Original Research

Immigration and adolescent health: the case of a multicultural population

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ARTICLE INFO

ABSTRACT

Objectives: Previous research indicates that the impact of immigration on health tends to be specific as it is influenced by many factors such as life stage and host country. The aim of this study was to examine the relationship between immigration and adolescent health within the multicultural context of the Brussels-Capital Region in Belgium.

Study design: The study was based on the 2014 Health Behaviour in School-aged Children survey. The sample consisted of 2962 adolescents from the fifth grade of primary to the last grade of secondary schools in Brussels.

Methods: Associations between health indicators and immigration status were analysed using multivariable logistic regression models adjusted for sociodemographic characteristics.

Results: Natives, first-generation immigrants, second-generation immigrants with both parents born abroad and second-generation immigrants with one parent born abroad represented 19%, 23%, 36% and 22% of the respondents, respectively. Sociodemographic characteristics and health behaviours varied according to immigrant status. Young immigrants were more likely to present overweight (odds ratio [OR] $_{\text{first-generation immigrants vs. natives}}$ = 1.76 [95% confidence interval {CI} = 1.16–2.65]; OR $_{\text{second-generation immigrants with both parents born abroad vs. natives}}$ = 2.06 [95% CI = 1.41–3.02]; OR $_{\text{second-generation immigrants with one parent born abroad vs. natives}}$ = 1.69 [95% CI = 1.12–2.56]). This effect turned out to be partially explained by sociodemographic status and health-related behaviours. No association was detected between immigration and self-rated health and multiple recurrent symptoms.

Conclusions: Discrepancies in health behaviours and weight status were identified between adolescents of different immigration background, whereas this was not the case for well-being. Socio-economic status, cultural characteristics and specific behaviours partly explained these findings. Future research is needed to better understand immigration-related risk and protective factors, at individual and school levels.

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Introduction

Even though the consequences of immigration depend on the circumstances surrounding the event, the conditions in which many immigrants live may result in increased vulnerability and affect their health. Several epidemiologic studies have shown indeed that immigrants tend to be more at risk of non-communicable diseases and poor mental health than natives.[1–5] Moreover, several obstacles such as language and administrative barriers may hamper access to health information and care resources.[6,7] Findings from previous research focussing on immigrant populations' health are yet inconclusive. For instance, a French systematic review found a higher life expectancy among immigrant men from North Africa than among their native-born counterparts.[8] The main reason for this variability is that the impact of immigration tends to be highly specific, depending on the health outcome studied, individual characteristics, the type of immigration, the region of origin, the host region and the duration of residence in the host country.[3,9–12]

Previous research has concluded that socio-economic factors underlie, at least in part, the association between immigration status and health.[3–13] Adolescence presents specific challenges that need to be particularly studied. For instance, socio-economic status may influence lifestyle and health in a different way during childhood and adulthood. Indeed, the influence of family tends to decrease during the adolescence, whereas peers and school environment play an increasing role.[14,15] Teenagers with an immigration background therefore have to deal simultaneously with several external influences, namely family, peers, school, community and society, which might be conflicting in some situations. They face specific challenges that may impact both their mental and physical health on a long term. Perceived discrimination, racism, marginalization and lack of social integration at school can be very detrimental to adolescents and might contribute in some cases to the deleterious impact associated with immigration status.[16–18]

In the Brussels-Capital Region (BCR) in Belgium, two residents out of three are born outside Belgium or have a family history of immigration, making it one of the most multicultural areas around the world.[19] We may therefore assume that, despite very diverse countries of origin, the effect of immigration on adolescent health would be mitigated by such a multicultural setting. In addition, the BCR is home to many international institutions; many immigrants, often native of another EU Member State, are highly educated, wealthy and therefore feel less excluded from the host society.[19] Indeed, the characteristics of the host society and the country of origin have been shown to play a role in the association between immigration and health.[2,10]

The aim of this study was to examine the relationship between immigration status and health among adolescents attending a school in BCR. Our objectives were to compare health status and behaviour indicators between teenagers with various immigration backgrounds and to investigate the association between immigration status and overweight taking into account sociodemographic characteristics and health behaviour factors.

Methods

Study design

Data originated from the 2014 Health Behaviour in School-aged Children (HBSC) survey. It is an international cross-sectional study on adolescent health behaviours conducted every four years, under the aegis of the WHO European office.[20] In the French-speaking part of Belgium, the HBSC survey is conducted among pupils from the fifth year of primary school (aged 10—11 years) to the last year of secondary school (aged 17—22 years). Data were collected using an international standardized questionnaire self-administered in classrooms and treated as confidential.[21] The study was approved by the regional education boards of the four different school networks in the Federation Wallonia-Brussels (Conseil de l'Enseignement des Communes et des Provinces, Direction Générale de l'Enseignement obligatoire de la Fédération Wallonie-Bruxelles, Conseil des Pouvoirs organisateurs de l'Enseignement official neutre subventionné, Secrétariat Général de l'Enseignement Catholique).

