Original Article

Clustering of Risk Behaviors and their Social Determinants among Primary School Learners in Beijing, China: A Cross-sectional Study

Yan Zhang[1], Ying Ji[2]

[1]Department of Nutrition and Food Hygiene, Beijing Centers for Diseases Control and Prevention, Beijing 100013, China
[2]Department of Social Medicine and Health Education, School of Public Health, Peking University Health Science Center, Beijing 100191, China

Abstract

Background: Studies in developed countries reveal that poor lifestyle choices triggering diseases typically cluster among children. However, there is insufficient evidence on the clustering of risk behaviors among children in developing countries. This study aimed to determine the clustering of risk behaviors and their social determinants among 4th-and 5th-grade learners in Beijing, China.

Methods: The sample comprised of 967 learners from six primary schools enrolled migrant and resident learners by two-stage stratified cluster sampling. Prevalence denoted the risk behaviors and their clustering. A log-linear model was used to explore the clustering patterns. Ordinal logistic regression determined the influence of demographic characteristics, school environment, and family context on behavioral clustering.

Results: The prevalence of none, one, two, and three or more risk factors was 61.2%, 20.0%, 10.8%, and 8.1% for infectious diseases and 46.0%, 30.6%, 15.4%, and 8.0% for chronic diseases, respectively. Some behaviors appeared dependent and were more likely to be observed together. The three most influential factors for infectious diseases were school type (odds ratio [*OR*] =4.47, 95% confidence interval [*CI*] 3.00–6.66), school located in an inner suburb (*OR* = 0.27, 95% *CI* 0.18–0.38), and gender (*OR* = 0.56, 95% *CI* 0.42–0.74). Regarding risk behaviors for chronic diseases, clustering was not associated with household registration status and number of appliances, but was significantly associated with school type (*OR* = 5.36, 95% *CI* 3.72–7.73), school located in an inner suburb (*OR* = 0.59, 95% *CI* 0.43–0.81), and gender (*OR* = 0.61, 95% *CI* 0.47–0.78). School environment variables were the most significant contributor to the number of risk behaviors.

Conclusions: The characteristics of schools enrolling migrants and residents influenced the number of risk behaviors. Therefore, improved school conditions and integrated behavioral interventions are particularly recommended for health promotion.

Key words: Clustering, Learners; Multiple Risk Behaviors; Social Determinants

Introduction

Unhealthy behaviors contribute significantly toward the development of diseases.[1-4] Moreover, people typically maintain childhood behavioral patterns.[5-7] Studies in developed countries reveal that poor lifestyle choices triggering noncommunicable diseases typically co-occur or "cluster" among children and adolescents.[8-12] These provide valuable information for interventions against risk behaviors. However, there is insufficient evidence on the clustering of risk behaviors among children in developing countries. Meanwhile, developing countries contend with the burden of infectious and chronic diseases[13,14] less so than risk behaviors for infectious diseases (RBID) among children and adolescents.

Social variables, such as family socioeconomic status (SES) and family structure, are known to contribute toward risk behaviors;[15-17] therefore, they contribute to risk behavior clustering. A low SES, which incorporates a low income and mothers' educational levels, is associated with the clustering of risk behaviors.[8,18,19] Therefore, interventions for risk behaviors must focus on disadvantaged children.

Rapid development in China is continuing to increase the number of rural-urban migrants. China's rural-urban migrant population (henceforth, "migrant population") is defined as individuals leaving their rural residences for urban cities for a certain period (more than 6 months) without changing household registration. In 2012, the migrant population

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.4103/0366-6999.158289

Address for correspondence: Dr. Ying Ji, Department of Social Medicine and Health Education, School of Public Health, Peking University Health Science Center, Beijing 100191, China
E-Mail: jiyingpku@163.com

was approximately 236 million.[20] According to 2010 data, 20.8% of the migrant population were children under 14 years old[21] with living conditions characterized by instability, overcrowded housing, poor sanitation, children attending disadvantaged schools, and social and cultural isolation.[22] These constitute risk factors for health and the cultivation of healthy behaviors. However, the clustering of risk behaviors and their determinants among children in China is under-researched.

This study examined the clustering of risk behaviors for infectious and chronic diseases, and the accompanying influence of social determinants among learners in the high grades in primary schools enrolling migrants and residents in Beijing.

