A longitudinal analysis of the effects of socioeconomic factors, foreign media, and attitude toward appearance on general and central adiposity in Chinese adolescents

Jamie Q. Felicitas [a,*], Hilary C. Tanenbaum [a,1], Yawen Li [b,2], Chih-Ping Chou [c,3], Paula H. Palmer [a,1], Donna Spruijt-Metz [c,3], Kim D. Reynolds [a,1], C. Anderson Johnson [a,1], Bin Xie [a,*]

[a] Claremont Graduate University, School of Community and Global Health, 675 West Foothill Boulevard, Suite 310, Claremont, CA 91711, USA
[b] San Diego State University, School of Social Work, Hepner Hall #119, 5500 Campanile Drive, San Diego, CA 92182, USA
[c] Keck School of Medicine, Department of Preventive Medicine, 1441 Eastlake Avenue, USC Norris Comprehensive Cancer Center, NOR-4435, Los Angeles, CA 90089, USA

ABSTRACT

This paper explores the longitudinal effects of socioeconomic factors (i.e., parent education and family income level), foreign media, and attitude toward appearance on general and central adiposity among Chinese adolescents.

A longitudinal analysis was performed using data from the China Seven Cities Study, a health promotion and smoking prevention study conducted in seven cities across Mainland China between 2002 and 2005. Participants included 5,020 middle and high school students and their parents. Explanatory variables included foreign media exposure, attitude toward appearance, parent education, and family income. Three-level, random-effect models were used to predict general adiposity (i.e., body mass index) and central adiposity (i.e., waist circumference). The Generalized Estimating Equation approach was utilized to determine the effect of explanatory variables on overweight status.

Among girls, foreign media exposure was significantly negatively associated with general adiposity over time ($\beta = -0.06$, $p = 0.01$ for middle school girls; $\beta = -0.06$, $p = 0.03$ for high school girls). Attitude toward appearance was associated with lesser odds of being overweight, particularly among high school girls (OR = 0.86, $p < 0.01$). Among boys, parental education was significantly positively associated with general adiposity ($\beta = 0.62$, $p < 0.01$ for middle school boys; $\beta = 0.37$, $p = 0.02$ for high school boys) and associated with greater odds of being overweight (OR = 1.55, $p < 0.01$ for middle school boys; OR = 1.26, $p = 0.04$ for high school boys). Across all gender and grade levels, family income was significantly negatively associated with central adiposity over time.

Interventions addressing Chinese adolescent overweight/obesity should consider these factors as potential focus areas.

Introduction

Existing literature has shown a marked increase in the prevalence of overweight and obesity across Mainland China (Chen, 2008) since the 1980s (Luo and Hu, 2002; Popkin and Doak, 1998). This increasing trend persists decades later, notably among Chinese adolescents. In 2005, the prevalence of overweight and obese children ages seven to 18 were 7.7% and 3.7%, respectively (Ji and Cheng, 2009). In 2010, the prevalence of overweight and obese children had increased to 9.9% and 5.1%, respectively (Ji et al., 2013). The rise in adolescent overweight and obesity may be explained by economic transitions occurring in China as it becomes a developed nation (Griffiths, 2010; Yang et al., 2011). Research has also suggested increased residential density (F. Xu et al., 2010), a shift in nutrition toward a high-fat diet (Du et al., 2002), and motorized transportation (Bell et al., 2002; Qin et al., 2012) all contribute to the overweight and obesity epidemic affecting China's population.

Economic changes in China have also exposed the country to foreign media, which may impact one's body image (Ata et al., 2007; Luo et al., 2005). This, in turn, can have a significant negative impact on psychological factors (Tang et al., 2010). Previous research has shown that

* Corresponding authors. Fax: +1 909 621 5221.
  E-mail addresses: jamie.felicitas@cgu.edu (J.Q. Felicitas), hilary.tanenbaum@cgu.edu (H.C. Tanenbaum), yli@mail.sdsu.edu (Y. Li), cchou@usc.edu (C.-P. Chou), paula.palmer@cgu.edu (P.H. Palmer), dmetz@usc.edu (D. Spruijt-Metz), kim.reynolds@cgu.edu (K.D. Reynolds), andy.johnson@cgu.edu (C.A. Johnson), bin.xie@cgu.edu (B. Xie).
  [1] Fax: +1 909 621 5221.
  [2] Fax: +1 619 594 5991.
  [3] Fax: +1 323 865 0125.

