1   **Predictive associations between lifestyle behaviours and dairy consumption: the**

2   **IDEFICS study**

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36

37   **Abstract**

38

39   **Background:** Physical activity (PA) and sedentary behaviours (SB) are related with
40   obesity and cardio-metabolic risk, however the literature is controversial regarding the
41   effect of dairy consumption on the development of cardiovascular diseases (CVD) risk
42   factors.

43   **Aim:** To assess longitudinally the relationship between specific lifestyle behaviours (PA
44   and SB) and dairy consumption in a sample of European children and adolescents.

45   **Methods:** Children from the IDEFICS study were included in the analyses. Two
46   measurements, with 2 years' interval, were conducted. 1 688 (50.8% boys) children
47   provided information regarding diet, measured by a 24-hour dietary recall, PA measured
48   by accelerometers, and parental reported sedentary screen time (SST) at both time points.
49   Different combinations of these behaviours, at each survey and over time, were derived
50   applying specific recommendations. Multilevel ordinal logistic regression and analysis of
51   covariance were used to assess their association with dairy consumption, adjusted for
52   potential confounders.

53   **Results:** Differences by gender were found regarding dairy products consumption and
54   also adherence to SB and PA recommendations at T0 and T1. Children meeting both
55   lifestyle recommendations, at both measurements' points, had higher probability to
56   consume more milk and yogurt and less cheese, in comparison with the rest of
57   combinations.

58   **Conclusions:** These results suggest that European children with a healthy lifestyle,
59   specifically regarding PA and SB over time, consumed more milk and yogurt. This study
60   suggests that the protective effect of specific dairy products found in literature could be
61   partially due to the association of their consumption with specific healthy lifestyles.

62

63   **Keywords:** Lifestyle behaviours, dairy consumption, European, children, IDEFICS
64   study, sedentary, physical activity

Introduction

Lifestyle behaviours such as eating patterns and physical activity are associated with cardio-metabolic risk in adolescence (1). Obese children (2) and adolescents (3) are more likely to track their obesity throughout adulthood, and at risk to develop metabolic and cardiovascular diseases later in their life (4). Literature suggest that obesity responds to a multifactorial model regulated by biological, environmental and lifestyle behaviours (5).

Lifestyle behaviours are mainly established during childhood and adolescence, and some of them such as breakfast skipping, lack of physical activity (PA), high levels of screen time and lack of sleep are shown to be associated with overweight and obesity among children (6). Strong evidence does exist for PA in overweight/obesity preschool children, while this evidence is moderate for sedentary behaviours (SB) (6). Some personal, social environmental determinants have also been related with dietary habits (7). Dairy consumption seems to have a role on cardiovascular diseases (CVD) although there is still no clear evidence (8). Results from meta-analyses and systematic reviews suggest that dairy intake seems to have a protective effect against most prevalent diseases: obesity, type 2 diabetes, CVD and some types of cancer (9, 10). A review has shown that yogurt is associated with healthy metabolic profile, dietary patterns and better diet quality (10). In adolescents, dairy consumption has been associated with lower adiposity and lower cardiovascular risk score in adolescent girls (11) and with low cardio-metabolic risk in children (12). However, there is no much information on how other lifestyles, such as physical activity or sedentary behaviours, may influence these associations.

To our knowledge, there are no studies addressing the issue on how children consuming more milk and dairy products are also more physically active and spend less time on sedentary behaviours. Thus, the aim of this study is to assess prospectively association between a combination of lifestyle behaviours (PA and SB), and dairy consumption in a sample of European children.

Material and methods

Study design

Data were obtained from a multi-centre population-based IDEFICS study, including an intervention component, performed in children from eight European countries: Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden. Design and main procedures have been described (13). The baseline survey (T0) was performed between September 2007 and May 2008, and the follow-up survey (T1) was performed between September 2009 and May 2010.

Authorization from the ethic committees was obtained. Parents provided written informed consent. The study was performed according to the ethical guidelines of the Edinburgh revision of the 1964 Declaration of Helsinki (2000).