Methods

Sample

We employed two-stage stratified cluster sampling. First, we stratified schools into urban districts, inner suburbs, and outer suburbs. Beijing comprises 16 districts, including 6 urban districts, 6 inner suburbs, and 4 outer suburbs. We randomly selected one district from each of these. Second, we randomly selected two medium-scale (800–1200) primary schools from each district, which enrolled migrant and resident learners. We selected two grade 4 and 5 classes from each school randomly, with all learners in those classes invited to participate. Among the 1021 learners recruited, 41 declined to participate, and 13 were excluded because their survey forms were unusable. The final sample size was 967, yielding a response rate of 94.7%. The data were collected from February to May 2011 by trained fieldworkers.

In this study, migrants were those whose household registration records (hukou) were not in Beijing. Given their different hukou statuses, learners were divided into two groups: Migrants and residents.

Informed consent was obtained from the participating learners and their parents by letters. This study was approved by the Institutional Review Board at Peking University (IRB00001052-11025).

Measures

The questionnaires were self-completed, and the research assistants were available to clarify arising questions.

Self-reported risk RBID included six items, namely: "Do you wash hands before eating?" "Do you wash hands after defecation?" "Do you wash fruit before eating?" "Do you spit in public?" "Do you drink tap water that is not boiled?" and "Do you share towels with others?" Response choices were "always," "sometimes," and "never." "Sometimes" or "never" were risk behaviors for the first three questions, whereas "always" was a risk behavior for the latter three. Related risk behavior interventions for infectious diseases are recommended in health education courses in Chinese primary schools, particularly public schools.

Risk behaviors for chronic diseases (RBCD) and growth included: Smoking; passive smoking (PS) (≥4 days/week); breakfast (≤3 days/week); and consumption of vegetables (≤3 days/week), fruits (≤3 days/week), and milk (≤3 days/week). We defined "smoking" as having ever smoked or tried[23] and PS as exposure to other people's tobacco smoke for more than 15 min/day. The frequency method was used to measure risk behaviors, and arbitrary cut-offs were adopted to identify whether behaviors posed health risks.

Clustering of risk behaviors was demonstrated by number of risk behaviors and clustering patterns of individual risk behaviors as previous studies.[24,25]

Data analysis

Statistical analysis was conducted through SPSS (version 13.0, SPSS Inc., USA). Descriptive analysis summarized the outcome of demographic characteristics and prevalence of risk behaviors with the percentage for categorical variables and mean for continuous variables. Chi-square tests were used to compare prevalence and clustering for the number of risk behaviors among the different groups, with a significance threshold of 0.05. A log-linear model was used to explore the clustering patterns. The main effects model would be a priority, assuming that the risk behaviors were mutually independent of one another. If it did not adequately fit, interactions between variables would be considered to establish an appropriate model. Ordinal logistic regression analysis demonstrated the social determinants of the number of risk behaviors. Four models were explored to distinguish the role of school and family context. Model 1 included only demographic characteristics (i.e., age and gender). Variables relating to the school environment were added to Model 2. Model 3 introduced family context variables to Model 1. All variables were included in Model 4. The test of parallel lines was used to judge whether the data fit the ordinal logistic regression model ($P > 0.05$). Goodness of fit was tested using − 2 log likelihood (−2 LL) ($P < 0.05$) and Pearson's Chi-square test ($P > 0.05$). Cox and Snell's pseudo R^2 were calculated to assess the models' interpretation power.

Results

Demographic characteristics

As can be seen in Table 1, boys outnumbered girls in all the districts. Two-thirds of the learners (age range: 9–14 years; mean = 11.25 years) were in public schools; 70.2% of the subjects were migrants. The education level of guardians in the outer suburbs was the lowest; only 13.5% had attended high school. The percentage of ownership of <3 household appliances increased with distance from an urban area, with 21.6% in an urban district, 54.9% in an inner suburb, and 62.2% in an outer suburb.

Multiple risk behaviors and clustering patterns

Table 2 shows the RBID and RBCD. Risk behavioral frequencies were higher in suburban than urban districts. The most prevalent RBID and RBCD were "not washing

Table 1: Demographic characteristics by district

Variables	Items	Urban district *n* (%)	Inner suburb *n* (%)	Outer suburb *n* (%)	Total *n* (%)
Gender	Boys	122 (50.8)	227 (55.2)	160 (53.9)	509 (53.7)
	Girls	118 (49.2)	184 (44.8)	137 (46.1)	439 (46.3)
Age (years)	Mean	11.26 ± 0.9	11.10 ± 1.1	11.46 ± 1.2	11.25 ± 1.1
School type	Public	245 (100.0)	192 (45.8)	218 (71.9)	655 (67.7)
	Private	0 (0.0)	227 (54.2)	85 (28.1)	312 (32.3)
Household registration	Resident	92 (37.6)	134 (32.0)	62 (20.5)	288 (29.8)
	Migrant	153 (62.4)	285 (68.0)	241 (79.5)	679 (70.2)
Number of appliances	≤3	53 (21.6)	230 (54.9)	189 (62.4)	472 (48.8)
	≥4	192 (78.4)	189 (45.1)	114 (37.6)	495 (51.2)
Guardians' education level	Secondary school and below	168 (68.6)	343 (81.9)	262 (86.5)	773 (79.9)
	High school and above	77 (31.4)	76 (18.1)	41 (13.5)	194 (20.1)

