)	362 (28.0)	243 (18.8)	253 (19.6)	352/584 (72.4)
			<i>P</i> <0.562		<i>P</i> <0.035			<i>P</i> <0.105		<i>P</i> <0.133
BMI^c										
<=20 kg/m²	34 (73.9)	6 (13.0)	6 (13.0)	2 (4.3)	10/26 (78.3)	81 (51.6)	41 (26.1)	35 (22.3)	34 (21.7)	42/67 (69.4)
>20-25 kg/m²	1100 (63.0)	457 (26.2)	189 (10.8)	129 (7.4)	517/782 (74.4)	1137 (51.0)	628 (28.2)	464 (20.8)	461 (20.7)	631/978 (72.2)
>25-30 kg/m²	1954 (64.4)	788 (26.0)	294 (9.7)	243 (8.0)	839/1387 (73.3)	1225 (54.6)	644 (28.7)	375 (16.7)	401 (17.9)	618/1053 (74.5)
>30 kg/m²	520 (74.8)	129 (18.6)	46 (6.6)	47 (6.8)	128/381 (73.2)	553 (62.0)	209 (23.4)	130 (14.6)	136 (15.2)	203/477 (76.2)
			<i>P</i> <0.001		<i>P</i> <0.744			<i>P</i> <0.001		<i>P</i> <0.052

SU, supplement user; sole SU, participant is the only SU in the household; NSU, non-supplement user; SU+CLO, cod liver oil supplement user; SU-CLO, supplement user who does not consume cod liver oil.

^a Chi-squared test: testing the hypothesis that there is no difference between SU+CLO, SU-CLO and NSU regarding the socio-demographic variables.

^b Chi-squared test: testing the hypothesis that there is no difference between concordant and discordant spouses regarding the socio-demographic variables.

^c Because of missing values, the numbers do not add up to 11,060.

1 **Table 2: Adjusted OR of using CLO or non-CLO supplements compared to not using a supplement at all in 10 855^a married (or living as**
 2 **married) participants sharing a household in the EPIC-Norfolk cohort study.**

	MEN				WOMEN							
		%	SU+CLO vs. NSU	95% CI	SU-CLO vs. NSU	95% CI		%	SU+CLO vs. NSU	95% CI	SU-CLO vs. NSU	95% CI
	5446		1362 (25.0%)		526 (9.7%)		5409		1486 (27.5%)		989 (18.3%)	
Concordance												
Spouse is NSU	2956	54.3	Ref		Ref		3528	65.2	Ref		Ref	
Spouse is SU	2490	45.7	9.85	8.45- 11.48	7.31	5.92- 9.03	1881	34.8	11.70	10.06- 13.60	6.15	5.21- 7.26
Age (per 5 years)	5446		1.26	1.21-1.32	1.07	1.01- 1.14	5409		1.00	0.96-1.05	0.89	0.84- 0.93
BMI (per 4 units)	5446		0.85	0.77-0.93	0.80	0.71- 0.91	5409		0.89	0.83-0.95	0.85	0.78- 0.91
Social class ^b												
Non-Manual	3263	59.9	Ref		Ref		3290	60.8	Ref		Ref	
Manual	2183	40.1	1.14	0.97-1.33	0.71	0.57- 0.88	2119	39.2	0.95	0.82-1.11	0.88	0.75- 1.04
Education level												
Some qualification ^c	3752	68.9	Ref		Ref		3031	56.0	Ref		Ref	
No qualification	1694	31.1	0.97	0.82-1.14	0.88	0.69- 1.11	2378	44.0	1.08	0.93-1.26	0.80	0.68- 0.94
Smoking												
Never	1810	33.2	Ref		Ref		3290	60.8	Ref		Ref	
Former	3134	57.5	1.04	0.89-1.21	0.99	0.80- 1.22	1660	30.7	1.06	0.91-1.24	1.13	0.96- 1.34
Current	502	9.2	0.52	0.39-0.70	0.51	0.34- 0.78	459	8.5	0.61	0.46-0.80	0.59	0.44- 0.81

Physical activity^d											
Active	2379	43.7	Ref		Ref		2113	39.1	Ref		Ref
Inactive	3067	56.3	0.84	0.72-0.97	0.83	0.68-1.01	3296	60.9	0.91	0.78-1.06	0.81 0.69-0.95
Season											
Summer (Apr-Sep)	2702	49.6	Ref		Ref		2721	50.3	Ref		Ref
Winter (Oct-Mar)	2744	50.4	1.04	0.90-1.19	1.15	0.94-1.39	2688	49.7	1.11	0.96-1.28	1.17 1.01-1.37

3 OR, odds ratio; CI, confidence interval; SU+CLO, cod liver oil supplement user; SU-CLO, supplement user who does not consume cod liver oil

