Cardiometabolic risk factors and subclinical markers of cardiovascular disease in urban and rural areas in Finland. The Cardiovascular Risk in Young Finns Study.

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Abstract

Aims: Disparity in cardiovascular disease (CVD) mortality and risk factor levels between urban and rural regions has been confirmed worldwide. The aim of this study was to examine how living in different community types (urban-rural) in childhood and adulthood are related to cardiovascular risk factors and surrogate markers of CVD such as carotid intima-media thickness (IMT) and left ventricular mass (LVM).

Methods: The study population comprised 2,903 participants (54.1% female, mean age 10.5 years in 1980) of the Cardiovascular Risk in Young Finns Study who had been clinically examined in 1980 (age 3-18 years) and had participated in at least one adult follow-up (2001-2011).

Results: In adulthood, urban residents had lower systolic blood pressure (-1mmHg), LDL-cholesterol (-0.05mmol/l), lower BMI (-1.0kg/m^2), and glycosylated hemoglobin levels (-0.05mmol/mol), and lower prevalence of metabolic syndrome (19.9% vs. 23.7%) than their rural counterparts. In addition, participants continuously living in urban areas had significantly lower IMT (-0.01mm), LVM (1.59 g/m$^{2.7}$), and pulse wave velocity (-0.22m/s) and higher carotid artery compliance (0.07%/10 mmHg) compared to persistently rural residents. The differences in surrogate markers of CVD were only partially attenuated when adjusted for cardiovascular risk factors.

Conclusions: Participants living in urban communities had a more favorable cardiovascular risk factor profile than rural residents. Furthermore, participants continuously living in urban areas had less subclinical markers related to CVD compared with participants living in rural areas. Urban-rural differences in cardiovascular health might provide important opportunities for optimizing prevention by targeting areas of highest need.

Key words: atherosclerosis, risk factors, urban, rural, arterial stiffness, left ventricular mass

Introduction

Cardiovascular diseases (CVD) are one of the leading causes of death and disability globally.[1] In the 1960's, coronary heart disease incidence and mortality in Finland were the highest in the world.[2] Remarkable geographic differences were observed in the Seven Countries Study showing that Eastern Finns had markedly higher coronary heart disease mortality and risk factors than Western Finns. Mortality due to coronary heart disease has decreased ever since in Finland and the difference in cardiovascular risk factor levels between Eastern and Western regions has narrowed resulting from successful preventive actions.[3] Still, health inequalities across different regions remain and place of residence is an essential determinant of health.[4,5]

Disparity in CVD mortality and risk factor levels between urban and rural regions has been confirmed worldwide.[6–8] Results from the Prospective Urban Rural Study have shown that the rates of cardiovascular events were higher in rural areas than in urban communities in middle-income and low-income countries, though the risk factors were higher in urban communities than in rural settings at the same time.[6] Nevertheless, no differences were observed in the rates of cardiovascular events between urban and rural communities in high-income countries including Sweden.[6] In addition, CVD mortality and risk factors were higher in rural areas than in urban communities in Iceland.[9] Furthermore, results from an earlier Finnish study suggest that elevated serum cholesterol levels and obesity are more prevalent in elderly citizens living in rural communities compared to individuals living in urban areas.[10] However, the urban-rural differences in cardiovascular risk factor levels and subclinical markers of CVD among working-age population are unknown in Finland and have not been extensively explored in other populations either.

The aim of this study was to examine how living in different community types (urban-rural) is related to CVD factors and subclinical markers of CVD. We report results using data from the

Cardiovascular Risk in Young Finns Study with 2,903 participants having comprehensive data on CVD risk factors and ultrasonic markers of subclinical CVD.