Table 2: Multiple risk behaviors and their clustering by district

Items	Urban *n* (%)	Inner suburb *n* (%)	Outer suburb *n* (%)	χ^2	*P*
RBID					
WHBE	31 (12.7)	53 (12.6)	63 (20.8)	10.70	0.005
WHAD	34 (13.9)	58 (13.8)	81 (26.7)	23.49	0.000
WFBE	14 (5.7)	36 (8.6)	42 (13.9)	11.18	0.004
SIP	5 (2.0)	15 (3.6)	16 (5.3)	4.01	0.135
Drinking tap water that is not boiled	8 (3.3)	25 (6.0)	44 (14.5)	27.44	0.000
Sharing towels with others	20 (8.2)	59 (14.1)	66 (21.8)	20.20	0.000
Number of risk behaviors					
0	176 (71.8)	280 (66.8)	136 (44.9)	54.39	0.000
1	41 (16.7)	68 (16.2)	84 (27.7)		
2	16 (6.5)	44 (10.5)	44 (14.5)		
≥3	12 (4.9)	27 (6.4)	39 (12.9)		
RBCD					
Ever smoking	10 (4.1)	29 (6.9)	37 (12.2)	13.26	0.001
Passive smoking: ≥4 days/weeks	43 (17.6)	101 (24.1)	70 (23.1)	4.10	0.129
Breakfast: ≤3 days/weeks	11 (4.5)	49 (11.7)	41 (13.5)	13.07	0.001
Vegetable consumption: ≤3 days/weeks	7 (2.9)	21 (5.0)	11 (3.6)	2.04	0.361
Fruit consumption: ≤3 days/weeks	18 (7.3)	78 (18.6)	48 (15.8)	15.81	0.000
Milk consumption: ≤3 days/weeks	41 (16.7)	140 (33.4)	102 (33.7)	24.90	0.000
Number of risk behaviors					
0	151 (61.6)	186 (44.4)	108 (35.6)	49.22	0.000
1	63 (25.7)	118 (28.2)	115 (38.0)		
2	26 (10.6)	69 (16.5)	54 (17.8)		
≥3	5 (2.0)	46 (11.0)	26 (8.6)		

RBID: Risk behaviors for infectious diseases; RBCD: Risk behaviors for chronic diseases; WHBE: Not washing hands before eating; WHAD: Not washing hands after defecation; WFBE: Not washing fruit before eating; SIP: Spitting in public.

hands after defecation (WHAD)" and "consuming milk ≤3 days/week," respectively. The prevalence of none, one, two, and three or more RBID was 61.2%, 20.0%, 10.8%, and 8.1%, respectively, and for RBCD it was 46.0%, 30.6%, 15.4%, and 8.0%, respectively.

The main effects in the log-linear model showed inadequate fit for the data and interactions between two of the variables demonstrated an appropriate model. As shown in Table 3, this was deemed to have a better fit to the data ($\chi^2 = 45.42$, $P = 0.538$; $\chi^2 = 61.64$, $P = 0.125$). In RBID, not washing hands before eating with WHAD (odds ratio [*OR*] =6.06, 95% *CI* 4.00–9.17), spitting in public (SIP) with drinking unboiled tap water (DUTW) (*OR* = 4.57, 95% *CI* 2.10–9.98), and WHAD with not washing fruit before eating (*OR* = 4.09, 95% *CI* 2.48–6.75) were behaviors more likely to be observed together. In RBCD, FC with MC (*OR* = 5.49, 95% *CI* 3.75–8.03), HB with VC (*OR* = 2.64, 95% *CI* 1.23–5.69), and PS with FC (*OR* = 2.58, 95% *CI* 1.77–3.77) were more likely to occur dependently.

