Neighbourhood socioeconomic circumstances, adiposity and cardiometabolic risk measures in children with severe obesity.

Abstract:

Background: It has recently been shown that neighbourhood socioeconomic disadvantage in childhood is associated with obesity, hypertension, fatty liver, and type 2 diabetes in adulthood. However, it is largely unknown whether neighbourhood socioeconomic circumstances are important predictors of adiposity and associated measures in children, especially in those with severe obesity. Therefore, we evaluated the associations between neighbourhood socioeconomic factors with the severity of obesity, and related cardiometabolic risk factors in a cohort of obese children.

Methods: The Childhood Overweight BioRepository of Australia (COBRA) cohort study comprises 444 children (mean age 11.1 years, mean BMI z-score 2.5). Neighbourhood socioeconomic advantage/disadvantage was evaluated based on postcode information by the national Australian Socio-Economic Indexes for Areas (SEIFA) scores. Participants/parents also completed self-administered questionnaires on neighbourhood related facilities, family education and family income.

Results: In analyses adjusted for age, sex and pubertal status, SEIFA indicating neighbourhood education/occupation was negatively associated with BMI, waist circumference and body fat%. Higher family education was associated with lower BMI. Neighbourhood walkability was related to lower waist circumference. Good shopping facilities in the neighbourhood were associated with increased risk of dyslipidemia and fatty liver, and the existence of parks and playgrounds nearby was related to dyslipidemia.

Conclusions: The present data suggest that neighbourhood-related issues are associated with less severe adiposity among children with established obesity. Concerning cardiometabolic risk factors, shopping facilities were related to dyslipidemia and fatty liver. These findings suggest that increased awareness and efforts are needed to diminish socioeconomic inequalities between neighbourhoods.

Key words: socioeconomic, childhood, adiposity

Introduction

The childhood obesity pandemic is one the most alarming trends for public health worldwide. Current forecasts suggest that the life expectancy of today's children will be shorter than their parents(1). To counteract the existing weight-trajectory trends and provide useful information for early prevention and intervention of obesity, it is essential to identify modifiable factors that are associated with obesity in childhood and its cardiometabolic complications, such as dyslipidemia, elevated blood pressure and non-alcoholic fatty liver disease (NAFLD).

Familial factors, such as having parents with obesity, have been consistently associated with obesity risk in offspring (2-4). In addition, household socioeconomic status (i.e. family education, occupation or income) has been related with child adiposity, independent of parental BMI levels (3, 5). Furthermore, it has recently been shown, in population-based longitudinal studies commencing in childhood, that neighbourhood socioeconomic disadvantage is associated with obesity, hypertension, fatty liver, and type 2 diabetes in adulthood (6). However, it is largely unknown whether neighbourhood socioeconomic circumstances are important predictors of adiposity and associated measures in children, especially in those with severe obesity.

In the present study, we utilized data from the Childhood Overweight BioRepository of Australia (COBRA) cohort. Our primary aim was to examine whether neighbourhood socioeconomic advantage/disadvantage is associated with the severity of obesity, and pre-clinical cardiometabolic measures.

Material and Methods

The Childhood Overweight BioRepository of Australia (COBRA) study was established through the weight management service at a tertiary children's hospital and data have been collected since 2009 (7). Children and adolescents were referred to the service by general practitioners or pediatricians with pre-referral criteria needing to be met. These are i) aged <10 years and BMI >95th percentile or aged >10 years with BMI >95th percentile and established comorbidity (dyslipidemia, hypertension, type 2 diabetes or insulin resistance, polycystic ovary syndrome, obstructive sleep apnea, NAFLD). Individuals with a recognized syndromic cause for obesity or insufficient English language skills necessary to complete self-administered surveys were excluded. This study is conducted in accordance with the RCH Human Ethics Committee and Helsinki Principles.

Clinical variables

Anthropometry, demographic and clinical data were collected at clinic visits, including height, weight, waist circumference, body composition by 4-point bioelectrical impedance (Tanita, USA), and pubertal status. To measure blood pressure, a standard clinical device with a cuff at least half of the distance between elbow and shoulder was used. Body-mass index (BMI) was calculated by dividing the weight (kg) by the height in meters squared (m^2) and converted into BMI z-scores adjusted for age and sex using the US Center for Disese Control (CDC) growth reference charts. A specialist pediatric endocrinologist or a consultant general pediatrician assessed the Tanner stage for pubertal development, where Tanner 1 was considered pre-pubertal, Tanner 2-3 peri-pubertal, Tanner 4-5 post-pubertal.