Methods

Study population

The Cardiovascular Risk in Young Finns Study is a population-based follow-up study on cardiovascular risk factors in Finland.[11] The study has been performed in five Finnish university cities with medical schools and nearby rural municipalities. The rural communities were chosen followingly: their industrial structure corresponding to the average of rural communities in the province, the cohorts in the communities should be large enough, the distances should not be impractically long and sample should include an equal number of urban and rural population in each area. This study comprised 2,903 participants (54.1% female) who had been seen in clinical examination in 1980 and at least once in adult follow-ups. Response rate compared to the baseline study was 73% in all participants (72 % in urban participants and 74% in rural participants according to place of residence in childhood) in 2001, 62 % for all participants (64% in urban participants and 61 % in rural participants) in 2007, and 59% for all participants (60% in urban participants and 57 % in rural participants) in 2011. Data was primarily from 2011 follow-up (71.5% of data), but in case of missing data from 2011, data from 2007 (13.8% of data) or 2001 (14.7% of data) were used. Written informed consent was obtained from participants or parents, and study was approved by local ethics committees.

Place of residence

Living area of participants was classified as urban or rural. At baseline, participants living in university cities were classified as having an urban place of residence, and the municipalities in the vicinity of those cities were classified as rural. In adulthood, area of residence was defined followingly according to questionnaire data: participants living in cities, suburbs or center of a town were classified as urban and participants living outside a population center were classified as rural. In sensitivity analyses, corresponding classification was also used in childhood.

Anthropometry, blood pressure and laboratory measurements

Weight was measured to the nearest 0.1 kg and height to the nearest centimeter. Body mass index (BMI) was calculated as weight/height. Blood pressure was measured with standard mercury sphygmomanometer in childhood and with random-zero sphygmomanometer in adulthood. Fasting blood samples analyzed with standard enzymatic methods.[11] Metabolic syndrome was defined according to the Harmonized criteria.[12] The diagnosis of type 2 diabetes included participants with fasting glucose ≥7mmol/L or glycosylated hemoglobin ≥6.5% or self-reported diabetes or use of medication.[13]

Health behaviors and socioeconomic status

Smoking, alcohol consumption, socioeconomic status (SES), physical activity, and attention paid to health habits were assessed by questionnaires. Data on smoking was obtained from participants aged 12-18 years at baseline. Smoking was defined as positive if participant smoked daily. Alcohol consumption was assessed as standard doses per week. Participants' SES (own/parental) was determined as amount of school years. Physical activity index was calculated.[14] Attention paid to health habits was assessed on a five-point scale, lower values indicating more attention paid.

Subclinical markers of cardiovascular risk

Carotid artery intima-media thickness (IMT), carotid artery compliance (CAC), pulse wave velocity (PWV), brachial artery flow-mediated dilatation (FMD), and left ventricular mass (LVM) were measured as described earlier.[15–17] LVM was indexed according to height using the allometric power of 2.7 since this indexation has been shown to perform better for obese subjects.[18]

Statistical methods

Differences between participants living in urban and rural areas were analyzed using independent samples t-test for continuous variables. Continuous variables were standardized according to age and sex before analyses. Differences in categorical variables were analyzed using Fisher's exact test in childhood and logistic regression models adjusted for age and sex in adulthood. Non-normally distributed variables were square root-transformed before the analyses. The association of SES and eastern-western origin with urban-rural differences in cardiovascular risk factor levels was tested using analysis of covariance adjusted for age, sex, and additionally for SES or eastern-western origin. The association of urban-rural migration was examined by dividing participants into four groups: 1) participants who had lived in rural areas as a child and had migrated to urban communities by adulthood (n=587); 2) participants who had continuously lived in urban areas (n=991) 3) participants who lived in urban areas as a child and had migrated to rural settings by adulthood (n=738); 4) participants who continuously lived in rural communities (n=283). Means adjusted for age and sex according to migration were calculated using analysis of covariance. Furthermore, analyses were additionally adjusted for risk factor levels at baseline (systolic blood pressure, total cholesterol, LDL-cholesterol, triglycerides, parental SES, smoking, and physical activity) and in adulthood (BMI, systolic blood pressure, diastolic blood pressure, LDL-cholesterol, glycosylated hemoglobin, SES, alcohol consumption, attention paid to health habits, and physical activity) to test whether the association of migration with surrogate markers of CVD was mediated by risk factor levels.