Study sample

Participating children were aged between 2 to 9 years at the time of recruitment. Only those meeting the overall inclusion criteria (data available on weight, height and parental questionnaire) were included in the overall study (n=16 228 at T0, and n=11 038 at T1, overall response rate of 68%). Out of them, children with complete information from the 24-h dietary recall (24-HDR), accelerometer data and parental reported SB, both at T0 and T1 were included in the current analysis (n= 1 688, 50.8 % boys). Also, they had complete data regarding: gender, age, parental educational level and body mass index (BMI) z-score.

Measurements

Anthropometric measurements at T0 and T1 were performed, following standardized procedures. Body height was measured with a portable stadiometer (SECA 225) while weight was measured with a child-adapted Tanita BC 420 SMA. Sex- and age-BMI z-score (zBMI) according to Cole et al.(14) was calculated. The highest parental education level was used as an indicator of socioeconomic status (SES) and was categorized according to the International Standard Classification of EDucation (ISCED) (15).

Physical activity and sedentary screen time behaviours

128　PA was objectively measured using Actigraph uniaxial accelerometers (ActiTrainer or

129　GT1M; Actigraph, LLC, Pensacola, FL, USA). Accelerometer was placed on the right

130　hip of children. Parents or caregivers had to record the non-wearing time, including water-

131　based activities and bedtime. Data were considered valid when the child wore the

132　accelerometer for three consecutive days (16). The average PA levels were defined

133　according the cut-off values proposed by Evenson (17), minutes per day were calculated.

134　Children with equal or more than 60 minutes/ day of moderate to vigorous PA (MVPA)

135　accomplished the recommendations of PA (18).

136

137　For this study we included the sedentary screen time (SST) derived from the parental

138　reported questionnaire which included the time spent passively watching screen-based

139　entertainment (TV, computer, mobile devices). Information regarding sedentary

140　behaviour derived from accelerometers was not consider due to the difficulty to identify

141　the type of activity. Questions regarding SST were 1) time spent watching TV, videos,

142　and DVDs, and 2) using a computer and or playing videogames on a weekday and a

143　weekend day separately (45). For both questions, six response categories were offered:

144　not at all =0; <30 min =1; 30 min to <1 h =2; 1 to ≤ 2 h =3; 2 to 3 h =4; and >3 h =5.

145　Finally, the average screen time in hours per week was calculated). Children who spend

146　less than 2 hours/ day of screen time accomplished the recommendations for SB (19).

147

148　*Dietary assessment*

149　Dietary and energy intake were assessed with a validate computer based 24-HDR, the

150　SACINA tool ('Self-Administered Children and Infant Nutrition Assessment') (20).

151　Information about type and amount of foods and drinks from the previous day in six meal

152　occasions was recorded by the caregivers with the assistance of trained researchers, using

153　standardized photographs of portions consumptions. In order to maximize the total

154　sample, only one 24-HDR was considered

155　Milk (ml), yogurt (grams) and cheese (grams) were considered as dairy products, along

156　with their combinations (milk+yogurt and milk+yogurt+cheese).

157

158　*Diet Quality Index (DQI)*

159　The food frequency questionnaire (FFQ) (21) was used to calculate the DQI. The FFQ

160　referred to the previous month and comprised 43 food items within 14 food groups.