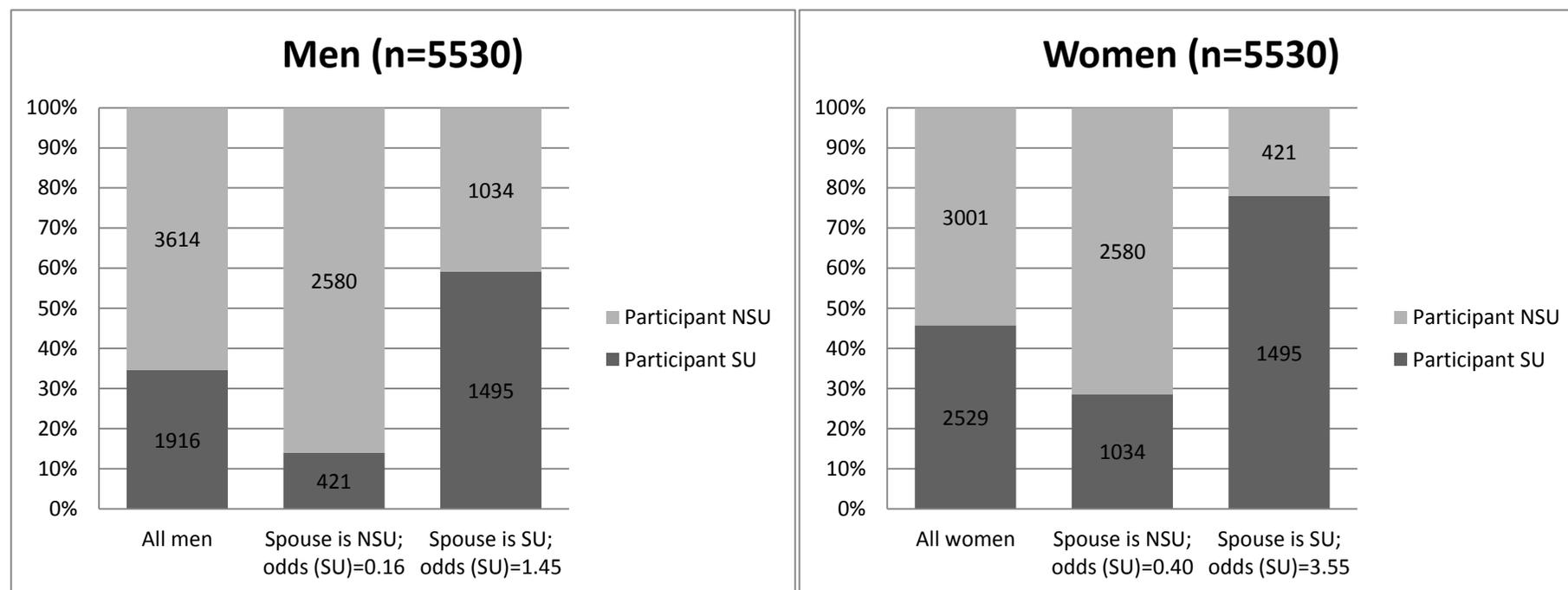
4 ^a Participants with complete variable data (listwise) were included in the analysis (98%).

5 ^b Some qualification takes the summed categories of A-level, O-level and Degree.

6 ^c Manual takes the summed categories of: skilled manual, semi-skilled and non-skilled. Non-manual takes the summed categories of: professional, managerial and skilled non-
7 manual.

8 ^d Active takes the summed categories of active and moderately active. Inactive contains the categories inactive and moderately inactive.

9 **Figure 1: Dietary supplement use in the EPIC-Norfolk cohort study, by spouse's supplement use (N=11 060).**



10

11 SU, supplement user, NSU, non-supplement user.

12 **Supplement Table 1: Comparison of household sample to all men and women in EPIC-**
 13 **Norfolk who attended the first health examination.**

Participant's characteristic	MEN		WOMEN	
	Attended health examination N (%)	Sample N (%)	Attended health examination N (%)	Sample N (%)
Dietary supplement use	10,241	5530	12,779	5530
NSU	6991 (68.3)	3614 (65.4)	7048 (55.2)	3001 (54.3)
SU	3250 (31.7)	1916 (34.6)	5731 (44.8)	2529 (45.7)
Age	11,607	5530	14,032	5530
<=50 years	2707 (23.3)	744 (13.5)	3652 (26.0)	1207 (21.8)
>50-60 years	3596 (31.0)	1782 (32.2)	4430 (31.6)	1981 (35.8)
>60-70 years	3635 (31.3)	2157 (39.0)	4163 (29.7)	1907 (34.5)
>70 years	1669 (14.4)	847 (15.3)	1787 (12.7)	435 (7.9)
Mean (SD) Age	59.1 (9.3)	61.1 (8.4)	58.4 (9.3)	58.5 (8.3)
Mean (SD) BMI	26.5 (3.3)	26.5 (3.2)	26.2 (4.4)	26.2 (4.2)
Social class ^a	11,400	5483	13,667	5463
Manual	4743 (41.6)	2197 (40.1)	5274 (38.6)	2143 (39.2)
Non-manual	6657 (58.4)	3286 (59.9)	8393 (61.4)	3320 (60.8)
Level of education ^b	11,598	5530	14,023	5530
Some qualifications	8064 (69.5)	3800 (68.7)	8103 (57.8)	3073 (55.6)
No qualifications	3534 (30.5)	1730 (31.3)	5920 (42.2)	2457 (44.4)
Smoking	11,526	5496	13,893	5483
Never	3837 (33.3)	1823 (33.2)	7837 (56.4)	3343 (61.0)
Former	6284 (54.5)	3165 (57.6)	4477 (32.2)	1671 (30.5)
Current	1405 (12.2)	508 (9.2)	1579 (11.4)	469 (8.6)
Physical activity	11,597	5530	14,023	5530
(Moderately) inactive	6435 (55.5)	3119 (56.4)	8761 (62.5)	3385 (61.2)
(Moderately) active	5162 (44.5)	2411 (43.6)	5262 (37.5)	2145 (38.8)

14 SU, supplement user, NSU, non-supplement user.

15 ^a Manual takes the summed categories of: skilled manual, semi-skilled and non-skilled. Non-manual takes the
 16 summed categories of: professional, managerial and skilled non-manual.

17 ^b Some qualification takes the summed categories of A-level, O-level and Degree.