Social determinants of risk behavior clustering

Ordinal logistic analysis results showed that no matter the model for RBID or RBCD, the data fit the ordinal logistic regression model well, with $P > 0.05$ in the test of parallel lines; the goodness of fit was also fine with $P < 0.05$ in − 2 LL and $P > 0.05$ in Pearson's Chi-square test [Tables 4 and 5]. Results of R^2 showed the explanatory

Table 3: Clustering patterns for risk behaviors

RBID	*OR*	95% *CI*	*P*	RBCD	*OR*	95% *CI*	*P*
WHBE × WHAD	6.06	4.00–9.17	0.000	ES × FC	2.57	1.51–4.37	0.001
WHBE × WFBE	2.60	1.54–4.39	0.000	PS × FC	2.58	1.77–3.77	0.000
WHBE × STWO	2.26	1.44–3.55	0.000	HB × VC	2.64	1.23–5.69	0.013
WHAD × WFBE	4.09	2.48–6.75	0.000	HB × FC	2.09	1.26–3.45	0.004
WHAD × SIP	2.67	1.29–5.53	0.008	HB × MC	1.98	1.26–3.10	0.003
WHAD × STWO	2.96	1.92–4.55	0.000	VC × MC	2.36	1.22–4.55	0.010
WFBE × DUTW	2.67	1.48–4.83	0.001	FC × MC	5.49	3.75–8.03	0.000
SIP × DUTW	4.57	2.10–9.98	0.000				
SIP × STWO	2.37	1.10–5.12	0.028				
DUTW × STWO	3.41	2.03–5.73	0.000				

RBID: Likelihood ratio goodness-of-fit tests $\chi^2 = 45.42$, $P = 0.538$; RBCD: Likelihood ratio goodness-of-fit tests $\chi^2 = 61.64$, $P = 0.125$. WHBE: Not washing hands before eating; WHAD: Not washing hands after defecation; WFBE: Not washing fruit before eating; SIP: Spitting in public; DUTW: Drinking unboiled tap water; STWO: Sharing towel with others; ES: Ever smoking; PS: Passive smoking; HB: Having breakfast; VC: Vegetables consumption; FC: Fruits consumption; MC: Milk consumption; *OR*: Odds ratio; *CI*: Confidence interval; RBID: Risk behaviors for infectious diseases; RBCD: Risk behaviors for chronic diseases.

power was lowest in Model 1 and highest in Model 4. R^2 in Model 2 was greater than it was in Model 3, whether in RBID or RBCD, and disclosed the important role of the school. Once all variables were included in Model 4, more RBID was exhibited by boys, migrants, those living in the outer suburbs, private school learners, learners with less educated guardians, and those from families with fewer household appliances. The three most influential factors were school type (*OR* = 4.47, 95% *CI* 3.00–6.66), school located in an inner suburb (*OR* = 0.27, 95% *CI* 0.18–0.38), and gender (*OR* = 0.56, 95% *CI* 0.42–0.74). Regarding RBCD, behavioral clustering was not associated with household registration status and number of appliances, but was significantly associated with school type (*OR* = 5.36, 95% *CI* 3.72–7.73), school located in an inner suburb (*OR* = 0.59, 95% *CI* 0.43–0.81), and gender (*OR* = 0.61, 95% *CI* 0.47–0.78).

Discussion

This study assessed the clustering of multiple risk behaviors for infectious and chronic diseases and their social determinants among learners in schools enrolling migrants and residents in Beijing, China. The prevalence of none, one, two, and three or more risk factors was 61.2%, 20.0%, 10.8%, and 8.1%, respectively, for infectious diseases, and 46.0%, 30.6%, 15.4%, and 8.0%, respectively, for chronic diseases.

Regarding some RBID, the participants engaged in more healthy behaviors than those in a nationwide, representative Chinese survey conducted in 2005, wherein elementary school learners washed their hands 72.5% (before eating) and 75.4% (after defecation) of the time.[26] The survey showed that, regarding some RBCD, daily breakfast and vegetable consumption was at 84.0% and 67.0%, respectively, among the learners; this was 79.4% and 81.2% in our study. As most Beijing schools provide lunch in recent years, vegetable intake was boosted in students.

Children who begin smoking earlier are more likely to develop severe nicotine addiction.[27] In a longitudinal Canadian study, the prevalence among 10–11-year-old children of having ever smoked was 6% from 2000 to 2001,[15] compared to 7.9% in our study. Data from the United Kingdom showed that 12–16-year-old children's breakfast intake ≥5 days a week was at 76.7%.[28] However, these studies are not comparable with the current one because of differences in the survey periods, regions, and population.