161 Responses included 7 frequency categories of consumption: 'never/less than once a
162 week,' '1–3 times/week,' '4–6 times/week,' '1 time/day,' '2 times/day,' '3 times/day'
163 and '4 or more times/day'. Also 'I have no idea' was a possible answer.
164 The DQI was used as a proxy to account for the diet quality, and it was also adapted and
165 validated for adolescents (22). It consists of three components: dietary quality, dietary
166 diversity and dietary equilibrium.
167
168 *Statistical analyses*
169 Mean and standard deviation were calculated for the continuous variables (age, zBMI,
170 DQI) and number of cases and percentages for the categorical variables (age categories,
171 BMI categories, parental education, meeting PA and SP recommendations), stratified by
172 gender and time point. Analysis of variance (ANOVA) and chi-square were used to test
173 differences in the sample. An exploratory linear regression models were applied to assess
174 the association between the DQI (as dependent variable) and the dairy products
175 consumption (as independent variable) in the total sample and for boys and girls
176 separately at T0 and T1. All models were adjusted by age, BMI z-score and SES.
177 Bonferroni analysis was performed to test for multiple comparisons.
178
179 For further statistical analysis, all SST and PA recommendation combinations of, at both
180 T0 and T1, were created. For the ANOVA, all these combinations were linked to each
181 defined dairy product group: milk, yogurt, cheese, milk+yogurt and milk+yogurt+cheese.
182 Adjusted mean values and 95% CI for each dairy product category are presented for each
183 combination of the lifestyle behaviours.
184 Finally, multilevel mixed effect logistic regression (level: country and study region
185 intervention versus control) was applied using as dependent variable the different dairy
186 products at T1 and, as independent variable, the combination of the lifestyle behaviours
187 at T0 and T1. For this analysis, children were assigned to three different categories
188 according to their consumption of the dairy products milk, yogurt, cheese, milk+yogurt,
189 and milk+yogurt+cheese. Non-consumers were assigned to category 0. After that subjects
190 were allocated into two categories, the first and second sex-specific milk-, yogurt-,
191 cheese-, healthy dairy- and overall dairy- tertiles versus the third sex-specific tertile.
192 Children consuming more than 0 but less than the second tertile were assigned to category
193 1 (from 0.01 thru 190 g/day for milk, 49 gr/day for yogurt, 287.5 g/ day for cheese, 149
194 g/day of healthy dairy, and 374 g/day for the overall dairy consumption), and the

195　remaining children were assigned to category 2 ($\geq$ 190 g/day for milk, $\geq$ 50 gr/day for

196　yogurt, $\geq$288 g/ day for cheese, $\geq$150 g/day of healthy dairy, and $\geq$375 g/day for the

197　overall dairy consumption). Odds ratios (OR) and 95% CI were derived to assess the odds

198　of being in one higher category of consumption of dairy products. The following

199　covariates at T1 were included in all the models: age, gender, country, region, SES, BMI

200　z-score, DQI, total energy intake, and the consumption of dairy products in T0. The

201　reference category was defined as meeting the PA and SST recommendations at T0 and

202　at T1. Statistical significance level of α=0.05.

203　Analyses were performed using Statistical Package for the Social Sciences (version 21.0;

204　SPSS, Inc.) and Stata (version 13.0).

Results

Descriptive characteristics are presented in Table 1. There were differences by gender regarding groups based on the recommendations of PA and SST (p<0.001 at T0 and p=0.012).

In the linear regression analysis (supplementary table A), significant associations were found between dairy consumption and DQI, in the total sample, in boys and in girls in both measurement time points. Associations with DQI were found for the milk+yogurt and milk+yogurt+cheese by gender and for both measurement times.

Table 2 presents the mean consumption of dairy products for each combination of PA and SST adequacy at T0 and T1. Male children who met PA and SST recommendations at T0 and not meeting any recommendation at T1 have the highest mean consumption of milk (131,4 g/per day, p<0.001). For cheese, highest mean consumption was observed among children not meeting recommendations at T0 and meeting both recommendations at T1 in males (278.9 g/per day, p=0.005). In males, highest mean consumption (205 g/per day) was found for those meeting both recommendations at both time points (p=0.029). For milk+yogurt, in males, highest mean value in (143.3 g/day, p=0.001) was observed among those meeting both recommendations at T0 and T1. In contrast, male subjects meeting none recommendations at T0 and both recommendations at T1 presented the highest mean consumption for milk+yogurt+cheese (354.08 g/day,-p=0.003).

