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The Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS (IDEFICS) study

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Associations between social vulnerabilities and psychosocial problems in European children.

- 2 **Results from the IDEFICS study.**
- 3
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- 28
- 29 Abstract
- 30 Background: The effect of socioeconomic inequalities on children's mental health remains unclear. This
- 31 study aims to explore the cross-sectional and longitudinal associations between social vulnerabilities and

32 psychosocial problems, and the association between accumulation of vulnerabilities and psychosocial

33 problems.

34 Methods: 5987 children aged 2-9 years participated at the baseline and two-year follow-up examinations 35 of the Identification and Prevention of Dietary-and Lifestyle-induced Health Effects in Children and 36 Infants (IDEFICS) study. Two different instruments were used to assess children's psychosocial 37 problems: the KINDL (Questionnaire for Measuring Health-Related Quality of Life in Children and 38 Adolescents) used to evaluate children's well-being and the Strengths and Difficulties Questionnaire 39 (SDQ) used to evaluate children's internalising-problems. Vulnerable groups were defined as follows: 40 children whose parents had minimal social networks, children from non-traditional families, children of 41 migrant origin or children with unemployed parents. Logistic mixed models were used to assess the 42 associations between social vulnerabilities and psychosocial problems at baseline and follow-up.

43 Results: After adjusting for classical socioeconomic and lifestyle indicators, children whose parents had
44 minimal social networks were in a greater risk of presenting psychosocial problems at baseline
45 (OR=1.82;[1.38-2.41]99%CI) and follow-up (OR=1.53,[1.11-2.11]99%CI) as well as non-traditional
46 families (OR=1.30;[1.04-1.63]99%CI) compared to non-vulnerable groups.

The highest risk for psychosocial problems was found in children whose parents had minimal social
networks (OR=1.97;[1.26-3.08]99%CI) at both time points. Children with more than 3 vulnerabilities
were at more than double the risk of developing psychosocial problems at baseline and follow-up.

50 Conclusions: Policy makers should implement measures to strengthen the social support of parents with51 a minimal social network.

52

53 Keywords: vulnerable groups: psychosocial problems: well-being: internalising problems:
54 inequalities: children

55

56 Introduction

It has been widely acknowledged that disadvantaged socio-economic circumstances are associated with increased health risk [1, 2]. Socioeconomic status (SES) including family income, parental education, and occupational status has been associated with a wide range of health, cognitive, and socioemotional outcomes in children, with effects beginning prior to birth and continuing into adulthood [2]. Particularly, children from low SES were shown to manifest more behavioural and emotional problems than children from high SES [3].

63 An array of mechanisms linking SES to child well-being have been proposed, with most involving 64 differences in access to material and social resources or reactions to stress-inducing conditions by the 65 children and their parents [4]. Since in most countries inequality and social vulnerabilities have increased 66 during the last two decades, it is important to study the association between social vulnerabilities and 67 psychosocial problems in children [5]. Some studies have concluded that parents' social support is 68 beneficial for the well-being of children and negatively predicted delinquency across adolescence through 69 positive parenting behaviors and maternal engagement [6, 7]. Parents' social support allows children to 70 access to other support agents who reduce stress by promoting skills and resiliency [6, 8]. Several studies 71 have found that children from traditional families had lower risk for high school dropout and teenage 72 pregnancy and had better adult outcomes e.g. fewer socio-emotional and health problems as well as 73 higher cognitive scores compared to non-traditional families [9-11]. Findings on the association between 74 migrant origin and children's mental health were inconsistent with positive, non-significant or negative 75 associations [12-14]. Concerning unemployment status, children with unemployed parents seemed to 76 have more internalising and externalising problems than those whose parents were both employed [15]. 77 Nevertheless, most of the studies conducted so far are from the United States and focused on classical 78 SES indicators, while other social vulnerabilities (such as children whose parents lack a social network, 79 children from non-traditional families, children of migrant origin and children with unemployed parents) 80 have been less frequently explored in the literature. Therefore, four vulnerable groups will be investigated 81 in the present study: 1) children from non-traditional families, 2) children whose parents lack a social 82 network, 3) children of migrant origin and 4) children with either one or both parents unemployed.

The present paper aims to explore (i) the cross-sectional and longitudinal associations between being member (vs. non-member) of a vulnerable group and psychosocial problems (poor well-being and internalising problems) in European children, (ii) the association between changes in vulnerabilities over 2-years and psychosocial problems at follow-up and (iii) the association of accumulated vulnerability with psychosocial problems at two time points. Studying these associations will give important insights to understand how disadvantaged socio-economic circumstances in children are associated with increased health risks.

90

91 Materials and methods

92 Study population

93 IDEFICS is a multi-centre prospective cohort study with a school and community-based obesity 94 prevention intervention embedded in selected regions, which are comparable in their infrastructural, 95 socio-demographic, and socio-economic characteristics [16], in eight European countries (Belgium, 96 Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden). For comprehensive information about 97 IDEFICS, a detailed description is given by Ahrens et al. [17]. In brief, a total of 16,228 children aged 2-9 98 years were examined from September 2007 to June 2008 at baseline (TO). The follow-up (T1) took place 99 two years later (September 2009-June 2010) applying the same standardised assessments where 11 041 100 children aged 4-11 years were re-examined.

