Migration status and cardiovascular disease risks in Hong Kong adolescents

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KEY MESSAGES

1. In Hong Kong, early childhood migrants and children of migrant women had more cardiovascular disease–related risk factors in adolescence.
2. An intergenerational transition in living condition early in life may be linked with susceptibility to cardiovascular disease–related risk factors in migrant populations or populations that undergo rapid economic development.

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Introduction

Cardiovascular diseases (CVD) are the leading cause of death worldwide and are expected to be more common in the next two decades, particularly in developing countries or migrant populations that undergo rapid economic development. This is potentially attributed to a 'mismatch' between living conditions over generations,[1] which may predispose to excess CVD risk in later life. Hong Kong has been largely composed of a migrant population from essentially pre-industrial China during the 1940-50s and more recent immigration. Migrants born in mainland China prior to the economic growth of the last 30 years were raised in very limited conditions. In the 1970s, the gross domestic product per person in China was about 12% of that in Hong Kong. Contemporary children in Hong Kong are growing up in an economically developed setting with a social infrastructure similar to western countries. They have different intergenerational experiences of economic development relative to where they were born or when their parents and grandparents migrated to Hong Kong. Understanding CVD risk among migrants and migrant generations in Hong Kong may identify target groups for effective early disease prevention.

This study built on the large population-representative Hong Kong Chinese birth cohort—'Children of 1997'—to examine the role of migration in CVD-related risk factors observed in adolescence. More specifically we examined the relation of (1) migration from China to Hong Kong at different life stages and (2) the number of generations in Hong Kong with CVD-related risk factors in adolescence. We also assessed whether associations varied by gender or were mediated by socio-economic position.

Methods

This study was approved by the University of Hong Kong-Hospital Authority Hong Kong West Cluster Joint Institutional Review Board (UW 12-320) and the Ethics Committee of the Department of Health, Government of the Hong Kong SAR, People's Republic of China.

This observational study was conducted from January 2013 to December 2013 to investigate CVD-related factors by migration status in Hong Kong adolescents born in 1997. Hong Kong (native-born) adolescents were derived from the 'Children of 1997' birth cohort,[2] a population-representative Chinese birth cohort (n=8327) that covered 88% of all births in Hong Kong in April/May 1997. Families were recruited at their first postnatal visit to a Maternal and Child Health Centre, where baseline characteristics were obtained using a self-administered questionnaire. Passive follow-up via record linkage with public health sectors and active follow-up via surveys has been started since 2005 and 2008, respectively. Migrant adolescents were born in mainland China. Staff from the Student Health Service (SHS) identified students who ever attended the SHS and who were born in 1997 elsewhere in China and migrated to Hong Kong before the age of 12 years.

Data were retrieved from the SHS records for both the birth cohort and the migrants, including weight, height, blood pressure, pubertal assessment of development of breast/genital and pubic hair and date of assessment, age at menarche, and sub-scores of the Achenbach's Youth Self-Report (YSR). Date of birth, year of migration, country of birth, and parental education attainment were also retrieved for migrants.

Exposure

The main exposure was migration status, classified by the participants' place of birth, Hong Kong (native-born) or elsewhere in China (migrants). Migrants were classified into four subgroups according to the age at migration (0-2, 2-6, 6-8, or 8-12 years). The secondary exposure was migrant generation among the native Hong Kong born (ie from the birth cohort), classified as 1st, 2nd, or 3rd+ generation migrant according to the place of birth (Hong Kong or elsewhere, mainly mainland China) of the mother and maternal grandmother (Fig 1).