A two-stage random sample was selected using stratification by province and school network proportionally to the school's population distribution. The primary sampling unit was the school. In 2014, among the 781 schools invited to participate, 168 took part in the survey. For the purpose of this study, only schools located in the BCR were taken into account (14 primary and 15 secondary schools). For the second sampling stage, classes were selected in each grade among schools that agreed to participate in the study.[22] All students in a selected class were invited to participate. The present study included data from 2962 adolescents attending a school in the BCR.

Measures

Health status indicators

Three dummy variables of health status were computed:

- Self-rated health was measured by the question 'Would you say your health is …?' with response categories 'excellent', 'good', 'fair' and 'poor'. For the purpose of the present study, categories were dichotomized to 'excellent to good' vs. 'fair to poor'.
- Multiple recurrent symptoms are an indicator based on a list of eight physical and mental symptoms: headache, stomach ache, back pain, depressed mood, irritability, nervousness, difficulties in getting to sleep and dizziness. The pupils were asked how often in the last six months they experienced the symptoms within five categories ranging from 'rarely or never' to 'more or less every day'. A score was constructed to identify adolescents with multiple recurrent symptoms, defined as reporting at least two symptoms several times a week or more.
- Overweight status was generated using self-reported height and weight which allowed body mass index (BMI) to be calculated (weight/height^2). Then, the gender- and age-specific BMI cut-offs produced by the International Obesity Task Force (IOTF)[23] were used to create the

'overweight' category (including obesity) corresponding to a BMI cut-off of 25 at 18 years. A total of 1836 adolescents (62%) completed the questions pertaining to height and weight.

Health behaviours

Health behaviours were assessed by dichotomizing responses to frequency questions based on health recommendations or usual thresholds retrieved in the literature concerning the following:

- Eating behaviours: breakfast on weekday, family dinner, vegetable consumption and soda consumption (daily vs. non-daily) and fast-food consumption (weekly vs. non-weekly).
- Physical activity: time taking part in organized sport ($\geq$2 h/week vs. <2 h/week).
- Sedentary habits: screen time on weekday ($\geq$2 h/day vs. <2 h/day) (TV, video games and Internet).
- Sleeping habits: time spent sleeping on weekday (<9 h/day vs. $\geq$9 h/day).
- Risk behaviours: alcohol consumption (weekly vs. non-weekly) and current tobacco use (daily/non-daily vs. never)

Immigration status

An 'immigration status' variable was generated using the country of birth of the child and of his/her parents and was categorized as follows:

- *natives*: adolescents born in Belgium with both parents born in Belgium
- *second-generation immigrants with one parent born abroad*: adolescents born in Belgium with only one parent born abroad (i.e., anywhere in the world apart from Belgium; Appendix 1) and the other parent being born in Belgium
- *second-generation immigrants with both parents born abroad*: adolescents born in Belgium with both parents born abroad
- *first-generation immigrants*: adolescents born abroad with at least one parent born abroad.

Adolescents born abroad but with both parents born in Belgium (n = 11) were included in the 'natives' category.

Sociodemographic characteristics

Pupils reported demographic data: age, gender, family structure (recoded in 'living with both parents' and 'other types') and main language spoken at home (recoded in 'French or Dutch'; 'other language'). The socio-economic status of the child's family was measured using the Family Affluence Scale (FAS), a 6-item scale concerning the material assets in the child's household (ownership of car(s), own bedroom, number of computers, number of bathrooms, ownership of a dishwasher and abroad holiday frequency during the last year).[20] The scale was categorized into 'low FAS' (between 0 and 6), 'medium FAS' (between seven and 9) and 'high FAS' (between 10 and 13).

Statistical analyses

Associations between immigration status and other socio-demographic variables were analysed using Pearson's chi-squared (χ^2) test.

Univariable logistic regression models were conducted to estimate the strength of association (odds ratio [OR] and 95% confidence intervals [CIs]) between immigration status and health status/behaviour indicators. The 'natives' class was fixed as the reference category.

In a second step, the relationship between immigration status and overweight was further examined to estimate whether it could be mediated by specific socio-economic characteristics and health behaviours. Therefore, three consecutive multivariable logistic regression models were conducted: In model 0, the association between immigration status and overweight was assessed when controlling for gender and age. In model 1, FAS and main language spoken at home were added to the model 0. At last, in model 2, model 1 was adjusted for several health behaviour indicators. Only covariates associated both with overweight and with immigration status at a P-value smaller than or equal to 15% in the univariable models were included in the multivariable models.[24]

All analyses were conducted using Stata® 14.1 (StataCorp, College Station, TX).

Results

In our sample, a minority of one out of five adolescents were native (19.3%), a quarter (23.2%) were first-generation immigrants and almost six out of ten were second-generation immigrants (35.8% with both parents born abroad and 21.7% with one parent born abroad). Age, FAS, main language spoken at home and family structure were statistically significantly (P < 0.05) associated with immigration status (Table 1).

Immigrant adolescents were less likely than natives to report daily breakfast, daily family dinner, daily vegetables consumption and weekly alcohol consumption and were more likely to report daily soda and weekly fast-food consumption. Second-generation immigrant adolescents with both parents born abroad were less likely than natives to take part in organized sport at least 2 h per week. As first-generation immigrants, they were more likely than natives to spend 2 h or more per day in front of a screen and to sleep less than 9 h on weekdays. Current tobacco use did not differ among adolescents according to immigration status (Table 2).