101

102 The present analysis employed two different parent proxy-report instruments to assess children's 103 psychosocial problems at baseline and follow-up: the KINDL (Questionnaire for Measuring Health-104 Related Quality of Life in Children and Adolescents–Revised Version) used to evaluate children's well-105 being during the last week and the Strengths and Difficulties Questionnaire (SDQ), which is a 106 behavioural screening questionnaire used in this study with the purpose of evaluating children's 107 internalising problems over the last 6 months.

108

109 Well-being from KINDL^R

110 The KINDL^R, a validated instrument for assessing health-related quality of life in children and 111 adolescents, was completed by the parents. The instrument included four of the six original KINDL 112 dimensions: Emotional well-being, Self-esteem, Family relations and Social contacts [18]. Questions on 113 Physical well-being and Everyday functioning were excluded in the IDEFICS study. Answers were given 114 according to a 4-point Likert scale (never, rarely, sometimes and often/always), that was adapted from the 115 original 5-point Likert scale with reversals according to the wording of the question [19]. Scores were 116 summed to a total score with higher scores representing more favourable indicators of well-being. To 117 distinguish those children at risk of poorer well-being, the 20th percentile of the total score was taken as 118 threshold to differentiate between children with a poor score (from 0 to 36) and a normal score (from 37 119 to 48). Even though KINDL^R has been created for those aged 3 years and older, we included children 120 aged 2 years (177 children in total) because those children, to be eligible for IDEFICS participation, were 121 attending pre-schools or kindergartens and then exposed to similar psychosocial factors as their peers. 122 Since analyses excluding these 2-year old children shown similar results, we decided to keep them 123 included.

124

125 Internalising problems from SDQ

126 The SDQ [20] is a 25-item behavioural screening questionnaire divided in 5 scales (Emotional problems, 127 Conduct problems, Hyperactivity-Inattention behaviour, Peer problems and Prosocial behaviour) that has 128 been validated for its use in several European countries for children aged 2-7 years old [21]. Since the 129 IDEFICS study did not incorporate the Hyperactivity scale, only internalising problems (from the 130 Emotional and Peer problems subscales) were included in the present study and were scored in 131 accordance with published scoring instructions such that a higher score represents a less favourable 132 outcome [22]. The scale of internalising problems was dichotomized into a normal score vs. abnormal 133 score according to published cut-offs [22, 23].

134

135 Definition of vulnerable groups

Four vulnerabilities (dichotomised as vulnerable or non-vulnerable) obtained from the parentalquestionnaire were defined at baseline as our main exposures.

Social network: Based on the parental response to the question of how many persons they could rely on in case of need including their family: "0-1 person" taken as the vulnerable category and "≥2 persons" as the non-vulnerable group.

141 *Family structure:* If the child did not live with both his/her parents, the family was defined as a 'non-142 traditional family' (including single-parent families, stepparent families, living with grandparents or 143 foster parents or in an institution).

144 Origin of the parents: A migrant background (vulnerable group) was assumed if one or both parents were

born in a country different from where the study took place.

146 *Employment status*: If at least one of the parents was unemployed or living on social assistance or 147 welfare, the child was considered as belonging to the vulnerable group.

A total vulnerability score was calculated by adding up the numbers of vulnerabilities a child was exposed to. In all, four vulnerability indicators (low social network, non-traditional family, migrant background, unemployed) and two more vulnerabilities derived from classical SES indicators (lowincome and low-education) were considered. Occupation status was not included as it was highly correlated with employment status. The total vulnerability score ranged from 0 (the child had none of the six vulnerability indicators) to 6 (the child had all six vulnerability indicators) and was divided into four categories (three to six vulnerabilities, two vulnerabilities, one vulnerability and no vulnerability). 155

156 *Lifestyle indicators* assessed at baseline:

157 Fruit and vegetable consumption was obtained using the food frequency section of Children's Eating 158 Habits Questionnaire-food frequency questionnaire (CEHQ-FFQ) [24]. This FFQ is a self-administered 159 validated screening tool in which parents were asked to report usual at-home-consumption frequencies of 160 42 food items of the previous four weeks. We calculated the sum of reported intake frequency of fresh 161 fruits, raw and cooked vegetables as a healthy diet indicator. Response options were as follows: 162 'never/less than once a week' (0/week), '1-3 times a week' (2/week), '4-6 times a week' (5/week), '1 163 time per day' (7/week), '2 times per day' (14/week), '3 times per day' (21/week) and '4 or more times per 164 day' (30/week).

165 *Physical activity*: Parents reported the total weekly hours the children spent playing outdoors and 166 children's participation in sports club activities in the previous month. Physical activity per week was 167 obtained with this formula: [(hours playing outdoors on weekdays \times 5) + (hours playing outdoors on 168 weekend days \times 2) + weekly sports participation].