Although few studies have focused on behaviors for infectious diseases, there are a number of studies that have examined the clustering of RBCD.[11,12,24,29] Our results from the log-linear models showed clear evidence that risk behaviors for infectious and chronic diseases were not independent, but were instead clustered together, such as washing hands before eating and after defecation, SIP and DUTW, fruit consumption and milk intake, and breakfast and vegetable consumption. Although the analytic techniques used to define clustering differed across studies,[30] it was clear that some risk behaviors clustered.[31] These findings would have substantial implications for health promotion. Multiple behavior interventions (i.e., targeting more than one health behavior simultaneously) would have the potential for a much greater public health impact compared to single behavior interventions. The limited clustering of smoking with the other factors was very different from the other studies. A possible reason for this was that the risk behaviors we investigated were more about diet and nutrition, and less about physical activity and alcohol consumption, which were observed clustering with smoking by other researchers. In addition, the population we studied was primary school students, among whom the smoking rate is comparatively low.[32] However, our results also showed that interventions for smoking and fruit consumption together would be good for primary school students.[33]

The literature shows that many factors – including gender, ethnicity, grade level, family, schooling, and community contexts – influence risk behaviors.[34-36] In our study, we considered demographic characteristics (i.e., gender and age), school environment (i.e., school type: Private or public; location: Urban district or suburb), and family

Table 4: Ordinal logistic regression by number of RBID (reference: No risk behaviors)

Variables	Items	Model 1			Model 2			Model 3			Model 4		
		OR	95% *CI*	*P*	*OR*	95% *CI*	*P*	*OR*	95% *CI*	*P*	*OR*	95% *CI*	*P*
Age	Continuous	1.43	1.27, 1.62	0.000	1.13	1.00, 1.28	0.059	1.22	1.07, 1.38	0.002	1.08	0.95, 1.23	0.248
Gender	Girls (reference: Boys)	0.59	0.45, 0.77	0.000	0.53	0.41, 0.71	0.000	0.62	0.47, 0.81	0.000	0.56	0.42, 0.74	0.000
School location	Urban				0.55	0.38, 0.79	0.002				0.64	0.44, 0.95	0.028
	Inner suburb (reference: Outer suburb)				0.23	0.16, 0.32	0.000				0.27	0.18, 0.38	0.000
School type	Private (reference: Public)				6.48	4.49, 9.36	0.000				4.47	3.00, 6.66	0.000
Household registration	Migrants (reference: Residents)							3.00	2.07, 4.36	0.000	1.86	1.25, 2.77	0.002
Guardians' education level	High school and above (reference: Middle school and below)							0.58	0.40, 0.86	0.007	0.61	0.41, 0.90	0.014
Number of household appliances	More than 4 (reference: No more than 3)							0.53	0.40, 0.71	0.000	0.73	0.53, 1.00	0.049
Test of parallel lines (*P*)			0.620			0.650			0.406			0.471	
Model fitting (−2 LL, *P*)			152.2, 0.000			460.1, 0.000			448.1, 0.000			848.9, 0.000	
Goodness of fit (Pearson's χ^2, *P*)			34.8, 0.573			196.5, 0.053			208.9, 0.641			555.3, 0.968	
Pseudo R^2 Cox and Snell			0.060			0.198			0.152			0.221	

OR: Odds ratio; *CI*: Confidence interval; RBID: Risk behaviors for infectious diseases.

Table 5: Ordinal logistic regression by number of RBCD and growth (reference: No risk behaviors)

Variables	Items	Model 1			Model 2			Model 3			Model 4		
		OR	95% *CI*	*P*	*OR*	95% *CI*	*P*	*OR*	95% *CI*	*P*	*OR*	95% *CI*	*P*
Age	Continuous	1.49	1.33, 1.66	0.000	1.21	1.08, 1.37	0.002	1.30	1.16, 1.46	0.000	1.18	1.05, 1.34	0.006
Gender	Girls (reference: Boys)	0.65	0.51, 0.83	0.001	0.60	0.47, 0.77	0.000	0.64	0.50, 0.83	0.001	0.61	0.47, 0.78	0.000
School location	Urban				0.61	0.43, 0.86	0.005				0.69	0.48, 0.99	0.042
	Inner suburb (reference: Outer suburb)				0.54	0.39, 0.73	0.000				0.59	0.43, 0.81	0.001
School type	Private (reference: Public)				6.48	4.66, 9.01	0.000				5.36	3.72, 7.73	0.000
Household registration	Migrants (reference: Residents)							1.98	1.46, 2.69	0.000	1.19	0.85, 1.66	0.305
Guardians' education level	High school and above (reference: Middle school and below)							0.68	0.49, 0.94	0.021	0.71	0.51, 0.99	0.046
No. of household appliances	More than 4 (reference: No more than 3)							0.51	0.39, 0.66	0.000	0.78	0.59, 1.05	0.098
Test of parallel lines (*P*)			0.438			0.141			0.183			0.156	
Model fitting (−2 LL, *P*)			169.6, 0.000			465.6, 0.000			527.2, 0.000			958.4, 0.000	
Goodness of fit (Pearson's χ^2, *P*)			45.0, 0.173			174.0, 0.320			222.7, 0.380			578.4, 0.877	
Pseudo R^2 Cox and Snell			0.069			0.224			0.145			0.232	