Blood samples were taken after an overnight fast. Glucose levels, lipid profile, and liver enzymes were analyzed with standard methods. Dyslipidemia was defined as a presence of one of the following; total cholesterol ≥ 5.2 mmol/L, triglycerides ≥ 1.13 mmol/L (age 0-9 years) or ≥ 1.5 mmol/L (age 10-19 years) or LDL cholesterol ≥ 3.4 mmol/L or HDL cholesterol ≥ 1.04 mmol/L. NAFLD was defined using age-specific reference intervals for elevated ALT (≥ 45.0 IU/L, 1-6 years; ≥ 25.0 IU/L, 6-9 years; ≥ 35.0 IU/L, 9-13 years; ≥ 55.0 IU/L; 13-15 years; ≥ 45.0 IU/L 15-19 years) or GGT (≥ 40.0 IU/L, 1-18 years) and/or the presence of fatty liver infiltrates on liver ultrasonography.

Questionnaire data

Data on socioeconomic variables were collected during the patients' visits at the clinic. To evaluate neighbourhood socioeconomic position, four different Socio-Economic Indexes for Areas (SEIFA) scores were used based on the postcode where the participant lived: education and occupation, economic resources, relative socio-economic advantage and disadvantage, and relative socio-economic disadvantage(8). These national SEIFA indices are standardized scores derived by geographic area compiled from census data to numerically summarize the social and economic conditions of Australian neighbourhoods; they have a national mean of 1000 and a standard deviation of 100, where higher values represent more advantage and lower values less advantage (8).

Participants and/or their guardians also answered questionnaires relating to family socioeconomic position ie. highest parental education and income, and neighbourhood facilities such as parks and playgrounds ("Are there good parks and playgrounds/play spaces?"), shops ("Is there good access to basic shopping facilities?"), walking possibilities ("Are there many places to go within easy walking

distance") and safety ("Is it safe to live?"). These data were available for between 147 and 223 participants depending on the variable.

Leisure-time physical activity was evaluated by questions estimating the time in hours per day of physical activity outside both at school and on non-school days. These data were available for 221 participants.

Statistical analyses

The present analyses were conducted in a cross-sectional setting. Linear regression models were performed to analyse the associations between exposure variables and continuous outcomes (BMI, waist circumference, body fat %, blood pressure and glucose). Logistic regression models were performed with categorical outcomes (dyslipidemia, NAFLD). First, the analyses were performed adjusting for age and sex, and then additionally for pubertal status and BMI (for non-adiposity outcome variables). In addition, several sensitivity analyses were performed in subgroups having data on all analysed variables taking into account i) both neighbourhood and family SES, ii) leisure-time physical activity and iii) several different neighbourhood variables. All statistical tests were performed using SAS version 9.4(SAS institute Inc., Cary, NC) with statistical significance inferred at a 2-tailed p-value <0.05.

Results

Characteristics of the cohort are shown in Table 1. Of 444 children, 48.1 % were boys and the mean age of the cohort was 11.1 years (range 1-18 years). Mean BMI was 32.6 kg/m^2, CDC z-score 2.5, (range 1.1 to 6.5), waist circumference 101 cm (N=332) and body fat% 42.6% (N=333). Blood pressure, lipid, glucose and liver data were available for between 269 and 368 participants. SEIFA data were available for all 444 children, and mean Relative Socio-Economic Advantage and Disadvantage score was 1001. Questionnaire data relating to neighbourhood area were available for 163 to 223 children, and family SES for 147 to 202 participants. As shown in Table 2, there were strong correlations especially between different SEIFA variables.

SES and adiposity measures

In all models, higher SEIFA indices for education/occupation and relative socioeconomic advantage/disadvantage were significantly associated with lower BMI (Table 3). Higher family education was also associated with lower BMI. Participant identification of the neighbourhood being 'friendly' for commuting by foot was also associated with lower BMI (all adjusted for age and sex).