Chinese girls, who are frequently exposed to Western media and place greater importance on physical appearance, are more likely to experience body dissatisfaction and develop risky behaviors, such as cigarette and alcohol consumption (Xie et al., 2006b). Moreover, weight misperceptions may lead to anxiety and depression (Xie et al., 2003), school-related stress, and poor academic performance (Xie et al., 2006a).

In addition to China's pervasive exposure to foreign media, socioeconomic status (SES) has emerged as a probable determinant of overweight and obesity (Xiao et al., 2013). A cross-sectional study conducted among seventh grade students living in Southern California and Wuhan, China, found that SES was significantly positively associated with risk of overweight and obesity, particularly among Chinese adolescents (Johnson et al., 2006). Such studies lend itself to previous research demonstrating the association between SES and obesity in developing and developed countries (Miech et al., 2006; Sobal and Stunkard, 1989).

Despite mounting evidence that socioeconomic factors, foreign media, and attitude toward appearance may impact the health of Chinese youth, there are a limited number of longitudinal studies focusing on the impact external and individual influences may have on the development of general and central adiposity in Chinese adolescents. Therefore, the aim of this study was to explore the relationship between foreign media exposure, attitude toward appearance, parental education, family income, and general and central adiposity among Chinese middle and high school students utilizing longitudinal data from the Chinese Seven Cities Study (CSCS).

Methods

Data source

The CSCS was a prospective observational cohort study implemented between 2002 and 2005 in seven cities across Mainland China (i.e., Chengdu, Hangzhou, Shenyang, Wuhan, Harbin, Kunming, Qingdao). The objective of the CSCS was to assess the trends and to examine the influences on tobacco and substance use, obesity, mental health, and other related health behaviors among youth, college students, and adults. Detailed design and sampling procedures, including questionnaire development (Xie et al., 2011), are described elsewhere (Palmer et al., 2011; Xie et al., 2006a,b). Three waves of data (2002, 2003, 2004) were analyzed for this study. The study sample consists of 5,020 middle (7th graders at baseline) and high school (10th graders at baseline) students (2,398 males; 2,622 females) and their parents residing in the CSCS study cities. The Institutional Review Boards of the University of Southern California and Claremont Graduate University approved the study.

Measures

Foreign media exposure

Foreign media exposure was assessed using the following questions: (1) Where do your most favorite TV shows come from? (2) Where do your most favorite films come from? (3) Where does your most favorite music come from? For each question, students were asked to select one response from the following options: China, Hong Kong, Taiwan, Japan, Korea, and USA. Responses to each question were recoded as 0 if China was indicated and 1 if any other option was indicated. Foreign media exposure was determined to be the sum score of the three questions with a possible score ranging from 0 to 3. A higher score indicates greater foreign media exposure. Separate exposure scores were further obtained for Asian media (i.e., media originating from Hong Kong, Taiwan, Japan, and Korea) and United States (US) media.

Attitude toward appearance

Attitude toward appearance was assessed based on students' responses to three items adapted from the Internalization subscale of the Sociocultural Attitudes Towards Appearance Questionnaire

(Heinberg et al., 1995). Students were asked to indicate their level of agreement using a 5-point scale (*strongly disagree* to *strongly agree*) for each of the following items: (1) it is important for people to work hard on their figures/physiques if they want to succeed in today's society; (2) attractiveness is very important if you want to get ahead in our society; (3) in the modern society, it is important to always look attractive. Attitude toward appearance was determined to be the sum score of the three items, with a higher score indicating greater importance is placed on appearance. The Cronbach alpha in this study was 0.76.

Parent education

Parent education was determined to be the highest level of education attained by either the father or mother of each participating student at baseline. Parents were asked to indicate their highest level of education from categorical increments ranging from "didn't go to elementary school or didn't graduate from elementary school" to "university graduate or higher." Parent responses were further collapsed into below high school, high school, and college.