Outcomes

The primary outcome was adiposity at 14 years old and blood pressure at 13 years old. The secondary outcomes were other CVD-related factors including age of puberty, tempo of height growth, and stress. Adiposity at 14 years was proxied by age and gender-specific body mass index (BMI) z-score relative to the 2007 World Health Organization growth reference, calculated from the height and weight taken between 12.5 and 15.5 years of age. For completeness we also presented the association of migration status with height z-score. Systolic and diastolic blood pressure (mm Hg) at 13 years was measured between 12.0 and 14.9 years of age on the right arm in a seated position mainly using the automated oscillometric device. Age of puberty was indicated by pubic hair development for both sexes, breast development and age at menarche for girls and genital development for boys. Tempo of height growth was proxied by height growth per year (cm/year) during 6-9, 9-12, and 12-15 years. We used the closest measurements to 6, 9, 12, and 15 years respectively for 5.0-7.5, 7.5-10.5, 10.5-13.5, and 13.5-16.5 years. Stress was proxied by internalising behaviour, externalising behaviour, anxiety/depression symptoms and social problems at age 13-14 years indicated by sub-scores of the self-administrated Achenbach's YSR. Higher scores indicated greater stress.

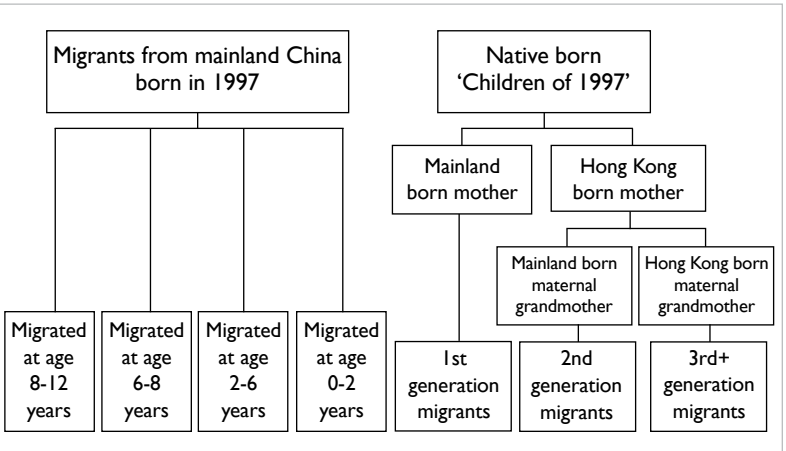

FIG 1. Classification of migration status

Statistical analysis

Multivariable linear regression was used to assess the association of migration status with BMI, blood pressure, tempo of height growth at each 3-year-period, stress, and age at menarche (girls only). Interval censored regression was used to examine the association of migration status with age at onset of puberty. We tested whether the associations varied by gender (by the significance of interaction terms), and whether these associations were mediated by family socio-economic position (proxied by the highest education attainment of both parents as ≤grade 9 or ≥grade 10 according to the Pearl's mediation formula).

Results

Participant characteristics

Of the original 8327 'Children of 1997', 8285 were alive and had not withdrawn as of 30 April 2012. Of them, 7671 (92%) had information for at least one of the CVD-related risk factors available for analysis. The SHS identified 13 245 students (6411 girls and 6834 boys) who were born in 1997 elsewhere in China and migrated to Hong Kong before aged 12 years from all students who had ever attended the SHS. Of these, 12 882 (97%) had information for at least one of the CVD-related risk factors. Respectively 10 259 (77%) and 7671 (73%) of the birth cohort members and migrants attended the SHS and had information on BMI at 14 years. Parents of adolescents who did not attend SHS at the age 12.5 to 15.5 years had similar education attainment to those who attended SHS service at least once.

Table 1 shows that 2nd and 3rd+ generation migrants had parents with similar level of education, which was higher than that of parents of 1st generation migrants. Parents of 1st generation migrants had a similar education level to migrants from mainland China. There was no difference in the distribution of parents' education attainment among migrants categorised by age at migration, except that children migrated to Hong Kong at 0-2 years had slightly higher educated parents.

Association of migration status with CVD-related risk factors

Compared with 2nd+ (2nd and 3rd+) generation migrants, migration from elsewhere in China to Hong Kong before 6 years of age was associated with faster height growth at 6-9 years, slower height growth at 12-15 years, earlier puberty, higher height z-score, higher blood pressure, and greater stress at 13-14 years in both boys and girls as well as higher BMI at 14 years in boys (Table 2). When height was adjusted, migrants and 1st generation migrants had higher diastolic but not systolic blood pressure (data not shown). These differences, except for stress, were

also observed between 1st and 2nd+ generation migrants (Table 3), but there was no difference in CVD-related risk factors between 2nd and 3rd+ generation migrants.