Higher SEIFA for education/occupation was related with lower waist circumference and body fat%. SEIFA for relative socioeconomic advantage/disadvantage and a neighbourhood 'friendly' for commuting by foot were also associated with waist circumference.

SES and cardiometabolic risk factors

None of the SES variables were statistically significantly related with blood pressure or glucose levels (Table 4). Proximity to parks/playgrounds and shopping facilities was associated with dyslipidemia (Table 5). In addition, proximity to shopping facilities was also related with NAFLD in all models, whereas SEIFA for education/occupation was associated with NAFLD only in the model adjusted for age and sex.

Sensitivity analyses

Three different sensitivity analyses were performed in subgroups having data on all analysed variables. First, we included family SES (highest education/qualification) in the models examining the effects of neighbourhood variables (and adjusted for age, sex and pubertal stage). These models included data on 133-142 participants, whereas primary models had 202-438 observations available. When compared to the statistically significant associations in primary models (Table 3 and Table 5), for BMI the effect estimates were attenuated approximately 50%, for waist circumference they remained similar or increased, for body fat they decreased 80%, for dyslipidemia and NAFLD they increased. Second, leisure-time physical activity was similarly included in the primary models (N-values 182-205). In these analyses the effect estimates for BMI and waist circumference were attenuated approximately 50%, for body fat they decreased 70%, for dyslipidemia and NAFLD they increased. Finally, for the dyslipidemia analyses (Table 5), we performed a model including data on both parks and playgrounds and shopping (in addition to age, sex and pubertal stage. In this model the OR for parks and playgrounds changed from 1.85 (95% CI 1.10-3.03) to 1.47 (0.85-2.54) and OR for shopping from 1.84 (1.11-3.04) to 1.61 (0.93-2.79).

Discussion

In this cohort of children with severe obesity, we observed that neighbourhood education/occupation and relative socioeconomic advantage/disadvantage associated SEIFA scores were associated with adiposity measures, but not with cardiometabolic risk factors. Among individuals with questionnaire data available on neighbourhood related factors and family SES, good walking opportunities and higher parental education levels were associated with better adiposity status, whereas better access to basic shopping facilities was related with higher prevalence of dyslipidemia and fatty liver. Proximity to parks and playgrounds was associated with dyslipidemia.

Prior studies performed mainly among adult cohorts have consistently shown that neighbourhood factors are associated with obesity, type 2 diabetes and cardiovascular disease (6, 9-12). Of specific neighbourhood factors, better walkability has been associated with decreased prevalence of overweight/obesity and lower incidence of diabetes (13), whereas shorter distance to fast food outlets has been linked with increased BMI and waist circumference (14). Concerning the effects of neighbourhood on obesity in childhood and CVD, a Canadian study reported that children from disadvantaged neighbourhoods were more likely to develop a CVD risk factor or have a CVD event during a 34-year follow-up (15). In the 31-year follow-up of the Cardiovascular Risk in Young Finns study, life-course neighbourhood disadvantage was related with obesity, type 2 diabetes, hypertension and fatty liver (6). In terms of adiposity measures, our findings from a cohort of exclusively children with obesity are in line with these prior reports suggesting that neighbourhood socio-economic advantage and walkability are associated with lower BMI and waist circumference levels. In our sensitivity analyses, taking separately into account family SES or physical activity, especially the associations with BMI and body fat were considerably attenuated suggesting the

importance of these factors above neighbourhood disadvantage. However, the data from these sensitivity analyses should be interpreted cautiously as the majority of the participants did not have family SES or physical activity data. Concerning the pre-clinical metabolic outcomes, short distance to shopping facilities was associated with increased dyslipidemia and fatty liver risk. Somewhat surprisingly the existence of parks/playgrounds nearby was related with dyslipidemia. However, the areas with good shopping facilities may have more parks/playgrounds thus providing a possible bias (16). In the present cohort these variables had a moderate correlation of r=0.43 (Table 2). In a sensitivity analysis including data on these variables in the same model, both of their effects attenuated.