Table 3 presents the OR and the confidence interval for the consumption of each dairy product with the different children status regarding PA and SST recommendations at T0 and T1, meeting both recommendations at both time points being the references. For milk, the odds of having a higher consumption decreased by 64% when children accomplished none recommendations at T0 and both recommendations at T1, and by 57% when improving the compliance of the recommendations between T0 and T1 or when meeting one of them at T0 and meeting both at T1, in comparison with meeting both recommendations at both time points. The odds of being in the highest category of yogurt consumption decreased by 91% when meeting both recommendations at T0 and none at T1, in comparison with the reference group. Also, the probability of being in the highest category of yogurt consumption decreased when meeting one recommendation in T0 and meeting both recommendations in T1 by a

236 45%. In contrast, probability of a higher consumption of cheese increased by 91% for those
237 who did not meet any recommendation of PA and SST at T0 and one of them at T1. Finally,
238 all combinations of not meeting the recommendations, or meeting only one of them at T0,
239 had significantly lower odds of having a higher consumption of milk+yogurt in comparison
240 with those meeting the PA and SST recommendations over time.
241

Discussion

The main finding of the present study was that meeting lifestyle recommendations for PA and SST was associated with higher milk and yogurt consumption cross-sectionally and over time. Despite a low percentage of children meeting both PA and SST recommendations at both T0 and T1, analysis showed that they were more likely to increase their milk+yogurt consumption in comparison with the other recommendation groups. To the authors' knowledge no previous studies have analysed the prospective and combined effect of PA and SST recommendations in relation with dairy consumption in children.

Dairy products are complex foods that have divergent health effects (10, 23), and their associations with several chronic diseases has attracted much attention (9). The intake of milk and dairy products contributes to meeting nutrient recommendations and may protect against the most prevalent chronic non-communicable diseases (9, 11), whereas very few adverse effects have been reported (24). For instance, in children, a diet rich in milk and dairy products seems to reduce the risk of obesity and, in adults, it improves body composition while yogurt is also associated with a reduced risk of type 2 diabetes (9). In a cross-sectional study in European adolescents, dairy products consumption was associated with a lower adiposity and a higher cardiorespiratory fitness and a lower cardiovascular risk score (11). A very recent review by Thorning et al. reported that although no clear relationship was observed between milk and dairy products consumption and the risk of cardiovascular diseases, an inverse association was found with the risk of hypertension and stroke (9).

For all these reasons, dairy products may therefore be considered as having the potential to reduce the burden of the most prevalent chronic diseases in the population and to substantially reduce the health care costs for society (25). The consumption of dairy could be part of a healthy lifestyle, combined with high levels of PA and low time to SST. In this study, both in males and females, associations between the consumption of the different dairy categories and the DQI both at T0 and T1 were found. For this reason, DQI was included as a covariate in the analyses; the association between lifestyle and dairy products consumption are therefore considered as independent of the overall quality of the diet. Some previous cross-sectional studies reported that girls consuming yogurt had a better dietary composition and higher PA levels (24). Also, yogurt consumption

274 may have a potential role in appetite and glycaemic control, contributing to the regulation
275 of energy metabolism and potentially facilitating weight management (26).

276 There is limited research on the associations between PA and SST and dietary habits.
277 Some studies have analysed the effect of some energy balance related behaviours as PA
278 or sedentarism and their effect on food consumption. Regarding PA levels, in European
279 adolescents from the HELENA study, the most active adolescents reported a high
280 consumption of milk products. Also, those reporting to spend more time in moderate to
281 vigorous PA, consumed less cheese compared to those spending less time in MVPA (27).
282 In the same study, meeting both PA and SST recommendations were associated with the
283 intake of milk and yogurt, but only in boys *(Moradell A et al. Unpublished results)*. Other
284 studies conducted with adolescents showed that those who practice sportive activities
285 almost every day were more likely to consume dairy products than the non-athletic Swiss
286 participants (28).

287 Analysing the relation between SST and dairy consumption, few studies have taken into
288 consideration dairy food types. In European pre-school children, exceeding total screen
289 time recommendations, established at 1 hour per day, was positively associated with
290 increased consumption of sweetened milk (29). In another study, the use of internet
291 during weekends was negatively associated with milk consumption in European
292 adolescents of both genders. In the HELENA adolescents, high TV, computer and internet
293 use were negatively associated with the 'health conscious' dietary pattern, which included
294 milk and milk products consumption (30). In another adolescent sample, from the
295 CASPIAN study, the odds of daily consumption of milk in those who used to spend more
296 than 4 hours per day in screen time activities, were lower than in those with lower screen
297 time (31).