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

Cardiovascular risk factors according to urban-rural residence in childhood (1980)

In childhood, participants living in urban areas had significantly lower systolic blood pressure, total cholesterol, LDL-cholesterol and triglyceride levels, were more likely to smoke and were physically more active at the age of 9-18 years compared with their peers living in rural settings (Table 1). In addition, urban residents had higher parental SES in childhood than their rural counterparts. No other significant urban-rural differences were observed at baseline in 1980.

Cardiovascular risk factors and subclinical markers CVD in adulthood according to urban-rural residence in childhood (1980)

Participants who had lived in urban communities as a child were significantly older, consumed more alcohol weekly, and had higher SES as well as lower systolic blood pressure in adulthood compared to rural residents (Table 2). Moreover, urban residents had lower LVM and higher CAC compared to participants with their rural counterparts. No other urban-rural differences were observed in adulthood according to place of residence in childhood.

Cardiovascular risk factors according to urban-rural residence in adulthood (2001-2011)

In adulthood, individuals living in urban settings were younger, had lower BMI, blood pressure, LDL-cholesterol, glycosylated hemoglobin and prevalence of metabolic syndrome than their rural counterparts (Table 3). In addition, participants living in urban areas were physically more active, had higher SES, and paid more attention to health habits than rural participants while their weekly consumption of alcohol was higher. Furthermore, urban participants also had lower carotid IMT, LVM and higher PWV than rural participants.

Sensitivity analyses

Because of urban-rural difference in SES, we additionally adjusted all prior analyses for parental SES in childhood or participant's own SES in adulthood. With adjustment for parental SES, childhood urban-rural differences (Table 1) in systolic blood pressure (p=0.052) and triglycerides (p=0.08) diluted to borderline significant. With adjustment for participant's own adulthood SES, observed urban-rural differences (Table 3) in diastolic blood pressure (p=0.20), total cholesterol (p=0.18), glycosylated hemoglobin (p=0.27), weekly alcohol consumption (p=0.07), physical activity (p=0.09), and prevalence of metabolic syndrome (p=0.11) were attenuated in adulthood.

Moreover, the classification of urban-rural residence differed between childhood and adulthood due to the original study design. When the classification of urban-rural residence in childhood (Tables 1 and 2) was made similarly as in adulthood, the results remained mostly unchanged except for childhood (Table 1) urban-rural differences in systolic blood pressure and triglycerides that became significant.

Finally, because of the previously observed east-west differences in CVD risk factor levels[19], analyses reported in Tables 2 and 3 were adjusted for place of residence (eastern – western) at baseline. After the adjustment, results remained similar except for the difference in CAC which became borderline significant (p=0.059) and attenuated differences in glycosylated hemoglobin (p=0.09) and alcohol consumption (p=0.29).

Association of subclinical markers of CVD and urban-rural migration between childhood and adulthood

Associations of urban-rural migration between childhood and adulthood on subclinical markers of CVD are shown in Figure 1. Participants who had continuously lived in urban areas had significantly lower IMT and LVM compared to participants who had continuously lived in rural communities or who had migrated to rural areas by adulthood. Likewise, these participants had lower PWV and higher CAC compared to participants who had continuously lived in rural communities. In addition, participants continuously living in urban setting had lower LVM than participants who had lived as a child in rural areas and had migrated to urban communities in adulthood. Furthermore, participants who had migrated to urban areas from rural areas by adulthood had significantly lower IMT and PWV than participants who had migrated to rural areas by adulthood. For PWV, participants who had migrated to urban areas by adulthood compared to participants continuously living in rural communities had significantly lower PVW. No significant differences between the groups were observed for FMD.