Possible mechanisms for the relationship between neighbourhood disadvantage and adiposity are most likely multifaceted, associated with lifestyle, behavioral and psychological factors. Interestingly, a US research group performed an intervention study among 4498 randomly assigned women with children living in public housing in high-poverty urban census tracts who were either 1) assigned to receive housing vouchers from the Department of Housing and Urban Development, which were redeemable only if they moved to a low-poverty census tract (where <10% of residents were poor), and counseling on moving; 2) assigned to receive unrestricted, traditional vouchers, with no special counseling on moving; and 3) assigned to a control group that was offered neither of these opportunities (10). At 10-15 years of follow-up, assignment to the low-poverty–voucher group was associated with a decreased risk of extreme obesity and diabetes.

Concerning the clinical and public health implications, the present data highlight the need for preventive efforts to tackle obesity at multiple levels, including individual, familial and community/neighbourhood interventions. Plausible intervention targets in disadvantaged areas

would be improved walkability and facilities for physical activity. To address obesity in childhood, novel ways are required to promote healthy food and drink choices. In addition, further research is needed to evaluate the effects of interventions to address risk factor differences between advantaged and disadvantaged areas on clinical disease outcomes, such as type 2 diabetes and clinical atherosclerotic disease.

There are several limitations that warrant consideration. A considerable number of participants did not have data on questionnaire derived neighbourhood variables and family SES variables. Therefore, even though we performed sensitivity analyses including data on both neighbourhood and family SES to examine whether the associations between SEIFA scores and study outcomes are independent of family SES, these analyses were not ideally powered. As many participants did not have data on blood pressure or laboratory based measures, the statistical power in these analyses were lower than that for BMI. Study participants are attending different schools, but we are not aware of specific policies in these schools regarding breaks, fitness classes etc. Therefore, we were not able to take this critical confounder into account in our analyses. In addition, we had data on leisure-time physical activity only among a minority of the cohort. As the study cohort comprises completely of individuals who are obese we could not examine the associations between neighbourhood and SES variables with cardiometabolic factors in a lean population. Finally, the present analyses were cross-sectional and therefore they cannot infer causality.

In conclusion, the present data show that among a population of children and adolescents with established severe obesity, neighbourhood advantage and living-related factors, such as walkability, are associated with less severe obesity. However, sensitivity analyses performed in subcohorts suggested that when taking into account family SES or physical activity, especially the associations

with BMI were considerably attenuated suggesting the importance of these factors. Proximity to shopping facilities were related with dyslipidemia and fatty liver.

Table 1. Characteristics of study cohort

Variable	N	Mean (SD)	Median (IQR)	%
Age (years)	447	11.1(3.6)		
Males	217			48.1
BMI (kg/m2)	444	32.6(7.6)		
BMI CDC z-score	444	2.5(0.5)		
Waist circumference (cm)	332	101(21)		
Body fat %	333	42.6(8.4)		
Systolic blood pressure (mmHg)	368	111(16)		
Glucose (mmol/l)	269	4.78(0.46)		
Non-alcoholic fatty liver disease	357			33.3
Dyslipidemia	356			24.4
Leisure-time physical activity (hours/day)	**221**	**1.5(1.3)**		
SEIFA: Education and Occupation	447	1004(80)		
Seifa: Economic resources	447	997(60)		
Seifa: Relative Socio-Economic Advantage and Disadvantage	447	1001(70)		
Seifa: Relative Socio-Economic Disadvantage	447	1000(70)		
Neighbourhood: Is it safe?*	163			0.6/6.1/52.8/40.5
Neighbourhood: Good parks and playgrounds, play spaces?*	219			1.8/11.0/50.7/36.5
Neighbourhood: Access to basic shopping facilities?*	223			4.5/5.8/45.3/44.4
Neighbourhood: Many places to go within easy walking distance*	224			8.9/25.0/45.1/21.0
Highest parental income (thousand AUD/year)	202		47(26-75)	
Highest parental education/qualification completed#	147			31.3/17.0/21.8/13.6/16.3