Screen time: Parents reported the daily screen time spent on audio-visual media (TV, video, DVD,
computer, game console) by the children for a typical weekday and weekend day. Total screen time per
week was calculated as "5*weekday + 2*weekend".

172

173 Weight categories

174 Anthropometric measurements were assessed at TO according to standardised procedures in all 175 participating countries. Barefoot body height was measured to the nearest 0.1 cm by trained staff using a 176 portable stadiometer (SECA 225). Body weight in kg was measured by a child-adapted version of 177 electronic scale TANITA BC 420 SMA with the children weighted in a fasting state and wearing only 178 light clothes. Body mass index (BMI) was calculated by dividing body weight in kilograms by squared 179 body height in metres and then transformed into an age- and sex-specific z-score [25]. Weight groups 180 were categorised using age and sex-specific cut points according to the criteria of the International 181 Obesity Task Force [26].

182

183 Classical SES indicators

Education: parents were asked to indicate the highest level of education of both themselves and their partners. The particular response categories for each country were coded according to the International

- 186 Standard Classification of Education (ISCED 1997) and re-categorised into three categories: low (ISCED
- 187 level 0-2), medium (ISCED level 3-4) and high (ISCED level 5-6) [27]. The highest level of either the

188 mother or the father was taken into account.

Income: parents also provided information on the monthly net income of the household after taxes and deductions responding to nine country-specific categories (1: from the lowest category to 9: the highest category). The category cut-offs were designed to be country-specific according to a fixed scheme based on the median equivalent income, thus guaranteeing comparability between countries. The results were organised into three categories: low (1-3), medium (4-6) and high income (7-9).

- 194 Occupation: parents were asked to specify their occupational position with 18 possible options, which
- 195 were later transformed into the three-class version of the European Socioeconomic Classification:
- 196 working class, intermediate and salariat [28].
- 197 The highest level of either the mother or the father was taken into account.
- 198

After excluding children with missing values in any of the exposures or outcomes at baseline or follow-up or any of the covariates at baseline, the present analysis finally included 5,987 children (50.6% boys) (see also Figure 1). Children lost to follow-up were more likely to belong to the high well-being group (82.2% vs. 75.3% in the present study) and shown less internalising problems (82.5% vs. 85.4%) than those included in the present study. However, no statistically significant differences were found in social vulnerabilities between children included in this study and those lost at follow-up.

205 Parents or legal guardians gave written informed consent for examinations and data collection for their 206 children, while children expressed oral consent. Ethical approval was obtained from the research ethics 207 authority of each participating centre.

208

209 Statistical analyses

Logistic mixed models were used to assess the cross-sectional and longitudinal associations between the four dichotomised exposures (social network, family structure, migrant origin and employment status) and each outcome (well-being and internalising problems). The reference category used was the normal (healthy) score for each outcome. All models included a random kindergartens/school and a random country effect to account for the clustered study design.

One cross-sectional and two longitudinal analyses were conducted. In the cross-sectional analysis,predictor and outcome variables from T0 were used. In the first longitudinal analysis, children's well-

being and internalising problems at T1 were related to the T0 exposures. In the second longitudinal analysis, evolution of vulnerability (from T0 to T1) were related to children's well-being and internalising problems at T1. Four patterns of vulnerability evolution from T0 to T1 (vulnerable at T0 and T1, vulnerable at T0 and non-vulnerable at T1, non-vulnerable at T0 and vulnerable at T1; and nonvulnerable at T0 and T1) were assessed for only three of the vulnerable groups considered since migrant status does not change between baseline and follow-up. Finally, two more analyses were conducted to estimate the accumulation of vulnerability at T0 and psychosocial problems at T0 and T1.

To adjust for possible confounders, 2 models were run for each analysis: model 1 for each outcome/exposure was adjusted for baseline age, sex and frequency of fruit and vegetable consumption, physical activity, total screen time and BMI z-score and model 2 was additionally adjusted for baseline classical SES indicators (education, income and occupation except for employment status model). For both longitudinal analyses, a variable indicating intervention versus control region was added and models were additionally adjusted for baseline outcomes (well-being and internalising problems at T0, respectively).

Before model building, correlations among classical SES indicators were checked resulting in the exclusion of occupation status in models with employment status as main exposure to avoid collinearity problems.

The significance level was set at 0.01 to account at least partially for multiple testing. The analyses were
performed using the Statistical Package for the Social Sciences (version 22.0; SPSS, Inc.).

236

237 Results

Table 1 summarises the distributions of predictors and background variables for the two outcomes (well-

being and internalising problems) at T0 and T1. For the continuous covariates, the median is shown.

Table 2 presents odds ratios (OR), 99% confidence intervals (CI) and p-values for the models assessing the cross-sectional and longitudinal associations between the four vulnerability indicators and well-being and internalising problems at baseline and after two-year follow up. After adjusting for lifestyle indicators and the classical SES indicators (full adjustment model 2), those children whose parents had minimal social networks (OR=1.82;[1.38-2.41]99%CI) at T0 and T1 and non-traditional families (OR=1.30;[1.04-1.63]99%CI) at T0. Similarly, there was a higher likelihood of internalising problems in children with minimal social network parents at T0 (OR=1.51;[1.12-2.03]99%CI) and T1 (OR=1.53;[1.11-2.11]99%CI) compared to those non-vulnerable. No statistically significant associations were observed for the othergroups but associations still pointed to the expected directions.