OR: Odds ratio; *CI*: Confidence interval; RBCD: Risk behaviors for chronic diseases; −2 LL: −2 log likelihood.

context as determinants of the clustering of risk behaviors. The family context in our study referred to SES, including place of household registration (Beijing or other), number of household appliances, and guardians' education levels. Here, household appliances (i.e., television, washing machine, air conditioner, refrigerator, and personal computer) were considered a measure of wealth because collecting data on income and savings is a sensitive issue in China and learners may not give accurate income-related information. Therefore, obtaining nonmonetary indicators of wealth is a simpler and considerate proxy.[37,38] As expected, demographic characteristics, school environment, and family context variables contributed toward the number of risk behaviors, with the school environment variables being the most significant contributor.

As learners spend most of their time in school, school conditions, interventions, and teachers' and peers' support reportedly facilitate the formation of healthy behaviors.[39,40] In China, urban schools' physical conditions and health education capacity are slightly better than those of suburban schools. However, while the conditions in urban schools are generally better, the gaps between urban and suburban schools are not qualitative but quantitative, and more differences exist between public and private schools enrolling migrant children. In public schools, health education courses are regularly offered by qualified teachers, and basic hygiene amenities (sufficient taps, washrooms, and classroom lights), desks and chairs adjusted according to child height, and a balanced diet can be provided. In most public schools, learners annually undergo professional health checks, participate in vaccination programs, and receive counseling; none of these is provided in most private schools recruiting migrant learners. Private schools have fewer studying facilities and lower teaching capacity.[21,41] Similarly, in our study, schools' characteristics mattered more than the family context as R^2 showed.

The family context, reflected by the SES, including household income, parents' educational level, and occupation, was another important determinant of risk behaviors.[15,42,43] In our study, number of appliances and guardians' educational levels (constituting the family context) significantly influenced the number of RBID, possibly because of misinformation regarding these and related prevention measures among learners of a lower SES.[44] Regarding RBCD, the guardians' education level significantly influenced behavioral clustering but proved less significant than the school environment. According to many studies, teenagers from low SES backgrounds are likely to report inadequate fruit and vegetable consumption.[45-48] However, comparisons are limited because differences in estimates may be confounded by differences in the risk factors investigated, data-gathering instruments, and analysis. The schools' characteristics in our study could be particularly influential because urban public primary schools in Beijing provide nutritional lunch – comprising fruit, vegetables, and milk – to learners.

Our study primarily suggests that integrated interventions may be optimal in facilitating healthy lifestyles. However, demographic and social determinants can directly influence the number of unhealthy behaviors. Since clustered risk behaviors may be particularly harmful to children's health,[49] public health interventions should target three or more risk behaviors according to socioeconomic conditions.

This study had several limitations. It was comprised of a cross-sectional survey, making it impossible to make causal inferences about risk behaviors. Moreover, the survey comprised self-reported data by the learners, increasing the possibility of misreporting. Further, we did not measure daily vegetable and fruit servings, but assessed the weekly frequency, with arbitrary cut-offs. However, we did maximize the likelihood of honest reporting by ensuring the learners' anonymity.

Thus, despite the limitations, this study is one of the few to focus on social determinants of multiple health behaviors among learners in developing countries, particularly migrant learners. Our results highlight the extent of health promotion among learners.

In conclusion, characteristics of schools enrolling migrants and residents influenced the number of risk behaviors. Therefore, improved school conditions and integrated behavioral interventions are particularly important for health promotion.

Acknowledgments

We thank the Institute of Health Education, Beijing, for their substantial support in the field survey for this study. We also thank Piao Wei, and Wang Qianyi for assistance in data collection.