* 1 Strongly disagree, 2. Disagree, 3. Agree, 4. Strongly agree

1. Certificate, 2. Advanced diploma/diploma, 3. Bachelor degree, 4. Graduate diploma/certificate, 5. Postgraduate degree

Table 2. Correlations between different SES measures

		1	2	3	4	5	6	7	8	9	10
1) SEIFA: Education/occupation	r		0.37	0.94	0.84	0.23	0.30	0.22	0.25	-0.19	-0.20
	P-value		<.0001	<.0001	<.0001	0.003	<.0001	0.0009	0.0001	0.02	0.004
	N		447	447	447	163	219	223	224	154	202
2) SEIFA: Economic Resources	r	0.37		0.63	0.76	0.30	0.26	0.11	-0.11	-0.15	-0.19
	P-value	<.0001		<.0001	<.0001	<.0001	0.0001	0.09	0.10	0.06	0.007
	N	447		447	447	163	219	223	224	154	202
3) SEIFA: Socio-economic Advantage and Disadvantage	r	0.94	0.63		0.96	0.27	0.32	0.22	0.16	-0.22	-0.24
	P-value	<.0001	<.0001		<.0001	0.0004	<.0001	0.0007	0.02	0.007	0.0005
	N	447	447		447	163	219	223	224	154	202
4) SEIFA: Socio-economic Disadvantage	r	0.84	0.76	0.96		0.32	0.31	0.18	0.07	-0.21	-0.23
	P-value	<.0001	<.0001	<.0001		<.0001	<.0001	0.008	0.28	0.01	0.001
	N	447	447	447		163	219	223	224	154	202
5) Safety	r	0.23	0.30	0.27	0.32		0.41	0.15	0.04	-0.11	-0.07
	P-value	0.003	<.0001	0.0004	<.0001		<.0001	0.06	0.6	0.23	0.37
	N	163	163	163	163		160	162	163	111	145
6) Parks and playgrounds	r	0.30	0.26	0.32	0.31	0.41		0.43	0.33	-0.16	-0.07
	P-value	<.0001	0.0001	<.0001	<.0001	<.0001		<.0001	<.0001	0.05	0.36
	N	219	219	219	219	160		217	218	150	193
7) Shops	r	0.22	0.11	0.22	0.18	0.15	0.43		0.52	0.01	-0.06
	P-value	0.0009	0.09	0.0007	0.008	0.06	<.0001		<.0001	0.98	0.4
	N	223	223	223	223	162	217		221	149	196
8) Walkability	r	0.25	-0.11	0.16	0.07	0.04	0.33	0.52		0.02	0.01
	P-value	0.0001	0.1	0.02	0.28	0.6	<.0001	<.0001		0.79	0.95
	N	224	224	224	224	163	218	221		151	197
9) Family education	r	-0.19	-0.15	-0.22	-0.21	-0.11	-0.16	-0.01	0.02		0.36
	P-value	0.02	0.06	0.007	0.01	0.23	0.05	0.97	0.79		<.0001
	N	154	154	154	154	111	150	149	151		142
10) Family income	r	-0.20	-0.19	-0.24	-0.23	-0.07	-0.07	-0.06	0.01	0.36	
	P-value	0.004	0.007	0.0005	0.001	0.37	0.36	0.4	0.95	<.0001	
	N	202	202	202	202	145	193	196	197	142	

Table 3. The association of SES variables with adiposity measures.