Family income

At each wave, monthly family income was determined to be the highest income reported by either the father or the mother of each participating student. Monthly family income was collapsed into the following categories: ≤500yuan (≤$60 USD) per month; 501–2000 yuan ($61–240 USD) per month; and, >2000 yuan (>$240 USD) per month.

General adiposity

General adiposity is reflected by a proxy measure of body mass index (BMI), calculated as weight in kilograms divided by height in meters squared. Height and weight were measured using a standard calibrated scale and stadiometer, with participants wearing light clothes with either thin socks or no shoes. BMI was then used to classify overweight and obesity status. Those deemed to be overweight or obese had a BMI at or greater than the 85th and 95th percentile of age-gender-specific BMI cutoffs recommended by the International Obesity Task Force (IOTF) (Cole et al., 2000). The categories of overweight and obesity were combined in the analysis to create a single overweight and obesity category.

Central adiposity

Central adiposity is described by waist circumference, measured twice to the nearest centimeter, midway between the rib cage and the superior border of the iliac crest using a flexible tape with the participant in a standing position at the end of gentle expiration (Lohman, 1986). A third measure was performed if the two measures differed by more than 0.5 cm. The average of the measurements was used for analysis.

Statistical analyses

Statistical analyses were conducted using Statistical Analysis Software (SAS), version 9.4. Chi-square tests and independent t-tests were conducted to evaluate differences between grade levels within gender for categorical variables and continuous variables, respectively. Three-level random-effect models implemented with the Proc Mixed procedure in SAS were employed to deal with the nested data of students nested within school and repeated assessments nested within student (Fitzmaurice et al., 2004; Littell et al., 1996). In the models, the main-effect terms of time, time squared, explanatory variables (i.e., foreign media exposure, attitude toward appearance, parent education, and family income), and interactions of time and explanatory variables were included to predict BMI and waist circumference of female and male participants by grade level over time. In addition, the Generalized Estimating Equation (GEE) approach was also implemented with the

Proc GENMOD procedure in SAS to evaluate the relationship between explanatory variables (i.e., foreign media exposure, attitude toward appearance, parent education, and family income) and overweight status among female and male participants by grade level (Liang et al., 1986; Zeger and Liang, 1992). City residence dummy variables were included as covariates in the three-level random-effect models and the GEE approach. Additional analysis was further conducted replacing foreign media exposure with Asian media exposure or US media exposure as predictors.

Results

Table 1 presents general characteristics of participants by grade level within gender. High school girls reported greater exposure to foreign media and placing greater importance on appearance compared to middle school girls at baseline ($p < 0.001$ for both foreign media exposure and attitude toward appearance). High school boys reported greater exposure to foreign media and placing greater importance on appearance compared to middle school boys at baseline ($p < 0.001$ for both foreign media exposure and attitude toward appearance). Across genders, parent education of middle school participants significantly differed from high school participants at baseline ($p < 0.001$ for girls and boys, separately).

Table 2 presents mean BMI scores, mean waist circumference measurements, and the prevalence of overweight among participants by grade level within gender at each wave. Across both genders, high school participants showed higher mean BMI scores and waist circumference measurements compared to middle school participants at each wave. However, there was a greater prevalence of overweight among middle school participants compared to high school participants at each wave.

Table 3 presents results from longitudinal analyses for middle and high school girls. Results show a significant decrease in BMI over time among middle and high school girls with greater exposure to foreign media at baseline ($\beta = -0.06$, $p = 0.01$ for middle school girls; $\beta = -0.06$, $p = 0.03$ for high school girls). Moreover, high school girls who placed greater importance on appearance had significantly lower BMI scores at baseline ($\beta = -0.11$, $p = 0.01$). Although middle and high school girls with higher family income levels had significantly higher mean waist circumferences at baseline, waist circumference was shown to significantly decrease over time ($\beta = -1.33$, $p < 0.01$ for middle school girls; $\beta = -1.29$, $p < 0.01$ for high school girls). Table 3 further presents GEE model results for overweight status among middle and high school girls. High school girls who placed greater importance on appearance at baseline were shown to have significantly lesser odds of being overweight (OR = 0.86 with 95% CI of 0.79–0.94, $p < 0.01$).