Concerning health status, overweight was the only indicator to be significantly associated with immigration status (Table 3). All immigrant adolescents were more likely than natives to be overweight, even after controlling for gender and age (Table 4, model 0).

After adjusting for FAS and main language spoken at home (model 1), first-generation immigrants did not differ from native-born adolescents anymore in terms of overweight status (Table 4). After controlling for socio-economic and health behaviours (i.e., daily breakfast, daily vegetable

Table 1 − Distribution (%) of sociodemographic characteristics according to the immigration status.						
Variable	Total	M0[a]	M1/2[a]	M2[a]	M1[a]	P-value
Gender						0.68
n	2872	553	623	1029	667	
Female	52.3	51.7	54.4	51.4	52.3	
Male	47.7	48.3	45.6	48.6	47.7	
Age (years)						<0.001
n	2872	553	623	1029	667	
10−11	12.7	17.4	15.6	11.4	8.2	
12−13	23.4	28.0	25.2	23.4	17.8	
14−15	22.0	23.2	24.2	19.1	23.4	
16−18	29.8	24.6	26.6	32.8	32.2	
19−22	12.1	6.9	8.4	13.2	18.3	
Family Affluence Score (FAS)[b]						<0.001
n	2601	517	573	921	590	
High	19.6	32.0	21.2	16.4	12.4	
Medium	50.8	48.3	50.9	53.2	49.1	
Low	29.6	19.7	27.8	30.4	38.5	
Main language spoken at home						<0.001
n	2597	549	592	939	517	
French or Dutch	92.5	97.6	96.1	92.4	83.0	
Other language	7.5	2.4	3.9	7.6	17.0	
Family structure						<0.001
n	2787	535	604	1011	637	
Living with both parents	66.3	57.9	62.9	73.8	64.5	
Other situations	33.7	42.1	37.1	26.2	35.5	

[a] M0 = natives; M1/2 = second-generation immigrants with 1 parent born abroad; M2 = second-generation immigrants with two parents born abroad; M1 = first-generation immigrants.

[b] The FAS is based on a 6-item questionnaire concerning the material assets in the child's household. The scale was categorized into 'low FAS' (between 0 and 6), 'middle FAS' (between 7 and 9) and 'high FAS' (between 10 and 13).

consumption, time spent sleeping and weekly alcohol consumption) (model 2), the association between overweight and immigration status became non-significant for second-generation immigrants with only one parent born abroad. Only second-generation immigrants with both parents born abroad remained at higher risk for overweight (OR = 1.79 [1.15−2.76]) (Table 4).

Discussion

The objective of our study was to examine the relationship between immigration status and health behaviours and outcomes among school adolescents in the multicultural context of the BCR. Our findings indicate that numerous adolescent health behaviours were closely related to immigration background. Immigrant teenagers were less prone to engage in weekly alcohol consumption, whereas they were more likely to report unhealthy dietary, physical activity and sleep habits. Specific health behaviours pertaining to substance use and diet, for instance, may arise out of home culture and religion and are characterized by the diversity of existing situations in relation to the country of origin.[25] For instance, in the BCR, adolescents born in Maghreb or in Turkey were less likely to have experienced drunkenness, whereas no difference was observed between other first-generation immigrants and natives.[26] Yet, some health behaviours observed at higher rates among immigrant adolescents, such as soft drink consumption and screen time, are less dependent on the culture of origin and are typical of socio-economically disadvantaged children in general.[27] Especially noticeable among second-generation immigrants, these unhealthy habits may be the consequence of acculturation and deterioration of life conditions with increasing time of residence in the host country.[20,28]

Despite the fact that young immigrants in the BCR were more likely to engage in several unhealthy habits than their native-born counterparts, it was observed that self-rated health and multiple recurrent symptoms did not differ between students with different immigration status. These findings also contradict previous studies which established the negative impact of immigration on adolescent physical and mental health.[14,28−30] The association is usually attributed to socio-economic inequities and to a shortage of social integration at school. In this regard, the FAS of immigrant teenagers was found to be lower than that of natives. In addition, the FAS turned out to be associated with self-rated health and multiple recurrent symptoms: As the FAS increased, health outcomes tended to become more favourable.[22] Thus, other factors are probably acting as a counterbalance on the adverse effect related to the socio-economic context. Previous studies have underlined the role of discrimination exposure in the negative mental health outcomes associated with immigration.[16−18] In this respect, the multicultural environment of the BCR may foster higher peer acceptance and lower discrimination at school and thus positively influence mental health outcomes. In the present study, for instance, the perception of relationships with classmates did not vary with immigration status.[26] In addition, in our study, well-being and health perception were both

Table 2 — Association between health behaviours and immigration status.