298 To our knowledge, none other study had analysed the combined effect of both PA and
299 SST at the same time and their longitudinal relation with dairy consumption in children.
300 In our sample, differences in individual and collective milk, yogurt and cheese
301 consumption were found in both genders according to the compliance of PA and SST
302 recommendations. These results indicate that a better lifestyle, regarding PA and SST
303 levels, is related with the considered healthy dairy products consumption, i.e. milk and
304 yogurt, in European children.

305 **Strengths and limitations**

306 This study has also some limitations. Data from diet and SB are based on parental-
307 reported questionnaires, thus a social bias must be considered. The youngest children
308 showed a very small proportion of low fat dairy products for these reason differences by
309 fat amount were not considered in the analysis. Although the assessment of energy
310 balance related behaviours has been shown to be difficult and complex in young children
311 diet and SB questionnaires from the IDEFICS study have been tested for reproducibility
312 (16, 21) and the SACINA has been previously validated (20). Also, some measurements
313 as the 24-HDR or accelerometer were optional, which reduced the total sample, along
314 with the longitudinal nature of the study which required that all the information of the
315 children was available at both time points (T0 and T1). In this sense, it's important to
316 note that current results could be influenced by a selection bias related with the
317 participation of the most motivated participants. Also, the IDEFICS study cohort included
318 a large quantity of measurements that could result into fatigue of the participants. Finally,
319 in the present study, the inclusion criteria affected the sample size and this might limit
320 the interpretation of the results.

321 One of the strengths of the study is the broad range of examinations of specific obesity-
322 related behaviours at European level, including children from 2 to 12 years old, and
323 followed during a couple of years with a highly-standardized procedure. The use of
324 accelerometry in this population, which is a objective measurement of PA, is a strength
325 that needs to be taken into account. Finally, the use of the 24-HDR in estimating dairy
326 consumption rather than derived from a FFQ and the use of an objective measure of PA
327 levels give a more detailed information.

328 **Conclusion**

329 This study adds evidence in the field of multiple lifestyle behaviours and their relationship
330 with dairy consumption, specifically with these dairy products considered as healthy:
331 milk and yogurt. These results suggest that the protective effect of dairy products found
332 in literature could also be related to the association of its consumption with a specific
333 lifestyle behaviour. These findings highlight the importance of a healthy lifestyle,
334 regarding PA and SST, and a healthy dietary pattern that could prevent the risk of chronic
335 diseases.

336

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348 **Conflict of interest:** The authors declare that they have no conflict of interest.

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350

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455

456

Table 1. Descriptive characteristics of the study sample included in the analysis.

	T0					T1				
	Males		Females		p	Males		Females		P
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Age (y)	6.07	1.81	6.23	1.79	0.055	8.03	1.83	8.18	1.80	0.082
Age categories	n	%	n	%		n	%	n	%	
2-6y	391	45.6	334	40.2	0.024	155	18.1	139	16.7	0.680
6-9y	466	54.4	497	59.8	0.024	562	65.6	561	67.5	
10-12y	-	-	-	-		140	16.3	131	15.8	
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
zBMI (Cole)	0.403	1.246	0.448	1.109	0.431	0.485	1.278	0.484	1.138	0.980
BMI categories (Cole)	n	%	n	%		n	%	n	%	
Underweight & Normal-weight	674	78.6	646	77.7	0.651	628	73.3	60	73.4	0.953
Overweight& Obese	183	21.4	185	22.3		229	26.7	221	26.6	
Parental education	n	%	n	%		n	%	n	%	
Low	58	6.8	48	5.8	0.549	56	6.6	48	5.8	0.264
Medium	564	65.8	540	45.0		556	65.2	516	62.4	
High	235	27.4	243	49.2		241	28.3	263	31.8	
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
DQI	87.23	18.05	88.68	17.87	0.116	86.24	17.86	89.01	18.20	0.02
Groups based on meet PA and SST										
	n	%	n	%		n	%	n	%	
Meet both recommendations	86	10.0	45	5.4	<0.001	161	18.8	116	14.0	0.012
Do not meet any recommendations	280	32.7	248	29.8		278	32.4	262	31.5	
Meet one of the recommendations	491	57.3	538	64.8		418	48.8	453	54.5	

BMI: body mass index, DQI: diet quality index, PA: physical activity and screen sedentary time (SST).