Table 4 presents results from longitudinal analyses for middle and high school boys. Middle school boys with greater exposure to foreign media ($\beta = 0.29$, $p = 0.02$ for BMI; $\beta = 0.74$, $p = 0.02$ for waist circumference) and whose parents completed higher levels of education ($\beta = 0.62$, $p < 0.01$ for BMI; $\beta = 1.51$, $p < 0.01$ for waist circumference) not only had significantly greater BMI scores but also larger waist circumferences at baseline. High school boys whose parents completed higher levels of education were also shown to have significantly higher BMI scores at baseline ($\beta = 0.37$, $p = 0.02$). The waist circumferences of high school boys whose parents completed higher levels of education were shown to significantly increase over time ($\beta = 0.33$, $p = 0.04$). Although middle and high school boys with higher family income had significantly higher mean waist circumferences at baseline ($\beta = 1.00$, $p < 0.01$ for middle school boys; $\beta = 1.31$, $p < 0.01$ for high school boys), waist circumference was shown to significantly decrease over time as family income levels increased ($\beta = -0.58$, $p < 0.01$ for middle school boys; $\beta = -1.07$, $p < 0.01$ for high school boys).

Table 4 also presents GEE model results for overweight status among middle and high school boys. Middle and high school boys whose parents completed higher levels of education had significantly greater odds of being overweight at baseline (OR = 1.55 with 95% CI of 1.28–1.88, $p < 0.01$ for middle school boys; OR = 1.26 with 95% CI of 1.02–1.57, $p = 0.04$ for high school boys). Additionally, middle school boys with higher family income also had significantly greater odds of being overweight at baseline (OR = 1.16 with 95% CI of 1.00–1.35, $p = 0.05$).

Generally, consistent results were observed across additional models conducted using Asian media exposure or US media exposure as predictors. However, several inconsistencies must be noted. Among middle school females, although Asian media exposure was found to be significantly negatively associated with BMI over time ($\beta = -0.06$, $p = 0.01$), US media exposure was not significantly associated with BMI over time ($\beta = -0.02$, $p = 0.61$). Moreover, Asian media exposure ($\beta = 0.16$, $p = 0.20$) and US media exposure ($\beta = 0.34$, $p = 0.08$) were not significantly associated with BMI among middle school males. Among high school females, Asian media exposure was found to be significantly negatively associated with BMI over time ($\beta = -0.05$, $p = 0.03$). This opposes what was found when using US media exposure as a predictor ($\beta = 0.09$, $p = 0.07$) for BMI among high school females.

Several inconsistencies were further found when using Asian media exposure and US media exposure to predict waist circumference. Among middle school males, although US media exposure was significantly positively associated with waist circumference ($\beta = 0.97$, $p = 0.05$), Asian media exposure was not significantly associated waist

Table 1
General characteristics of Chinese Seven Cities Study participants ($n = 5020$) by grade within gender (China, 2002–2005).