None of the associations of migration status with CVD-related factors was mediated by socio-economic position, except that association between migration at 0-6 years old and diastolic blood pressure was partially (20%) mediated.

Discussion

In a population-representative Hong Kong birth cohort 'Children of 1997' supplemented by migrants of the same age from elsewhere in China, we assessed the association of migration status with CVD-related factors. Most previous studies have compared migrants with a host population of different ethnicity, such that socio-cultural factors or gene-environment interactions cannot be excluded, or that comparison with non-migrants in home countries with poorer living condition cannot be made. Therefore, this fails to isolate the impact of intergenerational transition from that of the current living condition.

As previously reported, compared with 2nd+ generation migrants, 1st generation migrants were fatter, taller, and had earlier onset of puberty.[3] The present study showed that 2nd and 3rd+ generation migrants had comparable markers of cardiovascular health. However, the relation of migrant generation and CVD-related risks (bio-markers for cardiovascular health) will have to be confirmed after completion of puberty.

Migration before the age of 0-6 years was associated with higher blood pressure in both sexes, greater BMI in boys, and earlier age at menarche in girls. This suggested that migration in early childhood was associated with cardiovascular risk factors. Age at migration may be a proxy of acculturation, because time of residence increases social contacts and may be associated with the impact of migration on health, depending on the changes in behaviour, eg diet, lifestyle, and health seeking behaviour. We has previously reported that men migrated to Hong Kong in early childhood had a greater risk of developing heart disease,[4] and that the effect of migration on ischaemic heart disease mortality may differ according to the age at arrival in Hong Kong.[5] This suggested that childhood may be a critical window during which a transition of living condition may exert the greatest impact on subsequent health.

The prevalence of CVD is substantially higher among men than women. Migration from mainland China was associated with a greater BMI at 14 years in boys, although there was no gender difference in the association of migration with blood pressure and other CVD-related factors. Whether the greater BMI in boys implicates certain sex-specific acculturation process or an impact from intergenerational mismatch requires further studies in adulthood with better markers of cardiovascular health. Although migrants often have a lower socio-economic position than the general population, there was little evidence that the difference in CVD-related factors according to migration status was mediated by family socio-economic position.

Despite the large sample size, there were some limitations to this study. Attending the SHS was voluntary; nonetheless participants who were excluded due to missing data had similar parental education to those included. Although broad proxy was used for socio-economic position and parental education attainment, it positively predicted

TABLE 1. Baseline characteristics by migration status

Characteristics	Migrants (%)				Native born 'Children of 1997' (%)		
	Migrated at 8-12 years of age (n=3079)	Migrated at 6-8 years of age (n=1592)	Migrated at 2-6 years of age (n=5885)	Migrated at 0-2 years of age (n=2689)	1st generation migrant (n=3351)	2nd generation migrant (n=3733)	3rd+ generation migrant (n=1217)
Boys	50	51	53	51	53	53	52
Father's education							
≤Grade 9	57	60	62	55	60	32	36
Grade 10-11	33	32	32	37	28	37	38
≥Grade 12	9.9	8.1	6.6	8.6	12	31	27
Mother's education							
≤Grade 9	62	66	66	62	62	25	30
Grade 10-11	32	30	29.0	32	30	53	52
≥Grade 12	6.5	4.5	4.6	6.1	8.3	22	18
Parents' highest education							
≤Grade 9	51	54	54	47	48	18	21
Grade 10-11	38	37	38	42	37	46	48
≥Grade 12	12	9.2	8.5	11	15	36	30

TABLE 2. Adjusted (for age and sex) association between migration status and cardiovascular disease–related risk factors