Table 2. Analysis of variance on the association between changes of physical activity (PA) and sedentary screen time (SST) on milk (T.2.A), yogurt (T.2.B), cheese (T.2.C), combined consumption of milk and yogurt (T.2.D) and combined consumption of milk, yogurt and cheese (T.2.E) at T1

T.2.A. Groups based on meet or not PA& SST recommendations at T0 and T1				**Males** Milk consumption (g/day)				**Females** Milk consumption (g/day)			
Meet PA at T0	**Meet SST at T0**	**Meet PA at T1**	**Meet SST at T1**	**n**	**Mean**	**95% CI**	**p***	**n**	**Mean**	**95% CI**	**p***
Meet both recommendations		Meet both recommendations		42	108.0	63.98;152.09	0.000	16	90.2	42.56;137.91	0.188
Meet both recommendations		Do not meet any recommendations		7	131.4	4.37;258.48		5	75.0	-12.80;162.79	
Meet both recommendations		Meet one of the recommendations		37	96.3	52.35;140.21		24	56.1	10.31;101.88	
Do not meet any recommendations		Meet both recommendations		19	59.2	17.62;100.80		14	20.7	-4.01;45.44	
Do not meet any recommendations		Do not meet any recommendations		163	40.1	20.04;56.14		142	35.1	22.86;47.44	
Do not meet any recommendations		Meet one of the recommendations		98	53.2	31.34;75.08		92	32.6	18.24;46.98	
Meet one of the recommendations		Meet both recommendations		100	56.3	38.51;74.14		86	55.4	32.90;77.97	
Meet one of the recommendations		Do not meet any recommendations		108	43.2	26.99;59.37		115	50.7	33.30;68.04	
Meet one of the recommendations		Meet one of the recommendations		283	45.4	35.14;55.73		337	49.0	38.55;59.54	
T.2.B. Groups based on meet or not PA& SST recommendations at T0 and T1				**Males** Yogurt consumption (g/day)				**Females** Yogurt consumption (g/day)			
Meet PA at T0	**Meet SST at T0**	**Meet PA at T1**	**Meet SST at T1**	**n**	**Mean**	**95% CI**	**p***	**n**	**Mean**	**95% CI**	**p***
Meet both recommendations		Meet both recommendations		42	35.2	18.61;51.87	0.873	16	23.3	8.19;38.50	0.931
Meet both recommendations		Do not meet any recommendations		7	6.7	-9.63;22.94		5	0	0.00;0.00	
Meet both recommendations		Meet one of the recommendations		37	27.6	6.42;48.82		24	10.4	3.22;17.65	
Do not meet any recommendations		Meet both recommendations		19	15.9	0.11;31.73		14	24.8	-1.06;50.64	
Do not meet any recommendations		Do not meet any recommendations		163	21.8	17.79;28.71		142	21.6	13.37;29.89	
Do not meet any recommendations		Meet one of the recommendations		98	28.7	14.43;42.97		92	24.0	13.53;34.53	
Meet one of the recommendations		Meet both recommendations		100	25.6	16.28;35.09		86	20.7	8.74;32.70	
Meet one of the recommendations		Do not meet any recommendations		108	28.2	15.02;41.37		115	22.5	15.38;29.52	
Meet one of the recommendations		Meet one of the recommendations		283	24.7	17.85;31.60		337	20.7	15.95;25.37	
T.2.C. Groups based on meet or not PA& SST recommendations at T0 and T1				**Males** Cheese consumption (g/day)				**Females** Cheese consumption (g/day)			
Meet PA at T0	**Meet SST at T0**	**Meet PA at T1**	**Meet SST at T1**	**n**	**Mean**	**95% CI**	**p***	**n**	**Mean**	**95% CI**	**p***
Meet both recommendations		Meet both recommendations		42	153.2	99.56;212.75	**0.005**	16	205.0	130.22;279.78	**0.029**
Meet both recommendations		Do not meet any recommendations		7	157.1	7.47;306.82		5	105.0	-81.77;291.77	