		BMI (kg/m^2)	
SEIFA	N	Model 1	Model 2
Education and Occupation	438	**-0.87(-1.41 to -0.33)**	**-0.81(-1.40 to -0.23)**
Economic Resources	438	0.02(-0.52 to 0.56)	-0.14(-0.72 to 0.44)
Relative Socio-economic Advantage and Disadvantage	438	**-0.77(-1.31 to -0.23)**	**-0.75(-1.33 to -0.17)**
Relative Socio-economic Disadvantage	438	-0.46(-1.00 to 0.08)	-0.50(-1.08 to 0.08)
NEIGHBOURHOOD QUESTIONS			
Safety	160	0.46(-1.24 to 2.16)	0.61(-1.01 to 2.33)
Parks and playgrounds	216	-0.79(-1.97 to 0.39)	-0.51(-1.67 to 0.65)
Shopping	220	-0.17(-1.21 to 0.87)	-0.15(-1.19 to 0.89)
Many places to go by foot	221	**-1.08(-2.02 to -0.14)**	-0.73(-1.63 to 0.17)
FAMILY SES			
Highest education/qualification	144	**-0.78(-1.50 to -0.06)**	**-0.75(-1.41 to -0.09)**
Highest income	199	0.08(-0.22 to 0.38)	0.01(-0.29 to 0.31)
		Waist circumference (cm)	
SEIFA	N	Model 1	Model 2
Education and Occupation	326	**-2.2(-3.6 to -0.8)**	**-1.8(-3.2 to -0.4)**
Economic Resources	326	0.3(-1.1 to 1.7)	0.1(-1.3 to 1.5)
Relative Socio-economic Advantage and Disadvantage	326	**-1.7(-3.1 to -0.3)**	**-1.6(-3.0 to -0.2)**
Relative Socio-economic Disadvantage	326	-1.1(-2.5 to 0.3)	-1.0(-2.4 to 0.4)
NEIGHBOURHOOD QUESTIONS			
Safety	114	2.8(-1.2 to 6.8)	3.2(-1.0 to 7.4)
Parks and playgrounds	166	-0.9(-3.7 to 1.9)	-0.9(-3.9 to 2.1)
Shopping	167	-1.8(-4.4 to 0.8)	-1.9(-4.5 to 0.7)
Many places to go by foot	167	**-3.0(-5.2 to -0.8)**	**-2.7(-5.1 to -0.3)**
FAMILY SES			
Highest education/qualification	112	-1.1(-3.1 to 0.9)	-0.9(-2.5 to 0.7)
Highest income	149	0.6(-0.1 to 1.3)	0.5(-0.2 to 1.2)
		Body fat (%)	
SEIFA	N	Model 1	Model 2
Education and Occupation	328	**-1.0(-1.9 to -0.1)**	**-1.0(-1.9 to -0.1)**
Economic Resources	328	0.1(-0.7 to 0.9)	-0.1(-1.1 to 0.9)
Relative Socio-economic Advantage and Disadvantage	328	-0.7(-1.5 to 0.1)	-0.7(-1.7 to 0.3)
Relative Socio-economic Disadvantage	328	-0.3(-1.1 to 0.5)	-0.4(-1.2 to 0.4)
NEIGHBOURHOOD QUESTIONS			
Safety	128	-0.6(-3.0 to 1.8)	-0.3(-2.7 to 2.1)
Parks and playgrounds	171	-0.8(-2.6 to 1.0)	-0.7(-2.5 to 1.1)
Shopping	174	0.3(-1.3 to 1.9)	0.3(-1.3 to 1.9)
Many places to go by foot	176	-0.7(-2.1 to 0.7)	-0.6(-2.0 to 0.8)
FAMILY SES			
Highest education/qualification	115	-0.8(-1.8 to 0.2)	-0.8(-1.8 to 0.2)
Highest income	157	0.1(-0.3 to 0.5)	0.1(-0.3 to 0.5)

Results are from linear regression analyses. Model 1 is adjusted for age and sex, model 2 additionally for pubertal status. Values are β (95% CI) for 1-SD (SEIFA measures) or 1-category change in the examined variables

Table 4. The association of SES variables with blood pressure and glucose levels.