To examine whether the association of migration with subclinical markers of CVD was mediated by CVD risk factors, the analyses were adjusted for risk factor levels at baseline (Supplemental Figure 1). For IMT, the results were mainly similar, with the exception of lack of difference between participants who had continuously lived in urban or rural areas (p=0.42), and the emerged difference (p=0.03) between participants who had continuously lived in rural areas and those who had moved to rural areas by adulthood. For LVM, the results remained mostly unchanged, although the difference between participants who had moved to urban areas and participants who had continuously lived in urban communities became borderline-significant (p=0.06). For PWV, the difference between participants who had continuously lived in urban or rural areas was attenuated (p=0.16) while the difference between participants who had moved to urban areas and participants who had continuously lived in urban communities became significant (p=0.01). After the adjustments, the difference in CAC was diluted between participants who had continuously lived in urban or rural settings (p=0.16).

Secondly, the analyses were adjusted for CVD risk factors in adulthood (Supplemental Figure 2). For IMT, the difference between participants who had moved to urban communities by adulthood and participants who had moved to rural areas by adulthood remained similar but differences between participants who had continuously lived in urban or rural areas (p=0.30) or had moved to rural communities by adulthood (p=0.08) were attenuated. For LVM, the results remained unchanged. For PWV, the difference between participants who had moved to urban areas by adulthood and participants who had moved to rural areas remained significant (p=0.02) while the difference between participants who had moved to urban areas and participants who had continuously lived in urban communities became significant (p=0.02). Furthermore, there was no difference between participants who had continuously lived in urban or rural areas (p=0.84) as well as the difference between those who had moved to urban areas by adulthood and participants who had moved to rural areas by adulthood became borderline significant (p=0.055). For CAC, the difference between participants who had continuously lived in urban or rural settings was lost (p=0.83).

Discussion

We observed that participants living in urban communities in childhood and adulthood had a more favorable CVD risk factor profile including lower blood pressure and cholesterol levels in comparison to individuals living in rural settings. Furthermore, we found that participants who had continuously lived in an urban setting had more favorable IMT, LVM, PWV, and CAC, which have been shown to predict future cardiovascular events[20–22], than participants who had continuously lived in rural areas. These differences were only partially attenuated when the analyses were adjusted for CVD risk factor levels in childhood and adulthood suggesting that urban-rural differences are not completely mediated by differences in CVD risk factors.

Our findings considering CVD risk factors are consistent with the PURE study, an extensive study of cardiac risk factors and cardiovascular events among adults (n=156,424, mean age 50.7 years) in urban and rural communities on five continents, reporting that the mean INTERHEART Risk Score was higher in rural areas compared to urban communities in high income countries (Sweden, Canada, and United Arab Emirates).[6] However, no significant urban-rural difference was observed for major cardiovascular events in the PURE study. In this study, significant urban-rural differences for subclinical markers of CVD that have been shown to associate with future cardiovascular events were observed.[20–23] Furthermore, prior results from the GOAL cohort study, comprising 2,815 elderly Finnish participants aged 52 to 76 years, showed significant urban-rural differences in serum cholesterol and BMI that were mainly explained by SES.[10] Our results are in line with these observations as higher cholesterol and BMI was observed among rural adult participants. In this study, urban-rural differences were partially attenuated when analyses were adjusted for SES. However, urban-rural differences in LDL-cholesterol and systolic blood pressure, both being major risk factors for CVD[24], remained significant in adulthood suggesting that the difference observed in cardiovascular risk is not fully captured by SES.

Differences observed in lipid and blood pressure levels may by partly attributed to several behavioral and dietary factors. In part of rural communities fewer healthy dietary choices may be available compared to urban areas and access to health care services might differ. The possible differential access to health care services could affect adherence to primary and secondary prevention of CVD. Furthermore, results from a National Dietary Survey demonstrated that individuals living in rural areas tend to consume less vegetables and use more butter than urban residents.[25] Moreover, it has been hypothesized that cultural aspects might also contribute to the cardiovascular health differences observed between urban and rural residents in Sweden as a more masculine lifestyle has been traditionally linked to the living in rural communities.[26] Speculatively, cultural differences could have an unfavorably effect on adaption to the health promotion efforts by authorities also in Finland.