249 Table 3 displays the results for the associations between the patterns of vulnerability evolution over time 250 and well-being and internalising problems at T1. In model 2, those children whose parents reported to 251 have a minimal social network just at T1 (OR=1.95;[1.40; 2.71]99%CI) or at two time points (OR=1.57, 252 [1.06; 2.33]99%CI) as well as children from non-traditional families (OR=1.28;[1.00-1.65]99%CI) were 253 more likely to have a poor well-being than those who were non-vulnerable at two time points. Likewise, 254 there was a higher likelihood of internalising problems in children whose parents reported to have a 255 minimal social network at two time points (OR=1.97;[1.26-3.08]99%CI) and those children from non-256 traditional families just at T1 (OR=1.60;[1.07-2.39]99%CI) compared to those who were non-vulnerable 257 at two time points.

Table 4 shows the association between the accumulation of vulnerabilities assessed at baseline and wellbeing and internalising problems at T0 and T1. A higher number of vulnerabilities was associated with a higher probability of having psychosocial problems in both T0 and T1, where the OR increased with the number of present vulnerabilities: one vulnerability (OR=1.30;[1.03-1.64]99%CI); two vulnerabilities (OR=1.81;[1.38-2.37]99%CI) and three to six vulnerabilities (OR=2.63;[1.86-3.73]99%CI).

263

264 Discussion

265 The importance of SES for health is well established but there is a lack of research determining the 266 impact of SES and interrelated factors such as vulnerable groups on psychosocial problems in European 267 children [29, 30]. The present paper investigated the association between belonging to a vulnerable (vs. 268 non-vulnerable) group and psychosocial problems (poor well-being and internalising problems) over a 269 two-year period in children aged 2 to 9 years old participating in a European study. This research found 270 that children whose parents lack a social network and children from non-traditional families had a higher 271 likelihood of presenting psychosocial problems cross-sectionally and longitudinally compared to non-272 vulnerable groups.

The findings of our study are in line with the results of previous research despite some differences. Several studies have explored the relationship between different socioeconomic and cultural factors and psychosocial problems [31-33]. A systematic review shown that socioeconomically disadvantaged children and adolescents were two to three times more likely to develop mental health problems [33]. In our study, migrant status was not significantly associated with a higher risk of having psychosocial problems. This is in accordance with some studies [34-36], although other studies found that migrant children fare worse compared to their native peers in relation to mental health [15, 37]. However, studies varied with the informants used and the characteristics of the migrant group and the host country.

281 Concerning social network, we found a statistically significant association between children whose 282 parents reported to have a minimal social network with a higher risk of having psychosocial problems; 283 which is in agreement with previous studies that associated parents' minimal social networks and 284 children's behavioural disturbance [6, 7, 38].

Regarding family structure, children from non-traditional families had a higher risk of having psychosocial problems than those children from traditional families. These results confirmed previous investigations that concluded children from traditional families had fewer socio-emotional and higher cognitive scores than those from non-traditional families [11, 39].

289 Concerning parental unemployment, we found a statistically significant association with children's 290 psychosocial problems at baseline but not anymore when controlling for classical SES indicators. This 291 finding contradicted partly the conclusions of Powdthavee and Vernoit (2013) who found that parental 292 job loss had a positive influence on young children's well-being [40].

293 Some limitations of this study should be acknowledged. Firstly, the IDEFICS study is not representative 294 neither of the European population or of the countries participating since each survey centre only covered 295 a limited geographic area within a country. Secondly, some groups (from the lowest or the highest SES) 296 could be underestimated as participation in this study was voluntary and usually these populations are less 297 likely to take part in research. Likewise, a selection bias cannot be precluded because some participants 298 (with lower well-being score and more internalising problems) did not complete all required information 299 or did not continue the study at follow-up. Finally, migrant origin and reasons for migration may differ 300 significantly from one person to another and consequently some groups of migrants could be more 301 vulnerable than others. However, due to the small size of some migrant groups, no group differences were 302 taken into account in the present investigation.