		n	Mean	95% CI	n	Mean	95% CI
Meet both recommendations	Meet one of the recommendations	37	194.8	120.66;268.87	24	138.0	72.03;204.01
Do not meet any recommendations	Meet both recommendations	19	278.9	192.40;365.49	14	235.4	53.40;417.31
Do not meet any recommendations	Do not meet any recommendations	163	158.3	130.90;185.77	142	136.9	110.464;163.33
Do not meet any recommendations	Meet one of the recommendations	98	237.1	190.09;284.17	92	192.5	155.77;229.16
Meet one of the recommendations	Meet both recommendations	100	238.2	193.40;282.92	86	199.8	159.83;239.69
Meet one of the recommendations	Do not meet any recommendations	108	172.3	131.87;212.83	115	141.7	111.41;171.96
Meet one of the recommendations	Meet one of the recommendations	283	177.8	155.48;200.17	337	150.2	131.77;168.54

T.2.D. **Groups based on meet or not PA& SST recommendations at T0 and T1**				**Males** **Milk and Yogurt consumption (g/day)**				**Females** **Milk and Yogurt consumption (g/day)**		
Meet PA at T0 **Meet SST at T0**		**Meet PA at T1** **Meet SST at T1**	**n**	**Mean**	**95% CI**	**p***	**n**	**Mean**	**95% CI**	**p***
Meet both recommendations		Meet both recommendations	42	143.3	96.7;189.81	**0.001**	16	13.6	67.40;159.75	**0.454**
Meet both recommendations		Do not meet any recommendations	7	138.1	6.48;269.69		5	75.0	-12.79;162.80	
Meet both recommendations		Meet one of the recommendations	37	129.9	72.22;175.59		24	66.5	21.80;111.26	
Do not meet any recommendations		Meet both recommendations	19	75.1	33.49;116.77		14	45.5	8.38;82.62	
Do not meet any recommendations		Do not meet any recommendations	163	61.8	43.34;80.34		142	56.7	42.20;71.23	
Do not meet any recommendations		Meet one of the recommendations	98	81.9	56.22;107.60		92	56.6	39.32;73.95	
Meet one of the recommendations		Meet both recommendations	100	82.0	62.02;102.00		86	76.2	51.44;100.86	
Meet one of the recommendations		Do not meet any recommendations	108	71.4	50.36;92.41		115	73.1	53.34;92.92	
Meet one of the recommendations		Meet one of the recommendations	283	70.2	57.75;82.57		337	69.7	58.23;81.17	

T.2.E. **Groups based on meet or not PA& SST recommendations at T0 and T1**				**Males** **Milk, Yogurt and Cheese consumption (g/day)**				**Females** **Milk, Yogurt and Cheese consumption (g/day)**		
Meet PA at T0 **Meet SST at T0**		**Meet PA at T1** **Meet SST at T1**	**n**	**Mean**	**95% CI**	**p***	**n**	**Mean**	**95% CI**	**p***
Meet both recommendations		Meet both recommendations	42	296.43	232.92;359.93	**0.003**	16	318.6	234.70;402.46	**0.057**
Meet both recommendations		Do not meet any recommendations	7	295.23	30.72;559.74		5	180.0	-78.22;438.22	
Meet both recommendations		Meet one of the recommendations	37	318.67	216.97;420.37		24	204.6	130.89;278.22	
Do not meet any recommendations		Meet both recommendations	19	354.08	267.77;440.39		14	280.9	86.46;475.25	
Do not meet any recommendations		Do not meet any recommendations	163	220.18	186.57;253.79		142	193.6	163.14;224.09	
Do not meet any recommendations		Meet one of the recommendations	98	319.04	264.81;373.27		92	249.1	209.96;288.25	
Meet one of the recommendations		Meet both recommendations	100	320.17	272.24;368.10		86	275.9	230.40;321.42	
Meet one of the recommendations		Do not meet any recommendations	108	243.73	195.96;291.49		115	214.8	176.45;253.18	
Meet one of the recommendations		Meet one of the recommendations	283	247.98	221.34;274.63		337	219.9	197.12;242.60	

*p value: Differences in each dairy consumption (milk, yogurt, cheese, milk+yogurt, and milk+yogurt+cheese) between the nine's PA and SST groups by sex.