		Systolic blood pressure (mmHg)	
SEIFA	N	Model 1	Model 2
Education and Occupation	364	-0.7(-2.1 to 0.7)	-0.8(-2.2 to 0.6)
Economic Resources	364	0.4(-1.0 to 2.2)	0.3(-1.1 to 1.7)
Relative Socio-economic Advantage and Disadvantage	364	-0.7(-2.1 to 0.7)	-0.7(-2.1 to 0.7)
Relative Socio-economic Disadvantage	364	-0.8(-2.2 to 0.6)	-0.8(-2.2 to 0.6)
NEIGHBOURHOOD QUESTIONS			
Safety	144	2.1(-1.7 to 5.9)	1.4(-2.6 to 5.4)
Parks and playgrounds	195	2.3(-0.7 to 5.3)	2.2(-0.8 to 5.2)
Shopping	197	0.6(-2.0 to 3.2)	0.6(-2.0 to 3.2)
Many places to go by foot	198	0.2(-2.2 to 2.6)	-0.1(-2.5 to 2.3)
FAMILY SES			
Highest education/qualification	130	-0.4(-2.0 to 1.2)	-0.3(-1.9 to 1.3)
Highest income	178	0.4(-0.4 to 1.2)	0.4(-0.4 to 1.2)
		Glucose (mmol/l)	
SEIFA	N	Model 1	Model 2
Education and Occupation	266	0.04(-0.02 to 0.10)	0.04(-0.02 to 0.10)
Economic Resources	266	-0.02(-0.08 to 0.04)	-0.03(-0.09 to 0.03)
Relative Socio-economic Advantage and Disadvantage	266	0.02(-0.04 to 0.08)	0.02(-0.04 to 0.08)
Relative Socio-economic Disadvantage	266	0.02(-0.04 to 0.08)	0.02(-0.04 to 0.08)
NEIGHBOURHOOD QUESTIONS			
Safety	116	0.01(-0.15 to 0.17)	-0.01(-0.17 to 0.15)
Parks and playgrounds	158	-0.02(-0.12 to 0.08)	-0.01(-0.11 to 0.09)
Shopping	161	-0.02(-0.12 to 0.08)	-0.02(-0.12 to 0.08)
Many places to go by foot	162	0.07(-0.03 to 0.17)	0.07(-0.03 to 0.17)
FAMILY SES			
Highest education/qualification	106	-0.05(-0.11 to 0.01)	-0.05(-0.13 to 0.03)
Highest income	146	0.01(-0.03 to 0.05)	0.01(-0.03 to 0.05)

Results are from linear regression analyses. Model 1 is adjusted for age and sex, model 2 additionally for pubertal status and BMI. Values are β (95% CI) for 1-SD (SEIFA measures) or 1-category change in the examined variables

Table 5. The association of SES variables with dyslipidemia and NAFLD.

		Dyslipidemia	
SEIFA	N	Model 1	Model 2
Education and Occupation	355	1.11(0.87 to 1.43)	1.10(0.85 to 1.41)
Economic Resources	355	1.11(0.87 to 1.45)	1.11(0.86 to 1.43)
Relative Socio-economic Advantage and Disadvantage	355	1.15(0.90 to 1.48)	1.13(0.88 to 1.45)
Relative Socio-economic Disadvantage	355	1.15(0.85 to 1.48)	1.13(0.88 to 1.45)
NEIGHBOURHOOD QUESTIONS			
Safety	147	1.25(0.67 to 2.32)	1.24(0.67 to 2.33)
Parks and playgrounds	202	**1.85(1.12 to 3.08)**	**1.82(1.10 to 3.03)**
Shopping	206	**1.84(1.11 to 3.04)**	**1.90(1.14 to 3.16)**
Many places to go by foot	207	1.08(0.75 to 1.57)	1.07(0.74 to 1.55)
FAMILY SES			
Highest education/qualification	133	0.95(0.74 to 1.23)	0.91(0.70 to 1.20)
Highest income	186	0.97(0.86 to 1.10)	0.98(0.87 to 1.10)
		NAFLD	
SEIFA	N	Model 1	Model 2
Education and Occupation	356	**0.79(0.63 to 0.99)**	0.81(0.64 to 1.03)
Economic Resources	356	1.07(0.85 to 1.34)	1.07(0.85 to 1.35)
Relative Socio-economic Advantage and Disadvantage	356	0.86(0.69 to 1.08)	0.89(0.71 to 1.11)
Relative Socio-economic Disadvantage	356	0.90(0.72 to 1.11)	0.91(0.73 to 1.13)
NEIGHBOURHOOD QUESTIONS			
Safety	146	1.53(0.87 to 2.70)	1.47(1.83 to 2.62)
Parks and playgrounds	202	1.40(0.91 to 2.14)	1.40(0.91 to 2.18)
Shopping	205	**1.66(1.07 to 2.56)**	**1.67(1.07 to 2.59)**
Many places to go by foot	207	1.05(0.76 to 1.47)	1.08(0.78 to 1.49)
FAMILY SES			
Highest education/qualification	134	0.92(0.71 to 1.28)	0.91(0.70 to 1.18)
Highest income	186	1.07(0.96 to 1.20)	1.07(0.96 to 1.20)

Results are from logistic regression analyses. Model 1 is adjusted for age and sex, model 2 additionally for pubertal status and BMI. Values are odds ratios (95% CI) for 1-SD (SEIFA measures) or 1-category change in the examined variables

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