Variable	M1/2[a] (n=623)		M2[a] (n=1029)		M1[a] (n=667)	
	OR	95% CI	OR	95% CI	OR	95% CI
Breakfast weekday daily (vs. non-daily)	0.60	0.47—0.75***	0.46	0.38—0.58 ***	0.40	0.32—0.51***
Family dinner daily (vs. non-daily)	0.66	0.52—0.86**	0.40	0.32—0.50***	0.32	0.25—0.40***
Fast-food consumption weekly (vs. non-weekly)	1.59	1.23—2.05***	1.76	1.40—2.22***	1.51	1.17—1.94**
Vegetables consumption daily (vs non-daily)	0.64	0.51—0.81***	0.49	0.39—0.60***	0.47	0.37—0.59***
Sodas consumption daily (vs. non-daily)	1.28	1.00—1.62*	1.53	1.23—1.89***	1.33	1.05—1.62*
Time taking part in sport ≥2 h/week (vs. <2 h/week)	0.93	0.72—1.20	0.70	0.56—0.87**	0.80	0.63—1.03
Screen time weekday ≥2 h/day (vs. <2 h/day)	1.36	0.96—1.93	1.70	1.24—2.35**	2.18	1.49—3.19***
Time sleeping weekday <9 h/day (vs. ≥9 h/day)	1.19	0.94—1.51	1.70	1.36—2.12***	2.45	1.90—3.15***
Alcohol consumption weekly (vs. non-weekly)	0.38	0.23—0.62***	0.15	0.09—0.27***	0.40	0.24—0.64***
Current tobacco use daily or non-daily (vs. never)	0.85	0.58—1.25	0.81	0.58—1.14	0.92	0.63—1.32

*P < 0.05; **P < 0.01; ***P < 0,001.
OR, odds ratio; CI, confidence interval.
[a] M0 = natives; M1/2 = second-generation immigrants with 1 parent born abroad; M2 = second-generation immigrants with two parents born abroad; M1 = first-generation immigrants.

Table 3 — Association between health status indicators and immigration status.

Variable	M1/2[a]		M2[a]		M1[a]	
	OR	95% CI	OR	95% CI	OR	95% CI
Self-rated health						
n	613		999		648	
Fair to poor (vs. excellent to good)	1.53	0.87—2.69	1.64	0.97—2.74	1.31	0.74—2.32
Multiple recurrent symptoms						
n	554		911		593	
Yes (vs. no)	1.01	0.79—1.29	0.88	0.71—1.1	0.97	0.76—1.24
Overweight						
n	411		605		417	
Yes (vs. No)	1.79	1.19—2.7 **	2.13	1.46—3.1 ***	1.79	1.19—2.7 **

*P < 0.05; **P < 0.01; ***P < 0,001.
OR, odds ratio; CI, confidence interval.
[a] M0 = natives; M1/2 = second-generation immigrants with 1 parent born abroad; M2 = second-generation immigrants with two parents born abroad; M1 = first-generation immigrants.

associated with family structure: Teenagers living with both parents were more likely to report a good self-rated health.[22] It is noteworthy that the proportion of adolescents living with both parents was significantly higher among students with a migration background, which may have therefore also represented a protective factor for such health indicators.[26] Moreover, despite the validation of self-reported health indicators, the issue of their cross-cultural comparability could introduce bias in estimating the association between self-rated health and immigration status. Indeed, a comprehensive review of literature concluded that health perception depends on nationality and ethnicity.[31]

Among the different health status outcomes which were investigated in this study, overweight was the only one to be associated with immigration status. Even though overweight is a multifactorial condition, unhealthy lifestyle habits and environments are the main risk factors incriminated.[32] In the present study, adolescents with an immigration background were more likely to be overweight. Two systematic literature reviews studying the association between overweight and immigration status in adolescents living in Europe reached the same conclusion.[32,33] After controlling for sociodemographic factors, first-generation immigrants did not differ from native adolescents anymore, suggesting that the poor socioeconomic conditions characterizing this category of immigrants influence their bodyweight status. Indeed, many studies have established the negative association between socioeconomic status and youth overweight. Financial aspects

Table 4 – Multivariable logistic regression models examining the association between overweight and immigration status.

Variable	Model 0 (n = 1836)		Model 1 (n = 1571)		Model 2 (n = 1395)	
	OR	95% CI	OR	95% CI	OR	95% CI
Immigration status (vs. natives)						
Second-generation immigrants with one parent born abroad	1.76	1.16—2.65 **	1.80	1.18—2.76 *	1.56	0.98—2.46
Second-generation immigrants with both parents born abroad	2.06	1.41—3.02 ***	1.90	1.27—2.85 *	1.79	1.15—2.76 *
First-generation immigrants	1.69	1.12—2.56 *	1.39	0.88—2.21	1.19	0.72—1.97
Gender						
Female vs. Male	0.89	0.70—1.15	0.88	0.67—1.15	0.91	0.68—1.21
Age (vs. 10—11 years)						
12—13 years	1.46	0.88—2.42	1.28	0.75—2.19	1.02	0.58—1.83
14—15 years	1.61	0.98—2.65	1.31	0.77—2.23	1.05	0.58—1.92
16—18 years	1.22	0.75—1.98	1.05	0.62—1.78	0.72	0.39—1.34
19—22 years	1.86	1.10—3.15 *	1.66	0.94—2.93	1.14	0.58—2.22
Family affluence scale (vs. high)						
Middle			1.18	0.83—1.68	1.09	0.75—1.57
Low			1.55	1.10—2.28 *	1.42	0.97—2.09
Main language spoken at home						
Other language vs. French/Dutch			2.15	1.37—3.38 **	1.81	1.09—3.02 *
Breakfast on weekday						
Daily vs. non-daily					0.70	0.52—0.95 *
Vegetables consumption						
Daily vs. non-daily					0.96	0.72—1.29
Time spent sleeping on weekday						
<9 h/day vs. ≥ 9 h/day					1.42	0.96—2.11
Alcohol consumption						
Weekly vs. non-weekly					0.67	0.32—1.39