	Girls ($n = 2622$)		Boys ($n = 2398$)	
	Middle school	High school	Middle school	High school
Age at baseline (mean ± SD)	12.6 ± 0.6	15.7 ± 0.6	12.8 ± 0.7	15.9 ± 0.6
City residence (N (%))				
Chengdu	178 (14.5)	262 (18.8)*	169 (14.6)	211 (17.0)
Hangzhou	154 (12.6)	194 (13.9)	146 (12.6)	176 (14.2)
Shenyang	194 (15.8)	182 (13.1)	196 (16.9)	159 (12.8)
Wuhan	214 (17.4)	231 (16.6)	194 (16.7)	190 (15.4)
Harbin	156 (12.7)	165 (11.8)	143 (12.3)	162 (13.1)
Kunming	159 (13.0)	132 (9.5)	144 (12.4)	143 (11.6)
Qingdao	172 (14.0)	229 (16.4)	168 (14.5)	197 (15.9)
Media exposure (mean ± SD)				
Asian media from Hong Kong, Taiwan, Japan, and Korea	2.0 ± 1.0	2.3 ± 0.9**	1.7 ± 1.0	1.9 ± 1.0*
United States media	0.5 ± 0.7	0.8 ± 0.8**	0.8 ± 0.8	0.9 ± 0.8*
All foreign media	2.2 ± 0.9	2.5 ± 0.8**	2.2 ± 0.9	2.3 ± 0.8**
Attitude toward appearance (mean ± SD)	9.7 ± 2.3	10.7 ± 2.0**	9.4 ± 2.5	10.6 ± 2.1**
Parent education (%)				
Below high school	28.3	23.4**	28.6	24.3**
High school	35.0	47.5	36.9	46.6
College or above	36.7	29.1	34.5	29.2
Family income (%)				
Wave 1				
<500 yuan/mon	14.0	13.0	14.6	12.1
501–2000 yuan/mon	60.0	61.7	62.5	63.0
>2000 yuan/mon	25.9	25.4	23.0	24.9
Wave 2				
<500 yuan/mon	11.5	10.1	11.1	9.7
501–2000 yuan/mon	54.6	58.2	58.5	58.7
>2000 yuan/mon	33.9	31.7	30.4	31.6
Wave 3				
<500 yuan/mon	9.8	7.0*	9.7	8.4
501–2000 yuan/mon	54.1	56.1	56.5	54.6
>2000 yuan/mon	36.1	36.9	33.8	37.0

Note. Chi-square tests and independent t-tests were conducted to evaluate differences between grade levels within gender for categorical variables and continuous variables, respectively.
Asterisks indicate overall significant differences.
  * $p < 0.05$.
 ** $p < 0.001$.

Table 2
Body Mass Index (BMI), waist circumference, and overweight status of Chinese Seven Cities Study participants (n = 5020) at each wave by grade within gender (China, 2002−2005).

	Girls (n = 2622)			Boys (n = 2398)		
	Middle school	High school	p-value[a]	Middle school	High school	p-value[a]
BMI (mean kg/m^2 ± SD)						
Wave 1	19.3 ± 3.3	21.0 ± 3.1	<0.001	20.0 ± 3.8	21.5 ± 3.9	<0.001
Wave 2	19.9 ± 3.3	20.9 ± 2.9	<0.001	20.5 ± 4.0	21.7 ± 3.8	<0.001
Wave 3	20.3 ± 3.1	20.9 ± 3.0	<0.001	20.8 ± 4.0	21.9 ± 3.7	<0.001
Waist circumference (mean cm ± SD)						
Wave 1	71.3 ± 9.6	75.9 ± 9.5	<0.001	73.2 ± 10.8	78.4 ± 10.6	<0.001
Wave 2	66.0 ± 8.0	67.6 ± 6.6	<0.001	71.0 ± 10.5	74.5 ± 9.5	<0.001
Wave 3	67.2 ± 7.1	68.5 ± 6.9	<0.001	72.5 ± 10.3	75.9 ± 9.4	<0.001
Overweight (N (%))						
Wave 1	183 (14.9)	172 (12.3)	0.05	296 (25.5)	262 (21.2)	0.01
Wave 2	156 (12.7)	125 (9.0)	<0.05	274 (23.6)	241 (19.7)	0.02
Wave 3	155 (12.6)	115 (9.0)	<0.05	263 (22.7)	195 (18.0)	<0.05

[a] Chi-square tests and independent t-tests were conducted to evaluate differences between grade levels within gender for categorical variables and continuous variables, respectively.

circumference (β = 0.27, p = 0.38). Moreover, US media exposure was found to be significantly negatively associated with waist circumference over time among high school females (β = −0.50, p = 0.03). This finding opposes what was found when using Asian media exposure as a predictor (β = 0.21, p = 0.09) for waist circumference among high school females.