303

A special strength of the study is the fact that to our knowledge, previous research has not investigated the association between vulnerabilities such as social network, family structure and unemployment status with psychosocial problems in a longitudinal study. A large sample size including children from eight 307 different countries following standardised procedures and using validated instruments, is also a strength 308 of our study. 309 310 Conclusions 311 The current study suggests associations between social vulnerabilities and psychosocial problems (poor 312 well-being and internalising problems), independent of family income, parental occupation, parental 313 education and lifestyle indicators. Mainly having parents with minimal social network and the lack of a 314 traditional family structure were disadvantageous. Given these findings, interventions during the early 315 years of a child's life may be needed to reduce inequalities and counteract negative effects on children's 316 mental health. Therefore, policy makers should implement measures to strengthen the social support of 317 parents with a minimal social network. 318 319 What is already known on this subject? 320 • Significant associations between low 321 socioeconomic status (SES) and psychosocial problems have been found in children. 322 • Most of the studies have been conducted 323 in the United States and focused on classical SES indicators. 324 Other social vulnerabilities (such as • 325 children whose parents lack a social network, children from non-traditional families, children of 326 migrant origin and children with unemployed parents) have been less frequently explored in the 327 literature and have yielded inconsistent results. 328 329 What this study adds? 330 • This research found that children whose 331 parents lack a social network and children from non-traditional families had a higher likelihood 332 of presenting psychosocial problems cross-sectionally and longitudinally, compared to non-333 vulnerable groups. 334 Regarding changes social • in 335 vulnerabilities over time, children who were vulnerable at both times or only at follow-up had a 336 higher risk of having psychosocial problems than those who were not vulnerable at both times.

11

- A higher number of vulnerabilities was
 associated with a higher probability of presenting psychosocial problems cross-sectionally and
 longitudinally, compared to non-vulnerable groups.
- In order to make those from low
 socioeconomic backgrounds have better mental health outcomes, policy makers should
 implement measures to strengthen the social support of parents with a minimal social network.
- 343

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345

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- 351 The authors' contributions were as follows: I. I carried out the statistical analysis and drafted the
- 352 manuscript along with N. M. C. B. designed the statistical analyses. K. B., J. M. F.-A., W. G., R. F., B.T.,
- 353 and P.R. developed the measurement instruments; L. R., S. D. H., M. H., L. A. M., and T. V. supervised
- the national data collection authors read and critically reviewed the manuscript.
- 355

356 Conflict of interest Statement

357 The authors declare that there are no conflicts of interest.

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Table 1. Description of the study population, stratified by well-being and internalising problems (normal/abnormal) at baseline (T0) and follow-up(T1). Number of participants and percentages are shown for categorical variables and median for the continuous variables.