*P < 0.05; **P < 0.01; ***P < 0,001.
OR, odds ratio; CI, confidence interval.

such as family budget allocated to food and children's extra-curricular activities, as well as other health-related attitudes, can contribute to this association.[34,35] In addition, our findings indicate that teenagers from households where the dominant language was neither French nor Dutch were more likely to be overweight. Being allophone may indeed have an impact on family isolation from the Belgian society, with possible repercussions on healthcare knowledge and access.[36,37]

Further adjusting for several health behaviours including daily breakfast consumption made the association between immigration status and overweight disappear for second-generation immigrants with one parent born abroad. These specific lifestyle habits adding to the impact of low family socio-economic status are likely to be maintained from the culture of origin or to be related to the level of health literacy of the adolescent and his/her family.[33]

Thus, even after taking into account several sociodemographic parameters and health behaviours, second-generation immigrants with both parents born abroad remained more at risk for overweight than natives. First, this result may be partly explained by beauty ideals which are culturally determined and may influence body image perception and, indirectly, bodyweight status.[33] In our sample, there was no association between overweight and perception of beauty among adolescents with a migration background, whereas overweight natives were less likely to consider themselves 'beautiful' or 'very beautiful' than normal-weight or underweight native teenagers (data not shown). Second, linked to biological heredity, some

differences in health and anthropological characteristics may be observed depending on ethnicity. For instance, to conclude their systematic literature review on this topic, Gualdi-Russo et al.[33] recommended a well-advised use of growth reference charts to monitor immigrant children. Third, some aspects pertaining to the adolescent's life environment, such as the level of education of the parents, parental supervision after school and school context (e.g., soft drink availability, health promotion interventions), may have contributed to the association observed in this category of immigrants.[38,39]

It is essential to underscore the particularly high rate of non-response for self-reported height and weight (37%), as well as the potential reporting bias linked to social desirability in this study. However, a recent meta-analysis has concluded that the BMI based on self-reported data represented a reliable alternative to anthropometric measures in the screening of overweight among children and adolescents.[40] Another limitation of our study is that the 2014 HBSC survey did not aim to produce health indicators specifically for teenagers with an immigration background but rather for the overall adolescent population. As a consequence, in some subcategories of the analysis, sample size was relatively small, and one should therefore be cautious with the extrapolating of findings. In addition, even if we controlled for several confounding factors, residual confounding in the relationship between migration status and bodyweight status cannot be ruled out and may limit our interpretation. Finally, refugees, asylum seekers and out-of-school immigrant teenages, whose

situations are highly specific, were not included in the current research.[41,42] The aforementioned limitations would be important to consider in the further development of health promotion actions towards immigrant adolescents, which would therefore need to be better supported by complementary research studies. Indeed, few studies have evaluated health promotion interventions targeting immigrant youth.[43,44] These studies however pinpoint the need to adjust the interventions to the specificities of this population while taking into consideration heterogeneity in immigrant situations.

The present study which is based on a standardized data collection procedure provides new insight into the relationship between immigration status and a wide range of health promotion indicators, by taking measure of socio-economic status, family structure, language spoken at home, age and gender into account. Several health behaviours and weight status varied according to immigration status among adolescents attending schools in the multicultural context of the BCR, whereas this was not the case for self-rated health indicators. Such results could be related to the adolescent culture of origin and also to their socio-economic status, social environment (school, family, and peers) and acculturation process. This study paves the way towards better understanding of health behaviours and outcomes associated with immigration background. Further research is needed to identify individual risk and protective factors related to cultural identity and immigration background. In addition to individual characteristics, future investigations could also explore the role of contextual aspects – i.e., school context – on the association between immigration and health. Indeed, schools and health promotion services could represent opportunities to tackle health inequalities related to the student's financial situation by developing school environments that promote healthy eating and physical activity. They could also participate in improving health literacy of immigrant youth and their families (including participatory approaches, language-adapted information material …).

Author statements

Ethical approval

The study was approved by the regional education boards of the four different school networks in the Federation Wallonia-Brussels (Conseil de l'Enseignement des Communes et des Provinces, Direction Générale de l'Enseignement obligatoire de la Fédération Wallonie-Bruxelles, Conseil des Pouvoirs organisateurs de l'Enseignement official neutre subventionné, Secrétariat Général de l'Enseignement Catholique).

Competing interests

None to declare.

Data statement

Data available on request to the principal investigators.