Our earlier reports and other studies have demonstrated that difference in cardiovascular risk factors between eastern and western Finland has been declining[19,27]. The results of this study remained almost unchanged after adjustment for place of residence (eastern-western). Hence, urban-rural differences observed in our study are not likely explained by the geographic origin of the participants. However, similarities between association of eastern-western and urban-rural migration with CVD risk factor levels can be observed. In this study, urban-rural differences in CVD risk factor levels in adulthood were more pronounced according to place of residence in adulthood compared to differences observed in adulthood according to living area in childhood. The same phenomenon was earlier found between eastern and western Finns, possibly suggesting that those with lower risk profile may have been more prone to migrate by adulthood.[19]

In this study, we observed that participants living in urban areas as a child had lower LVM and higher CAC compared to their rural counterparts. Furthermore, those who had lived persistently in urban areas had lower IMT, lower LVM, and superior CAC to participants residing in rural communities. Likewise, participants who had migrated to urban communities by adulthood had lower IMT and PWV compared to participants living in rural areas. We have earlier shown that systolic blood pressure, LDL-cholesterol concentration, cigarette smoking and BMI are associated with IMT, a marker of structural atherosclerosis.[28] In addition, LVM is a marker of left ventricular remodeling often associated with arterial hypertension and obesity.[20] Furthermore, pathology of increased PWV normally includes a number of adverse functional and structural changes in vascular walls as exposure to cardiovascular risk factors such as arterial hypertension leads to e.g. a diminished quantities of elastin, an overproduction of collagen, and elevated smooth muscle tone.[29] Together, these markers of subclinical CVD have been shown to independently predict cardiovascular events.[20–23]

Differences observed in surrogate markers of atherosclerosis were partially attenuated after adjustment for risk factor levels in childhood and in adulthood. However, the urban-rural differences for LVM remained unchanged and were not fully attenuated for IMT and PWV after adjustments for risk factor levels in adulthood and childhood suggesting that the urban-rural differences are not entirely mediated by cardiovascular risk factor levels such as serum cholesterol, BMI, cigarette smoking, and blood pressure. In a more clinical perspective, our results showed a difference of 0.15 mm in carotid IMT levels between participants living continuously in urban surroundings compared to participant who had migrated from urban areas to rural environment by adulthood. Extending from the estimates of Lorenz et al. this difference could be converted to a 15-20% difference in myocardial infarction risk and a 20-25% difference in stroke risk in later in life.[23] The mechanism underlying increased subclinical atherosclerosis among individuals living in rural areas remains unknown and requires further study. Prior studies on association of urban-rural migration with subclinical atherosclerosis are scarce. Woo et al. have earlier found that urban Chinese living in Hong Kong and Australia had higher IMT than Chinese living rural areas (n=348, mean age 42 years).[8] The risk of atherosclerosis has been traditionally low in rural Chinese due to environmental factors and thus the results are not comparable to high income Western country such as Finland where rural lifestyle has become increasingly sedentary because of mechanization of agricultural work.

Limitation in longitudinal studies is non-participation at follow-up which is inevitable. However, our study group has been dynamic, and thus probably representative of the original population.[30] Moreover, categorization of migration used was based on information of participant's place of residence from childhood and adulthood. This categorization did not consider possibility that individuals may have moved repeatedly between childhood and adulthood. Finally, we have no clinical end-points because the participants are still relatively young. However, data on surrogate markers of CVD were available that have been shown to predict the risk of future cardiovascular events and total mortality.[20–23]

Conclusions

Participants living in urban communities had a more favorable CVD risk factor profile and less structural vascular and cardiac changes related to CVD compared with their rural counterparts. The differences in surrogate markers of CVD were only partially attenuated when adjusted for CVD risk factors. Our results suggest that enduring urban-rural differences in cardiovascular health might provide important opportunities for optimizing healthcare resources and improving prevention by targeting areas of highest need.

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Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

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Figure and Table legends.

Figure 1. Association of urban-rural migration with intima-media thickness, left ventricular mass, pulse wave velocity, flow-mediated dilatation, and carotid artery compliance in adulthood in 2,599 participants of the Cardiovascular Risk in Young Finns Study. Values are presented as age and sex adjusted means. Significant differences observed between groups are shown in the figure.