Cardiovascular disease–related risk factors	Migrants				Native born 'Children of 1997	
	Migrated at 8-12 years of age	Migrated at 6-8 years of age	Migrated at 2-6 years of age	Migrated at 0-2 years of age	1st generation migrant	2nd+ generation migrant
Body mass index z-score at 14 years* (β [95% CI])						
All	-0.09 (-0.15, -0.03)‡	0.03 (-0.04, 0.11)	0.02 (-0.03, 0.07)	0.13 (0.07, 0.20)‡	0.06 (-0.01, 0.12)	Ref
Boys	-0.07 (-0.16, 0.02)	0.09 (-0.03, 0.21)	0.09 (0.01, 0.17)‡	0.22 (0.12, 0.32)‡	0.10 (0.00, 0.21)‡	Ref
Girls	-0.11 (-0.19, -0.04)‡	-0.03 (-0.13, 0.07)	-0.05 (-0.12, 0.01)	0.04 (-0.04, 0.12)	0.01 (-0.07, 0.09)	Ref
Height z-score at 14 years* (β [95% CI])						
All	0.02 (-0.03,0.06)	0.05 (-0.01, 0.10)	0.11 (0.07, 0.15)‡	0.14 (0.09, 0.19)‡	0.14 (0.09, 0.19)‡	Ref
Boys	0.05 (-0.02, 0.11)	0.09 (-0.00, 0.17)	0.16 (0.11, 0.22)‡	0.20 (0.12, 0.27)‡	0.17 (0.10, 0.25)‡	Ref
Girls	-0.01 (-0.07, 0.04)	0.00 (-0.07, 0.07)	0.05 (0.00, 0.10)‡	0.09 (0.03, 0.15)‡	0.10 (0.04, 0.16)‡	Ref
Blood pressure at 13 years (mmHg) [β (95% CI)]						
Systolic blood pressure	0.33 (-0.26, 0.91)	-0.17 (-0.93, 0.58)	0.69 (0.18, 1.19)‡	0.68 (0.05, 1.30)‡	0.88 (0.25, 1.51)‡	Ref
Diastolic blood pressure	0.36 (0.04, 0.68)‡	0.41 (-0.00, 0.83)	0.72 (0.44, 1.00)‡	0.58 (0.24, 0.92)‡	0.81 (0.46, 1.15)‡	Ref
Onset of puberty† (time ratio [95% CI])						
Boys						
Genital development	-	-	0.993 (0.984, 1.002)	1.003 (0.992, 1.014)	0.993 (0.983, 1.002)	Ref
Pubic hair development	-	-	0.982 (0.973, 0.991)‡	1.000 (0.985, 1.007)	0.995 (0.985, 1.001)	Ref
Girls						
Breast development	-	-	0.973 (0.964, 0.981)‡	0.980 (0.970, 0.990)‡	0.980 (0.970, 0.990)‡	Ref
Pubic hair development	-	-	0.983 (0.973, 0.993)‡	0.992 (0.979, 1.005)	0.993 (0.982, 1.004)	Ref
Age at menarche (β [95% CI])	-0.00 (-0.08, 0.07)	-0.13 (-0.23, -0.04)‡	-0.24 (-0.30, -0.17)‡	-0.16 (-0.24, -0.09)‡	-0.17 (-0.25, -0.09)‡	Ref
Height growth† (cm/year) [β (95% CI)]						
6-9 years	-	-	0.19 (0.14, 0.22)‡	0.15 (0.10, 0.19)‡	0.11 (0.06, 0.15)‡	Ref
9-12 years	-	0.03 (-0.05, 0.10)	0.04 (-0.01, 0.09)	0.05 (-0.01, 0.11)	0.02 (-0.04, 0.08)	Ref
12-15 years	-	-0.10 (-0.22, 0.03)	-0.27 (-0.36, -0.19)‡	-0.20 (-0.31, -0.10)‡	-0.15 (-0.26, -0.05)‡	Ref
Stress at 13-14 years† (β [95% CI])						
Internalising behaviour	-	-	0.83 (0.41, 1.25)‡	0.87 (0.38, 1.35)‡	0.33 (-0.14, 0.81)	Ref
Externalising behaviour	-	-	0.49 (0.16, 0.82)‡	0.79 (0.40, 1.17)‡	0.14 (0.23, 0.52)‡	Ref
Anxious/depressive	-	-	0.47 (0.22, 0.72)‡	0.55 (0.26, 0.83)‡	0.26 (-0.02, 0.54)	Ref
Social problem	-	-	0.17 (0.52, 0.29)‡	0.18 (0.04, 0.31)‡	-0.04 (-0.18, 0.09)	Ref