Discussion

The present study illustrates the impact of socioeconomic factors, foreign media, and attitude toward appearance on general and central adiposity among Chinese middle and high school participants living in urban cities in Mainland China. Foreign media exposure was found to significantly decrease BMI over time among middle and high school girls. Moreover, placing greater importance on physical appearance was related to lesser odds of being overweight and having lower BMI at baseline among high school girls. Among middle and high school boys, participants whose parents completed higher levels of education had greater odds of being overweight and having higher BMI at baseline. Finally, higher family income levels were significantly negatively associated with waist circumference measurements over time across all gender and grade groups.

Table 3
Results of longitudinal analyses among girls participating in the Chinese Seven Cities Study (n = 2622) by grade (China, 2002–2005).

	Middle school (n = 1227)			High school (n = 1395)		
	Beta	SE	p-value	Beta	SE	p-value
BMI						
Time	0.94	0.14	<0.01	−0.06	0.15	0.69
Time*time	−0.10	0.04	0.01	0.03	0.04	0.36
Foreign media exposure	0.10	0.10	0.36	−0.02	0.10	0.83
Time*Foreign media exposure	−0.06	0.02	0.01	−0.06	0.03	0.03
Attitude toward appearance	0.04	0.04	0.31	−0.11	0.04	0.01
Time*attitude toward appearance	−0.01	0.01	0.38	0.00	0.01	0.96
Parent education	−0.01	0.12	0.91	0.04	0.12	0.71
Time*Parent education	0.02	0.03	0.50	−0.02	0.03	0.55
Family income	−0.08	0.07	0.28	0.05	0.07	0.49
Time*Family income	0.00	0.04	0.96	0.04	0.04	0.36
Waist circumference						
Time	−5.99	0.63	<0.01	−11.13	0.79	<0.01
Time*time	3.26	0.18	<0.01	4.72	0.19	<0.01
Foreign media exposure	0.10	0.25	0.70	0.00	0.26	0.99
Time*Foreign media exposure	−0.04	0.11	0.76	0.06	0.14	0.68
Attitude toward appearance	0.12	0.10	0.26	−0.11	0.10	0.27
Time*Attitude toward appearance	−0.08	0.05	0.11	−0.05	0.05	0.33
Parent education	0.34	0.32	0.29	0.25	0.32	0.43
Time*Parent education	−0.25	0.15	0.08	−0.04	0.17	0.81
Family income	1.44	0.32	<0.01	1.42	0.32	<0.01
Time*Family income	−1.33	0.20	<0.01	−1.29	0.22	<0.01
	OR	95% CL	p-value	OR	95% CL	p-value
Overweight status						
Time	0.80	(0.52,1.21)	0.29	0.71	(0.42,1.22)	0.21
Time*time	1.08	(0.97,1.21)	0.18	1.14	(0.99,1.31)	0.06
Foreign media exposure	1.05	(0.86,1.27)	0.64	1.02	(0.83,1.26)	0.87
Time*Foreign media exposure	0.99	(0.93,1.06)	0.83	0.97	(0.88,1.07)	0.52
Attitude toward appearance	0.97	(0.90,1.05)	0.46	0.86	(0.79,0.94)	<0.01
Time*Attitude toward appearance	1.00	(0.97,1.03)	0.92	1.00	(0.96,1.05)	0.84
Parent education	1.15	(0.92,1.45)	0.22	0.99	(0.75,1.30)	0.93
Time*Parent education	0.96	(0.87,1.05)	0.38	1.07	(0.92,1.24)	0.37
Family income	0.96	(0.77,1.20)	0.73	1.24	(0.96,1.59)	0.10
Time*Family income	1.03	(0.90,1.17)	0.70	0.86	(0.72,1.02)	0.08

Table 4
Results of longitudinal analyses among boys participating in the Chinese Seven Cities Study (n = 2398) by grade (China, 2002–2005).