Table 1. Cardiovascular risk factors according to urban-rural residence in childhood (1980).

Table 2. Cardiovascular risk factors and surrogate markers for cardiovascular disease in adulthood according to urban-rural residence in childhood (1980) in participants of the Cardiovascular Risk in Young Finns Study.

Table 3. Cardiovascular risk factors and surrogate markers for cardiovascular disease in adulthood according to urban-rural residence in adulthood (2001-2011) in participants of the Cardiovascular Risk in Young Finns Study.

Figure 1. Effect of urban-rural migration on intima-media thickness, left ventricular mass, pulse wave velocity, flow-mediated dilatation, and carotid artery compliance in adulthood in 1,793 - 2,599 participants of the Cardiovascular Risk in Young Finns Study. Values are presented as age and sex adjusted means. Significant differences observed between the groups are shown in the figure.

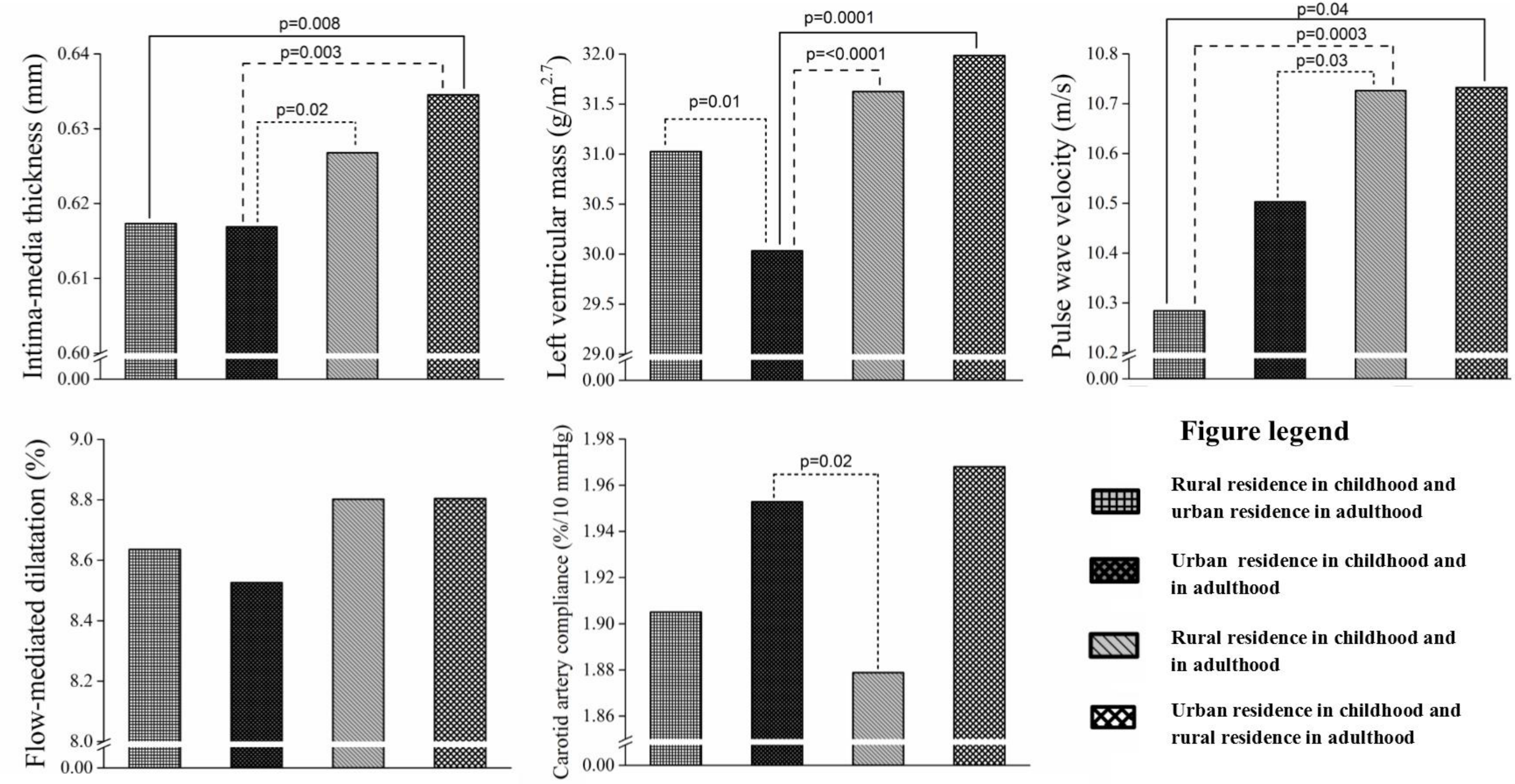

Table 1. Cardiovascular risk factor levels in childhood (1980) according to urban-rural residence in childhood in participants of the Cardiovascular Risk in Young Finns Study.

		Urban residence		**Rural residence**		**P for difference[a]**
N		1,394		1509		
Female %		53.3		54.8		0.43
Age (years)		10.7	±5.0	10.3	±5.0	0.09
BMI (kg/m2)		17.8	±3.0	17.8	±3.2	0.18
Systolic blood pressure (mmHg)		112	±12	113	±12	0.01
Diastolic blood pressure (mmHg)		69	±10	68	±10	0.15
Total cholesterol (mmol/l)		5.22	±0.9	5.40	±0.9	<0.0001
LDL-cholesterol (mmol/l)		3.36	±0.8	3.53	±0.9	<0.0001
HDL-cholesterol (mmol/l)		1.56	±0.3	1.56	±0.3	0.92
Triglycerides (mmol/l)		0.65	±0.3	0.68	±0.3	0.02
Insulin (mU/l)		9.60	±5.8	9.73	±6.1	0.10
Physical Activity	9-18 years (range 5-14)	9.2	±1.9	8.9	±1.7	0.01
	3-6 years (range 9-22)	16.0	±2.3	16.1	±2.6	0.18
Parental socioeconomic status (school years)		11.9	±3.9	10.2	±3.4	<0.0001
Smoking (%)		7.6		5.0		0.005

