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Descriptive Finding

The digital divide and body size disparity among Chinese adults

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Contents

The digital divide and body size disparity among Chinese adults

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Abstract

BACKGROUND
The rapid development of information and communication technology (ICT) in China has increased people's sedentary behavior and raised a number of related issues. ICT screen-viewing activities are increasingly considered to contribute to obesity, and sociodemographic characteristics such as gender, income, age, education, and geographical location seem to magnify the digital divide.

OBJECTIVE
This study first examines dissimilar stages of ICT transition, and then establishes how ICT screen-viewing activities relate to the Chinese obesity epidemic. Finally, this study assesses whether unequal access to digital resources and technology by geographic location and gender reinforces existing obesity disparities in China.

METHODS
This study uses longitudinal data drawn from 10,616 households and 17,377 person-years of those aged 18–55 who participated in the 2006, 2009, and 2011 China Health and Nutrition Survey (CHNS). Fixed effect linear regression models capture the link between ICT screen-viewing activities and body mass index (BMI).

RESULTS
The results show that while between 91.37% and 96.70% of individuals had access to televisions during 2006–2011, there is a significant disparity in terms of Internet activity by gender and geographical location. The results show that Internet use could decrease a rural women's BMI by .87 kg/m^2, while playing computer games could increase a rural man's BMI by .42 kg/m^2.

CONTRIBUTION
This study highlights that unequal access to digital resources and technology might reinforce existing obesity disparities in China.

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1. Introduction

The invention of modern information and communications technologies (ICT), such as cellular phones, the Internet, computers, and televisions (TVs), have brought about a radical change in the way we perceive, organize, and communicate information. China has made considerable advances in socioeconomic development in recent decades, while facing the issues and challenges of rapid ICT development. For example, age, education, and geographical location seem to magnify inequality in access to ICT, a phenomenon known as the digital divide (Fong 2009; Harwit 2004; Zhu and Wang 2001, 2005). In addition, the rapid expansion and use of ICT has shifted Chinese lives to a more sedentary routine, and screen-viewing activities using ICT are increasingly recognized as an important factor in the development of obesity (Eisenmann, Bartee, and Wang 2002; Foster, Gore, and West 2006; Grøntved and Hu 2011; Jakes et al. 2003; Robinson and Killen 1995; Thorp et al. 2011; Vandelanotte et al. 2009; Vioque, Torres, and Quiles 2000). Obesity is associated with many medical complications, including heart disease, type 2 diabetes, and bone and joint disease, and is rapidly becoming the primary cause of preventable death in China (Bray 2004; Wang et al. 2007).

China's experience provides us with an opportunity to examine the different stages of ICT transitions and investigate how these transitions relate to Chinese obesity epidemics and disparities. The aim of this descriptive paper is first to examine dissimilar stages of ICT transition, and then establish how ICT screen-viewing activities relate to the Chinese obesity epidemic. Finally, this study tests whether unequal access to digital resources by geographic location and gender reinforces existing obesity disparities in China.

2. Data and methods

2.1 Study population

The China Health and Nutrition Survey (CHNS) is an ongoing longitudinal survey designed to examine how the social and economic transition in Chinese society affects health and nutritional status at the individual, household, and community levels. The survey was launched in 1989, with follow-ups from eight additional panels. The original 1989 data was collected from family members aged 20 to 45 in 3,795 households, making 15,917 individuals for the first survey. The follow-up rates were approximately 90% of the previous year's participants (Popkin et al. 2010). In 2011 the CHNS increased the sample size by including responders from Beijing, Shanghai, and

Chongqing (Zhang et al. 2014). While the CHNS is not a nationally representative survey, the key physical composition and dietary data trends in the CHNS are similar to past nationally representative surveys (Ge et al. 1994; Wang et al. 2007).

This study omits the 1989–2004 surveys because they lack information regarding the individuals' ICT activities. This study therefore includes household members aged 18–55 who underwent detailed physical examinations that included obtaining their weight and height, and who participated in the CNHS survey waves for 2006, 2009, and 2011 (18,912 person-years from 11,199 households). Among the 18,912 person-years, those who were disabled, pregnant, or breastfeeding during any given survey were omitted. The final subsample therefore included 8,187 male person-years and 9,190 female person-years from 10,616 households.

2.2 Measures

Dependent variable. Body mass index (BMI) is a measure of body fat based on height and weight, $\frac{\text{Weight (kg)}}{\text{Height (m}^2)}$, in its continuous form that applies to adult men and women. This study uses the WHO Asia-specific cut-off point when referring to obese individuals (BMI ≥ 25) in the analysis (World Health Organization Expert Consultation 2004).

TV and Internet usage pattern. At each survey wave during 2006–2011 the CHNS collected information regarding each individual's participation in (1) TV viewing, (2) watching movies and videos online, (3) surfing the Internet, (4) participating in chat rooms, and (5) playing computer games. These five variables were coded as dichotomous variables in the regression models.

SES indicators: Educational attainment and household gross income. In this study, educational attainment was recoded into three categories. Household gross income was estimated by summing nine potential sources of income in each household. The CHNS project team imputed the missing data when any component was incomplete. Details of the imputation are described in the CHNS (2013a). For interpretability, household gross income was logged in the regression models.