	Middle school (n = 1160)			High school (n = 1238)		
	Beta	SE	p-value	Beta	SE	p-value
BMI						
Time	0.72	0.16	<0.01	0.07	0.18	0.69
Time*time	−0.06	0.05	0.19	0.05	0.05	0.30
Foreign media exposure	0.29	0.13	0.02	−0.01	0.14	0.92
Time*Foreign media exposure	−0.04	0.03	0.23	−0.04	0.03	0.24
Attitude toward appearance	−0.03	0.05	0.53	−0.04	0.05	0.51
Time*attitude toward appearance	−0.01	0.01	0.23	0.01	0.01	0.57
Parent education	0.62	0.15	<0.01	0.37	0.16	0.02
Time*Parent education	−0.04	0.04	0.27	−0.05	0.04	0.26
Family income	0.01	0.09	0.89	−0.02	0.09	0.85
Time*Family income	0.07	0.06	0.20	0.07	0.05	0.17
Waist circumference						
Time	−3.78	0.59	<0.01	−5.08	0.75	<0.01
Time*time	1.97	0.18	<0.01	2.79	0.20	<0.01
Foreign media exposure	0.74	0.33	0.02	0.02	0.34	0.95
Time*Foreign media exposure	0.00	0.11	0.97	−0.06	0.13	0.63
Attitude toward appearance	−0.18	0.12	0.15	0.00	0.14	0.97
Time*Attitude toward appearance	0.03	0.04	0.47	−0.06	0.05	0.22
Parent education	1.51	0.41	<0.01	0.35	0.41	0.39
Time*Parent education	−0.21	0.14	0.14	0.33	0.17	0.04
Family income	1.00	0.31	<0.01	1.31	0.34	<0.01
Time*Family income	−0.58	0.20	<0.01	−1.07	0.22	<0.01
	OR	95% CL	p-value	OR	95% CL	p-value
Overweight status						
Time	0.89	(0.67,1.18)	0.43	1.25	(0.87,1.79)	0.23
Time*time	1.03	(0.96,1.12)	0.42	0.97	(0.88,1.06)	0.46
Foreign media exposure	1.15	(0.98,1.34)	0.10	1.01	(0.84,1.21)	0.93
Time*Foreign media exposure	1.01	(0.95,1.07)	0.69	0.95	(0.87,1.03)	0.18
Attitude toward appearance	0.98	(0.92,1.03)	0.39	0.98	(0.92,1.05)	0.61
Time*Attitude toward appearance	1.00	(0.98,1.02)	0.79	0.99	(0.96,1.02)	0.66
Parent education	1.55	(1.28,1.88)	<0.01	1.26	(1.02,1.57)	0.04
Time*Parent education	0.98	(0.90,1.07)	0.60	0.97	(0.88,1.08)	0.63
Family income	1.16	(1.00,1.35)	0.05	1.04	(0.87,1.25)	0.66
Time*Family income	0.97	(0.88,1.08)	0.61	0.99	(0.87,1.12)	0.85

Foreign media exposure

The significant impact of foreign media exposure on adiposity, particularly among girls, may be explained by gender differences in preferred body ideals. Cross-sectional analysis of baseline CSCS data showed that Chinese adolescent boys were more likely to perceive themselves as being too thin, whereas adolescent girls were more likely to perceive themselves as too heavy (Xie et al., 2006b). Similarly, a study conducted among Chinese adolescents living in Chengdu, China, found that boys felt pressured to become more muscular, whereas girls were pressured to lose weight (X. Xu et al., 2010). The study further showed that the media served as a significant predictor for both girls and boys to engage in behaviors to lose or gain weight as well as to increase muscle bulk. Such findings are alarming, especially given the growing body of research documenting body dissatisfaction and eating disorder symptoms among male and female adolescents in China (Huon et al., 2002; Jackson and Chen, 2014; Lee and Lee, 2000; Li et al., 2005).

The results obtained using Asian media exposure and US media exposure as predictors of general and central adiposity support findings from a previous study using baseline CSCS data (Xie et al., 2006b). Future research is warranted to replicate these results and to determine any observable longitudinal trends. Moreover, additional research is needed to determine underlying mechanisms causing the distinguishable impact Asian media and US media may have on adiposity.

Attitude toward appearance

Pressures stemming from social influences may further explain the effect of attitude toward appearance on BMI and overweight status,

particularly among high school girls. A study conducted among adolescents living in northeastern US showed that girls at a high risk for negative eating attitudes and behaviors experienced significantly greater pressure to lose weight from family, friends, and media compared to those deemed to be at a lower risk (Ata et al., 2007). Studies conducted in China further show the impact of parental influence on adolescent weight and weight perception. For example, a study conducted among adolescents attending schools in Hong Kong found that the most prevalent source of "too fat" comments was mothers (Lo et al., 2009). The study further showed that receiving incorrect comments about weight from social sources was positively associated with weight misperceptions. Collectively, media and social pressures may affect not only body ideal preference but also the level of importance placed on appearance.