* Reference to the World Health Organization 2007 growth reference

† Analysis limited to migrants who came to Hong Kong before 6 or 8 years old because such information in those who migrated at older ages might have missed

‡ P<0.05

household income in the birth cohort. Information on potential mediators such as diet and physical activities was not available for the migrants and could not be analysed.

Conclusion

Early childhood migrants and children of migrant women had more CVD-related risk factors in adolescence. The impact of migration on cardiovascular health may be gender-specific and time-specific, with transition during early childhood being more important. Our findings highlight the need to assess the role of early intervention strategies at both individual and population levels in promoting cardiovascular health in Hong Kong adolescents.

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TABLE 3. Adjusted (for age and sex) association between migrant generations and cardiovascular disease–related factors

Cardiovascular disease–related risk factors	Native born 'Children of 1997'		
	1st generation migrant	2nd generation migrant	3rd+ generation migrant
Body mass index z-score at 14 years* (β [95% CI])			
All	0.06 (-0.03, 0.16)	-0.02 (-0.12, 0.08)	Ref
Boys	0.13 (-0.02, 0.29)	0.00 (-0.17, 0.17)	Ref
Girls	-0.01 (-0.13, 0.11)	-0.03 (-0.16, 0.10)	Ref
Height z-score at 14 years* β [95% CI])			
All	0.16 (0.09, 0.23)†	0.02 (-0.05, 0.10)	Ref
Boys	0.22 (0.11, 0.32)†	0.07 (-0.04, 0.17)	Ref
Girls	0.10 (0.00, 0.19)†	-0.02 (-0.12, 0.08)	Ref
Blood pressure at 13 years (mm Hg) [β (95% CI)]			
Systolic blood pressure	1.06 (0.12, 1.99)†	0.21 (-0.78, 1.21)	Ref
Diastolic blood pressure	0.95 (0.45, 1.45)†	0.11 (-0.40, 0.62)	Ref
Onset of puberty† (time ratio [95% CI])			
Boys			
Genital development	0.999 (0.985, 1.013)	1.007 (0.992, 1.021)	Ref
Pubic hair development	0.992 (0.976, 1.007)	0.998 (0.982, 1.015)	Ref
Girls			
Breast development	0.981 (0.968, 0.994)†	0.999 (0.986, 1.014)	Ref
Pubic hair development	0.993 (0.977, 1.009)	1.002 (0.986, 1.019)	Ref
Age at menarche (β [95% CI])	-0.13 (-0.25, -0.01)†	0.01 (-0.12, 0.13)	Ref
Height growth (cm/year) [β (95% CI)]			
6-9 years	0.08 (0.01, 0.15)†	-0.02(-0.10, 0.05)	Ref
9-12 years	0.02 (-0.07, 0.10)†	-0.00 (-0.09, 0.09)	Ref
12-15 years	-0.21 (-0.35, -0.07)†	-0.04 (-0.18, 0.11)	Ref
Stress at 13-14 years (β [95% CI])			
Internalising behaviour	0.04 (-0.65, 0.73)	-0.09 (-0.77, 0.60)	Ref
Externalising behaviour	0.23 (-0.27, 0.74)	0.10 (-0.49, 0.69)	Ref
Anxious/depressive	0.18 (-0.21, 0.56)	0.08 (-0.31, 0.47)	Ref
Social problem	-0.08 (-0.29, 0.14)	-0.01 (-0.23, 0.22)	Ref

* Reference to the World Health Organization 2007 growth reference
† P<0.05

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