Total 5987 (100%)	N (%)		TO (BASE	ELINE)		T1 (FOLLOW-UP)						
Categorical variables	11(//0)	Wel	l-being	Internalisi	ng problems	Well	-being	Internalisi	ng problems			
Age groups		Poor	Normal	Abnormal	Normal	Poor	Normal	Abnormal	Normal			
2-6 years	2660 (44.0%)	13.5	86.5	15.3	84.7	20.2	79.8	12.6	87.4			
6-10 years	3327 (55.6%)	21.3	78.7	16.4	83.6	20.2	72.1	15.0	84.1			
Sex of the child	5527 (55.070)	21.5	/0./	10.4	05.0	21.9	/ 2.1	15.9	04.1			
Male	3028 (50.6%)	18/	81.6	16.4	83.6	24.8	75.2	15.0	85.0			
Female	2959 (49.4%)	17.2	82.8	15.4	84.6	24.0	75.0	13.0	86.2			
BMI	2)3) (4).4/0)	17.2	02.0	15.4	04.0	24.1	15.7	15.0	00.2			
Thinese	680 (11.4%)	171	82.0	16.5	83.5	247	75 3	17.2	878			
Normal weight	(11.4%)	17.1	82.9	10.5	0J.J 01 C	24.7	75.5	17.2	82.8			
Overweight	4220(70.0%)	10.7	83.0	13.4	84.0 82.7	25.5	70.7	15.0	82.6			
Overweight	007(11.5%)	19.7	80.5 75 5	17.5	02.7	20.9	/ 5.1	10.4	83.0			
Country	392 (0.5%)	24.3	15.5	17.0	02.4	51.4	08.0	13.0	04.4			
	0.17(15.20())	24.0	76.0	164	02 6	20.0	70.1	12.1	96.0			
Italy Esternia	917(13.5%)	12.0	70.0	10.4	03.0 94.1	29.9	70.1	15.1	80.9			
Estonia	939 (15.7%)	12.6	87.3	15.9	84.1	23.5	/6.5	15.7	84.3			
Cyprus	499 (8.3%)	29.5	/1./	10.2	83.8	18.4	81.0	13.4	80.0			
Belgium	7/6(13.0%)	12.1	87.9	21.4	/8.6	20.0	80.0	20.5	/9.5			
Sweden	564 (9.4%)	/.8	92.2	5.5	94.5	12.8	87.2	4.3	95.7			
Germany	628 (10.5%)	15.0	85.0	16.6	83.4	15.0	85.0	17.5	82.5			
Hungary	780 (13.0%)	32.2	67.8	15.6	84.4	33.8	66.2	15.1	84.9			
Spain	884 (14.8%)	11.9	88.1	17.0	83.0	26.8	73.2	13.5	86.5			
Occupation (ESEC)												
Missing	99 (1.7%)	21.2	78.8	20.2	79.8	24.2	75.8	17.2	82.8			
Working class	1769 (29.5%)	22.4	77.6	19.1	80.9	28.2	71.8	16.7	83.3			
Intermediate	2306 (38.5%)	16.7	83.3	15.7	84.3	23.6	76.4	13.9	86.1			
Salariat	1813 (30.3%)	14.6	85.4	13.0	87.0	21.8	78.2	12.7	87.3			
Income												
Missing	301 (5%)	16.6	83.4	12.0	88.0	19.6	80.4	13.0	87.0			
Low	1792 (29.9%)	24.6	75.4	20.8	79.2	10.0	90.0	18.7	81.3			
Medium	1606 (26.8%)	16.6	83.4	16.1	83.9	10.3	89.7	14.3	85.7			
High	2288 (38.2%)	13.5	86.5	12.5	87.5	10.3	89.7	11.4	88.6			
Education (ISCED)												
Low	343 (5.7%)	25.9	74.1	29.2	70.8	28.9	71.1	21.9	78.1			
Medium	2996 (50%)	18.6	81.4	16.7	83.3	25.1	74.9	15.4	84.6			
High	2648 (44.2%)	15.9	84.1	13.3	86.7	23.1	76.9	12.4	87.6			
Social network ^a	· · · ·											
Minimal	534 (9.9%)	29.6	70.4	22.8	77.2	35.4	64.5	22.3	77.7			
Strong	5453 (91.1%)	16.7	83.3	15.2	84.8	23.4	76.6	13.7	86.3			
Family structure ^b												
Non-traditional family	1101 (18.4%)	25.0	75.0	20.5	79.5	31.1	68.9	18.9	81.1			
Traditional family	4886 (81.6%)	12.7	16.2	14.9	85.1	22.9	77.1	13.4	86.6			
Migrant status	1000 (01.070)	12.7	10.2	11.9	05.1	22.7	//.1	15.1	00.0			
Migrant origin	665 (11.1%)	26.1	73.9	20.6	79.4	31.4	68.6	14.0	86.0			
Native	5322 (88.9%)	17.4	82.6	15.7	84 3	24.1	75.9	14.0	85.5			
Funloyment status	5522 (00.770)	17.4	02.0	15.7	04.5	27.1	15.7	14.5	05.5			
Unemployed	287 (4.8%)	13.2	86.8	20.6	79.4	97	90.3	21.3	78 7			
Non-unemployed	5700 (95 2%)	12.5	87.5	15.7	8/13	10.5	89.5	14.1	85.9			
Patterns of social network evolution	5700 (55.270)	12.5	07.5	15.7	04.5	10.5	07.5	14.1	05.7			
V V	237(4.0%)	31.6	68.4	23.6	76.4	30.7	60.3	257	743			
NV-V	340 (5.7%)	22.0	77 1	23.0	75.9	38.8	61.2	20.7	79.4			
V NV	297(5.0%)	22.9	72.1	24.1	73.9	32.0	68.0	19.5	80.5			
NV-NV	5113 (85 4%)	13.4	86.6	14.6	85.4	22.0	00.0 77 7	13.2	86.8			
Patterns of family structure evolution	5115 (05.470)	13.4	00.0	14.0	05.4	22.3	//./	13.2	00.0			
V V	708 (12 20/)	24.4	75.6	21.1	78.0	22.0	68.0	20.2	70.8			
V-V NIV V	790(13.3%) 247(5.8%)	24.4	75.0	21.1	70.9	20.4	70.6	20.2	79.0			
	347(3.0%)	22.5	72.6	21.0	70.4 80.0	29.4	70.0	21.0	79.0 94.5			
V -1N V NIV NIV	303 (3.1%) 4520 (75 P)	20.4	13.0	19.1	0U.9 95 4	∠ð./ 22 4	11.5	13.5	04.J 97.2			
IN V-IN V	4339 (73.8)	13./	84.5	14.4	0.0	22.4	//.0	12.8	01.2			
ratterns of employment evolution	107 (1.99/)	22.4	77 6	22.4	766	22 6	CC A	107	01.2			
V - V NIX7 X7	10/(1.8%)	22.4	//.0	23.4	/0.0	33.0 20.5	00.4	18./	81.5			
IN V-V	5/0 (6.2%)	21.9	/8.1	21.1	/8.9	30.5	69.5	1/.8	82.2			
V-INV	180 (3.0%)	28.3	/1./	18.9	81.1	30.0	/0.0	22.8	11.2			
NV-NV	5330 (89%)	17.1	82.9	15.3	/5.4	23.6	/6.4	13.8	86.2			
Continuous variables (median)		• •		• •	2.0	c c	• •	• •	2.2			
Fruit-vegetables [times/day]	2.3	2.0	2.3	2.0	2.3	2.0	2.3	2.0	2.3			
Physical Activity [h/week]	16.0	14.2	16.0	14.0	16.0	14.2	16.0	15.0	16.0			
Total screen time [h/week]	10.5	12.0	10.5	11.5	10.5	12.0	10.5	12.0	10.5			
KINDL KINDL Questionnaire for Measuri	ng Health-Related	Quality c	of Life in Cl	nildren and A	Adolescents; SL	OQ Streng	ths and Dif	ficulties Ou	estionnaire;			

V-V Vulnerable at T0 and T1, NV-V Non-vulnerable at T0 and Vulnerable at T1, NV-NV Non-vulnerable at T0 and T1.