REFERENCES

1. Ujcic-Voortman JK, Baan CA, Seidell JC, et al. Obesity and cardiovascular disease risk among Turkish and Moroccan migrant groups in Europe: a systematic review. *Obes Rev* 2012;**13**(1):2–16.
2. Kouider EB, Koglin U, Petermann F. Emotional and behavioral problems in migrant children and adolescents in Europe: a systematic review. *Eur Child Adolesc Psychiatry* 2014;**23**(6):373–91.
3. Solé-Auró A, Crimmins EM. Health of immigrants in European countries. *Int Migr Rev* 2008;**42**(4):861–76.
4. Gualdi-Russo E, Rinaldo N, Khyatti M, et al. Weight status, fatness and body image perception of North African immigrant women in Italy. *Public Health Nutr* 2016;**19**(15):2743–51.
5. Ahmed SH, Meyer HE, Kjøllesdal MK, Madar AA. Prevalence and predictors of overweight and obesity among Somalis in Norway and somaliland: a comparative study. *J Obes* 2018;**3**:4539171.
6. International Organization for Migration. *World migration report 2015*. 2015. Available at: http://publications.iom.int/books/world-migration-report-2015-migrants-and-cities-new-partnerships-manage-mobility. [Accessed December 2017].
7. Rechel B, Mladovsky P, Ingleby D, et al. Migration and health in an increasingly diverse Europe. *Lancet* 2013;**381**(9873):1235–45.
8. Darmon N, Khlat M. An overview of the health status of migrants in France, in relation to their dietary practices. *Public Health Nutr* 2001;**4**(2):163–72.
9. Racape J, Schoenborn C, Sow M, et al. Are all immigrant mothers really at risk of low birth weight and perinatal mortality? The crucial role of socio-economic status. *BMC Pregnancy Childbirth* 2016;**16**(1):75.
10. Giannoni M, Franzini L, Masiero G. Migrant integration policies and health inequalities in Europe. *BMC Public Health* 2016;**16**(1):463.
11. Baumann M, Chau K, Kabuth B, et al. Association between health-related quality of life and being an immigrant among adolescents, and the role of socioeconomic and health-related difficulties. *Int J Environ Res Public Health* 2014;**11**(2):1694–714.
12. Brettschneider A-K, Hölling H, Schlack R, et al. Mental health in adolescents in Germany: a comparison with regard to

migration background and country of origin. *Bundesgesundheitsblatt - Gesundheitsforsch - Gesundheitsschutz* 2015;**58**(4—5):474—89.

13. Molcho M, Cristini F, Nic Gabhainn S, et al. Health and well-being among child immigrants in Europe. *Eurohealth* 2010;**16**(1):20—3.

14. Vieno A, Santinello M, Lenzi M, et al. Health status in immigrants and native early adolescents in Italy. *J Community Health* 2009;**34**(3):181—7.

15. West P. Health inequalities in the early years: is there equalisation in youth? *Soc Sci Med* 1997;**44**(6):833—58.

16. Aspinall PJ. Suicide amongst Irish migrants in Britain: a review of the identity and integration hypothesis. *Int J Soc Psychiatry* 2002;**48**(4):290—304.

17. Bécares L, Nazroo J, Stafford M. The buffering effects of ethnic density on experienced racism and health. *Health Place* 2009;**15**(3):700—8.

18. Bhugra D, Jones P. Migration and mental illness. *BJPsych Adv* 2001;**7**(3):216—22.

19. Myria. *La migration en chiffres et en droits*. 2017. Available at: http://www.myria.be/fr/publications/la-migration-en-chiffres-et-en-droits-2017. [Accessed January 2017].

20. Inchley J, Currie D. *Growing up unequal: Gender and socioeconomic differences in young people's health and well-being*. 2013. Available at: http://www.euro.who.int/en/publications/abstracts/growing-up-unequal.-hbsc-2016-study-20132014-survey. [Accessed January 2018].

21. Currie C, Inchley J, Molcho M, et al. *HBSC Study Protocol: Background, methodology and mandatory items for the 2013/2014 survey*. 2014. Available at: http://www.hbsc.org. [Accessed December 2017].

22. Moreau N, Lebacq T, Dujeu M, et al. *Comportements, bien-être et santé des élèves: enquête HBSC 2014 en 5e-6e primaire et dans le secondaire en Fédération Wallonie-Bruxelles*. 2017. Available at: http://sipes.ulb.ac.be/. [Accessed January 2018].

23. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes* 2012;**7**(4):284—94.

24. Hosmer DW, Lemeshow S, Sturdivant RX. *Applied logistic regression*. 3rd ed. Wiley; 2013. p. 528.

25. Sordo L, Iciar Indave B, Pulido J, et al. Epidemiology of alcohol abuse among Spanish immigrant populations. *Adicciones* 2015;**27**(2).

26. Méroc E, Moreau N, Dujeu M, et al. *Comportements, bien-être et santé selon le statut migratoire des adolescents scolarisés en Région de Bruxelles-Capitale*. 2017. Available at: http://sipes.ulb.ac.be/index.php?option=com_mtree&task=viewlink&link_id=228&Itemid=. [Accessed January 2017].

27. Jusot F, Silva J, Dourgnon P, et al. *Etat de santé des populations immigrées en France*. 2008. Available at: https://www.researchgate.net/profile/Catherine_Sermet/publication/5129659_Etat_de_sante_des_populations_immigrees_en_France/links/0912f50af6f6d6bd09000000/Etat-de-sante-des-populations-immigrees-en-France.pdf. [Accessed January 2018].