Table 3. Multilevel ordinal logistic regression between grouping of meeting or not physical activity (PA) and sedentary screen time (SST) recommendations and the consumption of milk, yogurt, cheese (T.3.A), combined consumption of milk and yogurt, and combined consumption of milk, yogurt and cheese (T.3.B) at T1.*

T.3.A

Groups based on meet or not PA& SST recommendations at T0 and T1			Milk consumption* (g/day)		Yogurt consumption* (g/day)		Cheese consumption* (g/day)	
Meet PA at T0 Meet SST at T0	Meet PA at T1 Meet SST at T1	n	OR	95% CI	OR	95% CI	OR	95% CI
Meet both recommendations	Meet both recommendations	58	Ref	Ref	Ref	Ref	Ref	Ref
Meet both recommendations	Do not meet any recommendations	12	1.33	0.41;4.32	**0.09**	**0.01;0.78**	0.67	0.19;2.38
Meet both recommendations	Meet one of the recommendations	61	0.75	0.35;1.58	0.61	0.30;1.24	1.42	0.68;2.99
Do not meet any recommendations	Meet both recommendations	33	**0.36**	**0.14;0.90**	0.47	0.19;1.12	1.74	0.74;4.09
Do not meet any recommendations	Do not meet any recommendations	305	0.56	0.30;1.05	0.62	0.35;1.09	1.25	0.69;2.27
Do not meet any recommendations	Meet one of the recommendations	190	**0.43**	**0.23;0.82**	0.61	0.34;1.10	**1.91**	**1.04;3.51**
Meet one of the recommendations	Meet both recommendations	186	**0.43**	**0.23;0.79**	**0.55**	**0.31;0.98**	1.82	0.99;3.34
Meet one of the recommendations	Do not meet any recommendations	223	0.71	0.38;1.32	0.76	0.43;1.35	1.17	0.64;2.15
Meet one of the recommendations	Meet one of the recommendations	620	0.58	0.33;1.01	0.63	0.37;1.08	1.46	0.83;2.57

T.3.B

Groups based on meet or not PA& SST recommendations at T0 and T1			Milk and Yogurt consumption* (g/day)		Milk , Yogurt and Cheese consumption* (g/day)	
Meet PA at T0 Meet SST at T0	Meet PA at T1 Meet SST at T1	n	OR	95% CI	OR	95% CI
Meet both recommendations	Meet both recommendations	58	Ref	Ref	Ref	Ref
Meet both recommendations	Do not meet any recommendations	12	0.68	0.20;2.29	0.42	0.11;1.64
Meet both recommendations	Meet one of the recommendations	61	0.60	0.29;1.21	0.97	0.46;2.06
Do not meet any recommendations	Meet both recommendations	33	**0.34**	**0.15;0.80**	0.71	0.29;1.76
Do not meet any recommendations	Do not meet any recommendations	305	**0.47**	**0.26;0.83**	0.81	0.44;1.49
Do not meet any recommendations	Meet one of the recommendations	190	**0.41**	**0.22;0.74**	1.15	0.61;2.17
Meet one of the recommendations	Meet both recommendations	186	**0.40**	**0.22;0.72**	1.06	0.56;1.97
Meet one of the recommendations	Do not meet any recommendations	223	0.57	0.31;1.02	0.78	0.42;1.47
Meet one of the recommendations	Meet one of the recommendations	620	**0.52**	**0.30;0.90**	0.98	0.55;1.75

All models of the multilevel logistic regression include random effects (country) to account for the study design.

Multilevel logistic regression adjusted for sex, zBMI, study region (intervention vs. control), parental education level (ISCED level), Dietary Quality Index (DQI), energy intake at T1 and consumption by each dairy group at T0.

*Dairy consumption categories were grouped as follow: <u>Category 0</u> => No dairy consumers; <u>Category 1</u>=> Low dairy consumers: tertile 1 and 2 from the consumers of each dairy product; <u>Category 2</u>=> Heavy dairy consumers: tertile 3 from the consumers of each dairy product.