^a Social network was assessed with the question how many persons they could rely on in case of need: minimal (0-1 person) and strong (>2 persons).

^b Family structure: If the child did not live with both his/her parents, the family was defined as a 'non-traditional family'.

Table 2. Cross-sectional and longitudinal associations between vulnerability indicators and well-being and internalising problems at baseline (T0) and follow-up (T1) (reference: normal) for the three models.

Results from the logistic mixed models: odds ratios (OR), 99% confidence intervals (CI) and p-values are shown.

	WELL-BEING AT TO FROM KINDL				DL	INTERNALISING PROBLEMS AT TO FROM SDQ				V	WELL-BEING AT T1 FROM KINDL				INTERNALISING PROBLEMS AT T1 FROM SDC								
	M1 ^a			$M2^{b}$		M1 ^a			$M2^{b}$			M1 ^c		$M2^{d}$		M1 ^c		M2 ^d					
	OR	99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P- value	OR99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P-value
Social network ^e																							
Minimal (534)	1.91	1.45-2.52	<0.001	1.82	1.38-2.41	<0.001	1.61	1.20-2.15	<0.001	1.51	1.12-2.03	<0.001	1.28	0.97-1.69	0.020	1.2 0.95-1.66	0.035	1.60	1.16-2.20	<0.001	1.53	1.11-2.11	0.001
Strong (5453)	1.00			1.00			1.00			1.00			1.00			1.0		1.00			1.00		
Family structure ^f																							
Non-traditional (1101)	1.43	1.15-1.77	<0.001	1.30	1.04-1.63	0.002	1.43	1.14-1.79	<0.001	1.25	0.99-1.58	0.015	1.22	0.99-1.51	0.015	1.1 0.94-1.46	0.062	1.30	1.01-1.67	0.008	1.11	0.85-1.45	0.301
Traditional (4886)	1.00			1.00			1.00			1.00			1.00			1.0		1.00			1.00		
Migrant status																							
Migrant origin (665)	1.28	0.97-1.69	0.024	1.17	0.88-1.54	0.141	1.22	0.91-1.64	0.083	1.12	0.83-1.51	0.330	0.92	0.69-1.22	0.443	0.8 0.67-1.18	0.307	0.95	0.67-1.34	0.694	0.87	0.61-1.24	0.314
Native (5322)	1.00			1.00			1.00			1.00			1.00			1.0		1.00			1.00		
Employment status																							
Unemployed (287)	1.50	1.03-2.19	0.006	1.30	0.88-1.90	0.082	1.26	0.84-1.87	0.142	1.02	0.68-1.54	0.896	1.19	0.82-1.74	0.229	1.1-0.78-1.67	0.385	1.56	1.02-2.39	0.008	1.35	0.87-2.11	0.074
Non-unemployed (5700)	1.00			1.00			1.00			1.00			1.00					1.00			1.00		

KINDL KINDL Questionnaire for Measuring Health-Related Quality of Life in Children and Adolescents, SDQ Strengths and Difficulties Questionnaire

Statistically significant results shown in bold font.

All models include random effects (school/kindergarten, country) to account for the study design.

^a M1 at T0 were adjusted for baseline age, sex and lifestyle indicators: frequency of fruit and vegetable consumption, physical activity, total screen time and z-score of BMI (Body Mass Index) by Cole & Lobstein [26].

^b M2 at T0 were additionally adjusted for baseline classical SES indicators (education, income and occupation except for employment status model).

^cM1 at T1 were adjusted for baseline age, sex, study region (intervention v. control) and well-being and internalising problems at T0 for KINDL and SDQ models respectively.

^dM2 at T1 were additionally adjusted for baseline classical SES indicators (education, income and occupation except for employment status model).

^e Social network was assessed with the question how many persons they could rely on in case of need including their family: minimal (0-1 person) and strong (>2 persons).

^f Family structure: If the child did not live with both his/her parents, the family was defined as a 'non-traditional family'.