28. Grande H de, Vandenheede H, Gadeyne S, et al. Health status and mortality rates of adolescents and young adults in the Brussels-Capital Region: differences according to region of origin and migration history. *Ethn Health* 2014;**19**(2):122—43.

29. Kolarcik P, Geckova AM, Reijneveld SA, et al. The mediating effect of discrimination, social support and hopelessness on self-rated health of Roma adolescents in Slovakia. *Int J Equity Health* 2015;**14**(1):137.

30. Nielsen SS, Krasnik A. Poorer self-perceived health among migrants and ethnic minorities versus the majority population in Europe: a systematic review. *Int J Public Health* 2010;**55**(5):357—71.

31. Bombak AE, Bruce SG. Self-rated health and ethnicity: focus on indigenous populations. *Int J Circumpolar Health* 2012;**71**(1):18538.

32. Labree LJW, van de Mheen H, Rutten FFH, et al. Differences in overweight and obesity among children from migrant and native origin: a systematic review of the European literature. *Obes Rev* 2011;**12**(5):e535—47.

33. Gualdi-Russo E, Zaccagni L, Manzon VS, et al. Obesity and physical activity in children of immigrants. *Eur J Public Health* 2014;**24**(suppl_1):40—6.

34. Barriuso L, Miqueleiz E, Albaladejo R, et al. Socioeconomic position and childhood-adolescent weight status in rich countries: a systematic review, 1990—2013. *BMC Pediatr* 2015;**15**(1):129.

35. Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *Int Rev Psychiatry* 2012;**24**:176—88.

36. Eneriz-Wiemer M, Sanders LM, Barr DA, et al. Parental limited English proficiency and health outcomes for children with special health care needs: a systematic review. *Acad Pediatr* 2014;**14**(2):128—36.

37. Stella MY, Singh GK. Household language use and health care access, unmet need, and family impact among CSHCN. *Pediatrics* 2009;**124**(Supplement 4):S414—9.

38. Fernández-Alvira JM, Bourdeaudhuij I de, Singh AS, et al. Clustering of energy balance-related behaviors and parental education in European children: the ENERGY-project. *Int J Behav Nutr Phys Act* 2013;**10**(1):5.

39. Inskip H, Baird J, Barker M, et al. Influences on adherence to diet and physical activity recommendations in women and children: insights from six European studies. *Ann Nutr Metab* 2014;**64**(3—4):332—9.

40. He J, Cai Z, Fan X. Accuracy of using self-reported data to screen children and adolescents for overweight and obesity status: a diagnostic meta-analysis. *Obes Res Clin Pract* 2017;(3):257—67.

41. Renard F, Martin E, Cueva C, et al. Newly immigrant adolescents health and quality of life in Belgium: screening and prevention in school medicine. *Arch Pediatr* 2005;**12**(10):1471—7.

42. Hollifield M, Warner TD, Lian N, et al. Measuring trauma and health status in refugees: a critical review. *J Am Med Assoc* 2002;**288**(5):611—21.

43. Miller AB, Bixby CB, Ellis BH. School-based interventions. In: Patel S, Reicherter D, editors. *Psychotherapy for immigrant youth*. Cham: Springer; 2016.

44. Bal A, Perzigian A. Evidence-based interventions for immigrant students experiencing behavioral and academic problems: a systematic review of the literature. *Educ Treat Child* 2013;**36**:5—28.

Appendix 1. Birth country

Birth country of the child:

Belgium (n = 2203), Morocco (n = 85), Democratic Republic of Congo (n = 67), Romania (n = 66), Spain (n = 49), Poland (n = 48), Italy (n = 34), France (n = 34), Portugal (n = 30), Guinea Conakry (n = 29), Brazil (n = 28), Armenia (n = 19), Turkey (n = 16), Ecuador (n = 15), Bulgaria (n = 14), Cameroon (n = 12), Albania (n = 12), Ru+ssia (n = 11), Algeria (n = 8), Ivory Coast (n = 8), Germany (n = 7), Lebanon (n = 7), China (n = 6), Pakistan (n = 6), Rwanda (n = 6), Syria (n = 6), Kosovo (n = 6), Togo (n = 5), Ukraine (n = 5), Chili (n = 5), North Macedonia (n = 5), Thailand (n = 5), United Kingdom (n = 4), United States

of America (n = 4), Afghanistan (n = 4), Colombia (n = 4), Greece (n = 4), Iran (n = 4), Senegal (n = 4), Angola (n = 3), Niger (n = 3), Burundi (n = 3), Switzerland (n = 3), Somalia (n = 3), Tunisia (n = 3), the Philippines (n = 2), Vietnam (n = 2), Austria (n = 2), Canada (n = 2), Croatia (n = 2), Dominican Republic (n = 2), Egypt (n = 2), Finland (n = 2), Indonesia (n = 2), Iraq (n = 2), Moldavia (n = 2), Mongolia (n = 2), Nepal (n = 2), Nigeria (n = 2), Serbia (n = 2), South Africa (n = 2), Australia (n = 1), Benin (n = 1), Belarus (n = 1), Central African Republic (n = 1), Denmark (n = 1), El Salvador (n = 1), India (n = 1), Luxembourg (n = 1), Madagascar (n = 1), Mauritania (n = 1), Mozambique (n = 1), the Netherlands (n = 1).