Values are expressed as mean ± standard deviation or as proportions (%). N varied between 1,192 and 1,395 in participants living in urban areas and 1,244 and 1,509 in participants living in rural areas.

[a]Continuous variables standardized according to age and sex before analyses. T-test used for continuous variables and Fisher's exact t-test for categorical variables. Insulin, triglycerides, and physical activity (for 9-18 years old participants) were square root-transformed before analyses due to skewed distributions.

Table 2. Levels of risk factors and surrogate markers for cardiovascular disease in adulthood according to urban-rural residence in childhood (1980) in participants of the Cardiovascular Risk in Young Finns Study.

	Urban residence		Rural residence		P for difference[b]
n	1,394		1,509		
Female (%)	53.3		54.8		0.41
Age (years)	39.9	±6.2	39.2	±6.6	0.001
BMI (kg/m2)	26.3	±4.9	26.4	±5.1	0.50
Systolic blood pressure (mmHg)	119	±14	120	±15	0.0004
Diastolic blood pressure (mmHg)	75	±11	75	±11	0.98
Total cholesterol (mmol/l)	5.15	±1.0	5.18	±1.0	0.26
LDL-cholesterol (mmol/l)	3.22	±0.8	3.27	±0.8	0.051
HDL-cholesterol (mmol/l)	1.33	±0.3	1.32	±0.3	0.55
Triglycerides (mmol/l)	1.37	±1.0	1.35	±1.3	0.26
Glucose (mmol/mol)	5.35	±0.9	5.37	±1.1	0.29
Glycosylated hemoglobin (mmol/mol)	36.7	±5.4	36.8	±5.2	0.43
Insulin (mU/l)	9.77	±12.6	9.84	±13.1	0.79
Socioeconomic status (school years)	15.4	±3.6	14.7	±3.5	<0.0001
Alcohol Consumption (drinks per week)	6.6	±9.3	5.6	±9.1	<0.0001
Physical Activity (Range 5-15)	9.0	±1.9	8.9	±1.8	0.33
Attention paid to health habits (range 1-5)[a]	2.5	±1.0	2.5	±1.0	0.39
Intima-media thickness (mm)	0.62	0.09	0.62	0.10	0.56
Left ventricular mass ($g/m^{2.7}$)	30.42	6.55	31.10	6.66	0.01
Pulse wave velocity (m/s)	10.53	2.04	10.45	1.96	1.00
Flow-mediated dilatation (%)	8.67	4.53	8.84	4.53	0.68
Carotid artery compliance (%/10mmhg)	1.96	0.72	1.92	0.69	0.02
Smoking (%)	20.8		20.0		0.55
Metabolic Syndrome (%)	21.3		21.5		0.50
Type 2 Diabetes (%)	3.5		3.8		0.65