Socioeconomic factors

Results from our study also suggest that Chinese adolescent boys in households with high parental education and family income may be at greater risk for overweight or obesity. These results oppose what has been found in studies conducted in Western countries, like the United States, where individuals in lower SES groups are often more at risk for overweight or obesity (Wang, 2001). This observation is further exemplified in a cross-sectional study conducted among adolescents living in Jiangsu Province, China, which found that high SES was positively associated with high-energy foods (Shi et al., 2005). As China becomes an increasingly developed nation, economic transitions, such as technological advances and greater accessibility to high-energy foods (Finkelstein et al., 2005; Swinburn et al., 2011), may play a role in the prevalence of overweight and obesity among Chinese youth.

Interestingly, the results of our study also showed a negative association between family income and central adiposity over time. Future research is warranted to monitor and further explore the association between socioeconomic factors and overweight and obesity, particularly among Chinese adolescents.

Parental education

Parental education was also found to significantly impact general and central adiposity of boys. The reason behind this finding is not clear. This result may be related to China's historical preference of sons over daughters (Das Gupta et al., 2003) or the cultural preference for overweight baby boys. Future research is needed to elucidate if and how parent education may disproportionately affect Chinese adolescent boys compared to girls.

Study limitations

Several limitations must be considered when interpreting the results of this study. The study utilizes data that were last collected in 2005. Despite the aged data, this study is one of the first efforts investigating the longitudinal linkages between specific factors (i.e., foreign media, attitude toward appearance, SES factors) and Chinese adolescent adiposity. The results of this study contribute to the growing need of addressing and investigating the persistent burden of obesity affecting Chinese adolescents (Sun et al., 2014).

Although BMI measures have been conventionally used to determine weight status, research has shown that the growth patterns of Chinese adolescents may differ from adolescents of other ethnic groups (Xiong et al., 2012). Because the IOTF BMI cutoffs used to determine weight status are based upon samples from six countries, the cutoffs used may not be realistic and/or accurate specifically for Chinese youth. However, the IOTF cutoffs have been extensively used in Chinese adolescent obesity research (Cui et al., 2010; Luo and Hu, 2002; Wang and Lobstein, 2006) and have produced comparable results to other international references (Wang and Wang, 2002).

Further bias may also be introduced into the results due to the nature of self-reported data. Additionally, the limited number of items used to measure several variable constructs may not reflect objective and true measures of participants' experiences. SES is a complex, multi-dimensional construct that may be operationalized with varying combinations of factors. However, parent education has been found to be a reliable measure of SES (Liberatos et al., 1988), and it has been suggested researchers investigate the effect of individual SES components on obesity risk separately (Ball et al., 2002). Moreover, the study utilized a broad measure of media exposure that did not include measures of exposure intensity, duration, and content. Future research is called upon to consider comprehensive measures of media exposure.

Conclusions

This study adds to the dearth of longitudinal research using parent and child data from China to assess influences on adolescent obesity. The results show socioeconomic and cultural factors—foreign media exposure, value placed on appearance, parent education, and family income—significantly impact general and central adiposity of Chinese adolescents over time. Given the changing economic and social conditions occurring in China, the significant relationships found in this study warrant the need for future research to replicate and observe these associations over time. Future research is also encouraged to elucidate the underlying mechanisms of these influences on adolescent adiposity and how they may be related to weight-related behaviors, such as diet and physical activity. Integrating these factors into obesity interventions may lead to improved program efficacy, which, in turn, may impose a greater impact on the obesity burden persistently affecting China's youth. Because the strength of these effects differ across gender and grade levels, an intervention design that is targeted at particular age or gender groups may be even more beneficial.

Conflict of interest statement

The authors declare there are no conflicts of interest.

Acknowledgments

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