References

1. Centers for Disease Control and Prevention (CDC). Acute hemorrhagic conjunctivitis outbreak caused by Coxsackievirus A24 – Puerto Rico, 2003. MMWR Morb Mortal Wkly Rep 2004;53:632-4.
2. Feachem RG. Interventions for the control of diarrhoeal diseases among young children: Promotion of personal and domestic hygiene. Bull World Health Organ 1984;62:467-76.
3. Giudice R, Izzo R, Manzi MV, Pagnano G, Santoro M, Rao MA, *et al.* Lifestyle-related risk factors, smoking status and cardiovascular disease. High Blood Press Cardiovasc Prev 2012;19:85-92.
4. Ma CN, Wu SS, Yang P, Li HY, Zhang Y, Li XY, *et al.* Study on the risk factors of diarrhea-related behaviors among adults in Beijing (in Chinese). Chin J Epidemiol 2012;33:42-5.
5. Rew L, Horner SD. Youth Resilience Framework for reducing health-risk behaviors in adolescents. J Pediatr Nurs 2003;18:379-88.
6. Hayman LL, Himmelfarb CD. Cardiovascular health promotion and risk reduction in children and adolescents: The new integrated guidelines. J Cardiovasc Nurs 2012;27:197-200.
7. Harrell JS, McMurray RG, Bangdiwala SI, Frauman AC, Gansky SA, Bradley CB. Effects of a school-based intervention to reduce cardiovascular disease risk factors in elementary-school children: The Cardiovascular Health in Children (CHIC) study. J Pediatr 1996;128:797-805.
8. Hardy LL, Grunseit A, Khambalia A, Bell C, Wolfenden L, Milat AJ. Co-occurrence of obesogenic risk factors among adolescents. J Adolesc Health 2012;51:265-71.