	WELL-BEING AT T1 FROM KINDL							INTERNALISING PROBLEMS AT T1 FROM SDQ						
		M1			M2		N	11		M				
	OR	99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P-value	OR	99% CI	P-value		
Social network ^d														
V-V (237)	1.61	1.08-2.38	0.002	1.57	1.06-2.33	0.003	2.05	1.31-3.21	<0.001	1.97	1.26-3.08	<0.001		
NV-V (340)	1.97	1.42-2.72	<0.001	1.95	1.40-2.71	<0.001	1.47	0.98-2.19	0.013	1.44	0.96-2.15	0.021		
V-NV (297)	1.18	0.82-1.71	0.238	1.15	0.80-1.67	0.318	1.36	0.88-2.10	0.064	1.30	0.84-2.01	0.122		
NV-NV (5113)	1.00			1.00			1.00			1.00				
Family structure ^e														
V-V (798)	1.34	1.06-1.71	0.002	1.28	1.00-1.65	0.010	1.40	0.94-1.68	0.002	1.24	0.93-1.67	0.056		
NV-V (347)	1.20	0.85-1.71	0.180	1.20	0.84-1.71	0.180	1.62	1.08-2.42	0.002	1.60	1.07-2.39	0.003		
V-NV (303)	1.00	0.68-1.47	0.978	0.98	0.67-1.44	0.897	1.25	0.78-2.01	0.221	1.21	0.75-1.94	0.298		
NV-NV (4539)	1.00			1.00			1.00			1.00				
Employment status														
V-V (107)	1.50	0.83-2.70	0.075	1.44	0.79-2.61	0.115	1.22	0.60-2.48	0.474	1.01	0.49-2.09	0.964		
NV-V (370)	1.25	0.90-1.75	0.082	1.22	0.87-1.70	0.136	1.21	0.81-1.80	0.232	1.09	0.73-1.65	0.573		
V-NV (180)	1.07	0.66-1.72	0.731	1.02	0.63-1.65	0.911	1.85	1.10-3.10	0.002	1.62	0.95-2.74	0.020		
NV-NV (5330)	1.00			1.00			1.00			1.00				

Table 3. Longitudinal associations between the changes in vulnerability from T0 (baseline) to T1 (follow-up) and well-being and internalising problems at follow-up (T1) (reference: normal) for the three models. Results from the logistic mixed models: odds ratios (OR), 99% confidence intervals (CI) and p-values are shown.

KINDL KINDL Questionnaire for Measuring Health-Related Quality of Life in Children and Adolescents; SDQ Strengths and Difficulties Questionnaire; V-V Vulnerable at T0 and T1, NV-V Non-vulnerable at T0 and T1, NV-V Non-vulnerable at T0 and T1

Statistically significant results shown in bold font.

All models include random effects (school/kindergarten, country) to account for the study design.

^a M1 at T1 were adjusted for baseline age, sex, study region (intervention v. control), well-being and internalising problems at T0 for KINDL and SDQ models respectively and lifestyle indicators: frequency of fruit and vegetable consumption, physical activity, total screen time and z-score of BMI (Body Mass Index) by Cole & Lobstein [26].

^c M2 were additionally adjusted for baseline classical SES indicators (education, income and occupation except for employment status model).

^d Social network was assessed with the question how many persons they could rely on in case of need including their family: minimal (0-1 person) and strong (>2 persons).

^e Family structure: If the child did not live with both his/her parents, the family was defined as a 'non-traditional family'.

Table 4. Association between the accumulation of vulnerabilities at T0 and well-being and internalising problems at T0 and T1 (reference: normal)*. Results from the logistic linear mixed model: odds ratios (OR) and 99% confidence intervals (CI) are shown.

	ACCUMULATION OF VULNERABILITY AT TO												
	WELL-I	BEING AT TO		INTERNA	LISING PROBL	EMS	WELL-BEING AT T1			INTERNALISING PROBLEMS			
	F KUM KINDL"			AT TUFKUWI SDQ			FKOM	KINDL			ALIIFKU		
	OR	99% CI	p-value	OR	99% CI	p-value	OR	99% CI	p-value	OR	99% CI	p-value	
Number of vulnerabilities ^c													
Missing (301)	1.19	0.76-1.85	0.582	0.90	0.55-1.47	0.582	0.85	0.56-1.27	0.290	1.12	0.69-1.80	0.545	
3-6 vulnerabilities (381)	2.63	1.86-3.73	<0.001	2.86	2.00-4.10	<0.001	1.85	1.33-2.57	< 0.001	2.58	1.77-3.76	<0.001	
2 vulnerabilities (881)	1.81	1.38-2.37	<0.001	1.74	1.30-1.85	<0.001	1.47	1.15-1.87	< 0.001	2.10	1.57-2.79	<0.001	
1 vulnerability (1562)	1.30	1.03-1.64	0.004	1.55	0.82-1.38	<0.001	1.15	0.94-1.41	0.067	1.47	1.15-1.88	<0.001	
Non vulnerable (2862)	1.00			1.00			1.00			1.00			

KINDL KINDL Questionnaire for Measuring Health-Related Quality of Life in Children and Adolescents, SDQ Strengths and Difficulties Questionnaire

Statistically significant results shown in bold font.

^a Models at TO Basic models were adjusted for baseline age, sex and lifestyle indicators: frequency of fruit and vegetable consumption, physical activity, total screen time and z-score of BMI by Cole & Lobstein [26].

^b Models at T1 were additionally adjusted for study region (intervention v. control).

^c A total vulnerability score was calculated by adding up the scores (1 vs 0) of the six vulnerability indicators (low social network, non-traditional family, migrant background, unemployed, low-income and low-education). Total vulnerability score ranges from 0 (the child has none of the six vulnerability indicators) to six (the child has all six vulnerability indicators).

Fig. 1 Final study sample.



Missing outcome data: missing values in well-being from KINDL and internalising problems from SDQ.

Missing covariate data: missing values in frequency of fruit and vegetable consumption, physical activity and total screen time.

Missing exposure data: missing values in social vulnerabilities.