Birth country of the father:

Belgium (n = 803), Morocco (n = 755), Turkey (n = 177), Democratic Republic of Congo (n = 143), Romania (n = 71), France (n = 68), Portugal (n = 62), Algeria (n = 59), Poland (n = 59), Italy (n = 53), Guinea Conakry (n = 42), Spain (n = 32), Brazil (n = 31), Armenia (n = 27), Tunisia (n = 27), Syria (n = 21), Ecuador (n = 20), Lebanon (n = 19), Albania (n = 19), Pakistan (n = 18), North Macedonia (n = 18), Bulgaria (n = 17), Greece (n = 17), Cameroon (n = 13), Angola (n = 12), Germany (n = 11), Rwanda (n = 11), Russia (n = 10), Ivory Coast (n = 10), Togo (n = 10), Vietnam (n = 9), Iran (n = 8), Colombia (n = 7), Senegal (n = 7), United States of America (n = 6), Serbia (n = 6), Afghanistan (n = 6), India (n = 6), China (n = 5), Somalia (n = 5), Iraq (n = 5), South Korea (n = 5), The Philippines (n = 5), Burundi (n = 5), Ukraine (n = 4), Egypt (n = 4), Nigeria (n = 4), Mauritania (n = 4), Chili (n = 3), United Kingdom (n = 3), Nepal (n = 3), Japan (n = 3), Moldavia (n = 3), Mali (n = 3), Venezuela (n = 3), Niger (n = 3), Central African Republic (n = 2), Canada (n = 2), Croatia (n = 2), Dominican Republic (n = 2), the Netherlands (n = 2), Ghana (n = 2), Finland (n = 2), Indonesia (n = 2), Bangladesh (n = 2), Peru (n = 2), Argentina (n = 2), Ireland (n = 2), Israel (n = 2), Bosnia (n = 2), Benin (n = 2), Belarus (n = 1), Denmark (n = 1), El Salvador (n = 1), Luxembourg (n = 1), Madagascar (n = 1), Bolivia (n = 1), Cuba (n = 1), Djibouti (n = 1), Libya (n = 1), Sweden (n = 1), Ethiopia (n = 1), Hungary (n = 1), Georgia (n = 1), Martinique (n = 1), Laos (n = 3), Uganda (n = 1), Uzbekistan (n = 1), Czech Republic (n = 1), Kosovo (n = 1), Mongolia (n = 1), Austria (n = 1).

Birth country of the mother:

Belgium (n = 928), Morocco (n = 649), Democratic Republic of Congo (n = 151), Turkey (n = 145), Poland (n = 78), Portugal (n = 72), France (n = 71), Romania (n = 70), Spain (=45), Italy (n = 43), Guinea Conakry (=43), Algeria (n = 41), Brazil (n = 33), Armenia (n = 33), Kosovo (n = 29), Ecuador (n = 24), Germany (n = 18), Bulgaria (n = 17), Tunisia (n = 17), North Macedonia (n = 16), Albania (n = 15), Rwanda (n = 15), Lebanon (n = 15), Syria (n = 14), Pakistan (n = 14), Cameroon (n = 14), Ivory Coast (11), Algeria (n = 11), Ukraine (n = 9), China (n = 9), Russia (n = 9), Angola (n = 9), the Philippines (n = 9), Togo (n = 8), Vietnam (n = 8), Senegal (n = 7), Iran (n = 7), the Netherlands (n = 6), Colombia (n = 6), Afghanistan (=6), Greece (n = 6), India (n = 5), Indonesia (n = 5), Iraq (n = 5), Moldavia (n = 5), Somalia (n = 5), Nigeria (n = 4), Peru (n = 4), United States of America (n = 4), Canada (n = 3), Chili (n = 3), Croatia (n = 3), Germany (n = 3), Ghana (n = 3), Mali (n = 3), Luxembourg (n = 3), Niger (n = 3), Mauritius (n = 3), South Korea (n = 3), Mauritania (n = 3), Serbia (n = 3), Switzerland (n = 3), Thailand (n = 3), Central African Republic (n = 2), Dominican Republic (n = 2), Laos (n = 2), Mexico (n = 2), Austria (n = 2), Nepal (n = 2), Senegal (=2), Djibouti (n = 2), Albania (n = 2), Egypt (n = 2), South Africa (n = 1), Sierra Leone (n = 1), Argentina (n = 1), Belarus (n = 1), Bosnia (=1), Burundi (n = 1), Cyprus (n = 1), Cuba (n = 1), Finland (n = 1), Mongolia (n = 1), Sweden (n = 1), Ethiopia (n = 1), Hungary (n = 1), Ireland (n = 1), Japan (n = 1), Jordan (n = 1), Georgia (n = 1), Bangladesh (n = 1), Uzbekistan (n = 1), Republic of Seychelles (n = 1), Slovakia (n = 1).