9. Mistry R, McCarthy WJ, Yancey AK, Lu Y, Patel M. Resilience and patterns of health risk behaviors in California adolescents. Prev Med 2009;48:291-7.
10. Plotnikoff RC, Karunamuni N, Spence JC, Storey K, Forbes L, Raine K, *et al*. Chronic disease-related lifestyle risk factors in a sample of Canadian adolescents. J Adolesc Health 2009;44:606-9.
11. Sabbe D, De Bourdeaudhuij I, Legiest E, Maes L. A cluster-analytical approach towards physical activity and eating habits among 10-year-old children. Health Educ Res 2008;23:753-62.
12. Cameron AJ, Crawford DA, Salmon J, Campbell K, McNaughton SA, Mishra GD, *et al.* Clustering of obesity-related risk behaviors in children and their mothers. Ann Epidemiol 2011;21:95-102.
13. Yang G, Wang Y, Zeng Y, Gao GF, Liang X, Zhou M, *et al.* Rapid health transition in China, 1990-2010: Findings from the Global Burden of Disease Study 2010. Lancet 2013;381:1987-2015.
14. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, *et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2197-223.
15. Alamian A, Paradis G. Individual and social determinants of multiple chronic disease behavioral risk factors among youth. BMC Public Health 2012;12:224.
16. Ottova V, Ravens-Sieberer U. Social determinants in child health: Reflections from the Health Behaviour in School-aged Children survey. Int J Public Health 2010;55:525-6.
17. Prättälä RS, Puska P. Social determinants of health behaviours and social change. Eur J Public Health 2012;22:166.
18. O'Loughlin J, Maximova K, Tan Y, Gray-Donald K. Lifestyle risk factors for chronic disease across family origin among adults in multiethnic, low-income, urban neighborhoods. Ethn Dis 2007;17:657-63.
19. Silva KS, Barbosa Filho VC, Del Duca GF, de Anselmo Peres MA, Mota J, Lopes Ada S, *et al.* Gender differences in the clustering patterns of risk behaviours associated with non-communicable diseases in Brazilian adolescents. Prev Med 2014;65:77-81.
20. Department of Floating Population Service and Management of National Population and Family Planning Commission of China. 2013 Report on China's Migrant Population Development. Beijing: Population Publishing House; 2013.
21. Department of Floating Population Service and Management of National Population and Family Planning Commission of China. Current living situation of migrant population in China (in Chinese). Popul Res 2010;34:6-18.
22. DuPlessis HM, Cora-Bramble D; American Academy of Pediatrics Committee on Community Health Services. Providing care for immigrant, homeless, and migrant children. Pediatrics 2005;115:1095-100.
23. Canada H. Youth Smoking Survey: Terminology. Available from: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/survey-sondage_term-eng.php2010. [Last accessed on 2014 Nov 27].
24. Ottevaere C, Huybrechts I, Benser J, De Bourdeaudhuij I, Cuenca-Garcia M, Dallongeville J, *et al*. Clustering patterns of physical activity, sedentary and dietary behavior among European adolescents: The HELENA study. BMC Public Health 2011;11:328.
25. Dumith SC, Muniz LC, Tassitano RM, Hallal PC, Menezes AM. Clustering of risk factors for chronic diseases among adolescents from Southern Brazil. Prev Med 2012;54:393-6.
26. Yu XM, Yang TB, Wang SM, Zhang X. Study on student health literacy gained through health education in elementary and middle schools in China. Health Educ J 2011;71:452-60.
27. O'Loughlin J, Renaud L, Paradis G, Meshefedjian G, Zhou X. Prevalence and correlates of early smoking among elementary schoolchildren in multiethnic, low-income inner-city neighborhoods. Ann Epidemiol 1998;8:308-18.
28. Pearson N, Atkin AJ, Biddle SJ, Gorely T, Edwardson C. Patterns of adolescent physical activity and dietary behaviours. Int J Behav Nutr Phys Act 2009;6:45.
29. Sanchez A, Norman GJ, Sallis JF, Calfas KJ, Cella J, Patrick K. Patterns and correlates of physical activity and nutrition behaviors in adolescents. Am J Prev Med 2007;32:124-30.
30. McAloney K, Graham H, Law C, Platt L. A scoping review of statistical approaches to the analysis of multiple health-related behaviours. Prev Med 2013;56:365-71.
31. van Nieuwenhuijzen M, Junger M, Velderman MK, Wiefferink KH, Paulussen TW, Hox J, *et al.* Clustering of health-compromising behavior and delinquency in adolescents and adults in the Dutch population. Prev Med 2009;48:572-8.
32. Galán I, Rodríguez-Artalejo F, Tobías A, Díez-Gañán L, Gandarillas A, Zorrilla B. Clustering of behavior-related risk factors and its association with subjective health. Gac Sanit 2005;19:370-8.
33. Harley AE, Devine CM, Beard B, Stoddard AM, Hunt MK, Sorensen G. Multiple health behavior changes in a cancer prevention intervention for construction workers, 2001-2003. Prev Chronic Dis 2010;7:A55.
34. Rew L, Horner SD, Fouladi RT. Factors associated with health behaviors in middle childhood. J Pediatr Nurs 2010;25:157-66.
35. Peltzer K. Health behavior and protective factors among school children in four African countries. Int J Behav Med 2009;16:172-80.
36. Adelmann PK. Social environmental factors and preteen health-related behaviors. J Adolesc Health 2005;36:36-47.
37. Pollack CE, Chideya S, Cubbin C, Williams B, Dekker M, Braveman P. Should health studies measure wealth? A systematic review. Am J Prev Med 2007;33:250-64.
38. Islami F, Kamangar F, Nasrollahzadeh D, Aghcheli K, Sotoudeh M, Abedi-Ardekani B, *et al*. Socio-economic status and oesophageal cancer: Results from a population-based case-control study in a high-risk area. Int J Epidemiol 2009;38:978-88.
39. Wechsler H, Devereaux RS, Davis M, Collins J. Using the school environment to promote physical activity and healthy eating. Prev Med 2000;31:S121-37.
40. Maes L, Lievens J. Can the school make a difference? A multilevel analysis of adolescent risk and health behaviour. Soc Sci Med 2003;56:517-29.
41. Gao GD, Luo CY. Health care management in migrant-run schools in Shanghai (in Chinese). Shanghai J Prev Med 2005;17:573-4.
42. Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. Soc Sci Med 1997;44:809-19.
43. Tsuboi S, Hayakawa T, Kanda H, Fukushima T. Physical activity in the context of clustering patterns of health-promoting behaviors. Am J Health Promot 2011;25:410-6.
44. Weyers S, Dragano N, Richter M, Bosma H. How does socio economic position link to health behaviour? Sociological pathways and perspectives for health promotion. Glob Health Promot 2010;17:25-33.
45. Laitinen S, Räsänen L, Viikari J, Akerblom HK. Diet of Finnish children in relation to the family's socio-economic status. Scand J Soc Med 1995;23:88-94.
46. Terre L, Ghiselli W, Taloney L, DeSouza E. Demographics, affect, and adolescents' health behaviors. Adolescence 1992;27:12-24.
47. Xie B, Gilliland FD, Li YF, Rockett HR. Effects of ethnicity, family income, and education on dietary intake among adolescents. Prev Med 2003;36:30-40.
48. Hanson MD, Chen E. Socioeconomic status and health behaviors in adolescence: A review of the literature. J Behav Med 2007;30:263-85.
49. Khaw KT, Wareham N, Bingham S, Welch A, Luben R, Day N. Combined impact of health behaviours and mortality in men and women: The EPIC-Norfolk prospective population study. PLoS Med 2008;5:e12.

Received: 15-12-2014 **Edited by:** Li-Shao Guo
How to cite this article: Zhang Y, Ji Y. Clustering of Risk Behaviors and their Social Determinants among Primary School Learners in Beijing, China: A Cross-sectional Study. Chin Med J 2015;128:1567-73.

Source of Support: This study was supported by a grant from the National Social Science Foundation of China (No. 11CGL080).
Conflict of Interest: None declared.