Values are expressed as mean ± standard deviation or as proportions (%). N varied between 1,004 and 1,395 in participants living in urban areas and 1,018-1,509 in participants living in rural areas.

[a] Lower is better

[b]Continuous variables standardized according to age and sex before analyses. T-test used for continuous variables and logistic regression adjusted for age and sex for categorical variables.

Table 3. Levels of risk factors and surrogate markers for cardiovascular disease in adulthood according to urban-rural residence in adulthood (2001-2011) in participants of the Cardiovascular Risk in Young Finns Study.

	Urban residence		Rural residence		P for difference[b]
n	1,754		1,149		
Female (%)	54.1		54.1		1.00
Age (years)	39.3	±6.6	39.9	±6.1	0.01
Body mass index (kg/m2)	25.9	±4.9	26.9	±5.2	<0.0001
Systolic blood pressure (mmHg)	119	±14	121	±14	<0.0001
Diastolic blood pressure (mmHg)	75	±11	76	±11	0.04
Total cholesterol (mmol/l)	5.14	±1.0	5.21	±0.9	0.07
LDL-cholesterol (mmol/l)	3.21	±0.8	3.30	±0.8	0.005
HDL-cholesterol (mmol/l)	1.33	±0.3	1.32	±0.3	0.34
Triglycerides (mmol/l)	1.37	±1.3	1.34	±1.0	0.54
Glucose (mmol/mol)	5.33	±0.8	5.41	±1.2	0.053
Glycosylated hemoglobin (mmol/mol)	36.5	±5.0	37.0	±5.7	0.04
Insulin (mU/l)	9.52	±11.8	10.24	±14.3	0.07
Socioeconomic status (school years)	15.6	±3.7	14.2	±3.2	<0.0001
Alcohol Consumption (drinks per week)	6.2	±9.1	5.9	±9.3	0.01
Physical Activity (Range 5-15)	9.0	±1.9	8.8	±1.8	0.001
Attention paid to health habits (range 1-5)[a]	2.4	±0.9	2.6	±1.0	<0.0001
Intima-media thickness (mm)	0.61	0.09	0.63	0.10	0.0008
Left ventricular mass ($g/m^{2.7}$)	30.24	6.45	31.54	6.78	<0.0001
Pulse wave velocity (m/s)	10.38	1.96	10.66	2.05	0.0002
Flow-mediated dilatation (%)	8.67	4.62	8.91	4.39	0.42
Carotid artery compliance (%/10mmhg)	1.95	0.71	1.91	0.69	0.27
Smoking (%)	20.5		20.3		0.65
Metabolic Syndrome (%)	19.9		23.7		0.04
Type 2 Diabetes (%)	3.4		4.0		0.69

Values are expressed as mean ± standard deviation or as proportions (%). N varied between 1,195 and 1,754 in participants living in urban areas and 827-1,509 in participants living in rural areas.

[a] Lower is better

[b]Continuous variables standardized according to age and sex before analyses. T-test used for continuous variables and logistic regression adjusted for age and sex for categorical variables.