Physical activity, daily food energy consumption, and demographic background. In this study, food intake was summed as the energy value of all food consumed daily, averaged over three days, and calculated using the 2002/2004 Chinese food composition table. Detailed descriptions of the dietary survey are obtainable through the CHNS (2013b). Physical activity is estimated as the time spent on any specific activity, multiplied by its specific value of metric of the metabolic equivalent (MET) based on the compendium of physical activities (Ainsworth et al. 2000). In this study, physical activity is considered to be the total energy expenditure on leisure activities, occupational activities, transportation activities, and home activities collected by the CHNS.

Other covariates that we have controlled for in our statistical models include (a) current age in each survey year, (b) marital status, (c) currently smoking, and (d) currently drinking.

2.3 Statistical analyses

This study used fixed effect (FE) linear regression models to examine whether changes in ICT activities are associated with changes in BMI during the period 2006–2011. The FE linear regression models serve to difference out any time-invariant factors among unobserved variables (Allison 2009). In other words, ordinary least squares regressions that suffer from omitted variable bias due to unmeasured factors are likely to correlate with both the outcome and independent variables, whereas FE models are intended to examine the changes in an individual by controlling for potential unobserved heterogeneity bias. The final FE models with time-invariant covariates in this study are written as

$$\Delta BMI_{ijt} = \Delta\alpha + \sum_{k=1}^{K}(\beta_k - \beta_{k-1})(x_{1ijt} - x_{kijt-1}) + \Delta\varepsilon_{ijt}.$$

We used the FE to evaluate the BMI variation value of individual i in household j at time t between 2006 and 2011 by gender and geographic location. $\Delta\alpha$ is an intercept variation, β is vector of coefficients, and x represents time-varying covariates, including one of five independent variables: TV viewing, watching movies and videos online, surfing the Internet, participating in chat rooms, and playing computer games. Other covariates that have been controlled for in this study are age, marital status, education, physical activities, daily food energy consumption, current smoking and drinking status, and log household gross income at the household level. The error terms ε_{ijt} represents the idiosyncratic errors.

Initially, we were unable to estimate the impact of migration from rural to urban areas or vice versa because the CHNS did not track information related to moving out of households. In other words, geographic area and gender were considered time-invariant, fixed variables, with values that did not change across time within individuals and therefore could not be included in the FE models. However, since we believe that significant lifestyle differences exist based on geographic area and gender, which might impact the prevalence of obesity dissimilarly, we divided FE regression models by geographic area and gender. The divided models implicitly assume that the established FE models vary between urban/rural area and men/women. The divided models allow the unobserved, time-invariant characteristics of the establishments to play a separate role in the BMI variation. Finally, all longitudinal linear analyses were estimated using Stata 13.1.

3. Descriptive statistics

Tables 1 and 2 show the descriptive statistics for the variables in this study, divided by gender and geographical location.

3.1 Women

Rural women were not only heavier but also had a higher rate of increasing obesity prevalence over the period 2006–2011. Specifically, from 2006 to 2011 the average BMI increased from 22.93 to 23.38 kg/m^2 for urban women and from 23.17 to 23.71 kg/m^2 for rural women. The obesity rate ($BMI \geq 25$) increased substantially from 22.03% to 26.49% for women living in urban areas and from 26.72% to 32.09% for women living in rural areas.

3.2 Men

The data for men showed that the average BMI increased from 23.73 to 24.55 kg/m^2 for urban residents and from 23.11 to 23.94 kg/m^2 for rural residents during the period 2006–2011. The male obesity rate also increased considerably, from 33.76% to 39.42% in urban areas and from 25.34% to 34.14% in rural areas.

3.3 Differences in ICT screen-viewing activities

Figure 1 shows the ICT screen-viewing activities by gender and geographical location during the survey years 2006–2011. As Figure 1a illustrates, TV viewing in China has mirrored the society as a whole, in that more than 90% of individuals have access to TV activities despite their gender and geographical location. Nevertheless, a significant inequality remains between the Internet activities of women and men in rural and urban areas, with rural women appearing to be the most disadvantaged group regarding Internet activities.

Table 1: Descriptive statistics by geographical location (CHNS, 2006–2011, women)[a]

	Urban						Rural					
	2006		2009		2011		2006		2009		2011	
	Mean or %	(S.D.)[b]	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)
Body mass index (kg/m^2)	22.93	(5.01)	22.88	(3.28)	23.38	(4.19)	23.17	(3.28)	23.24	(3.43)	23.71	(3.98)
Obesity (BMI ≥ 25; %)	22.03		22.22		26.49		26.72		28.35		32.09	
Age (years)	41.32	(9.14)	41.68	(9.15)	40.71	(9.44)	41.04	(9.22)	40.69	(9.56)	41.04	(9.45)
Education												
No/primary education (%)	44.30		44.57		33.13		82.66		83.27		79.57	
Secondary education (%)	42.03		42.49		34.99		14.84		13.41		15.15	
College education and higher (%)	13.67		12.94		31.87		2.51		3.31		5.29	
Household income (RMB, per 10,000/year)	3.27	(3.96)	5.30	(7.11)	7.05	(7.14)	2.52	(3.27)	3.99	(5.69)	5.19	(5.59)
Married (%)	85.32		85.71		83.93		91.23		90.26		91.79	
Activities (metabolic equivalents, METs/week)	1.75	(1.87)	1.85	(1.76)	1.98	(1.67)	3.13	(2.99)	3.03	(2.78)	3.17	(2.93)
Daily food energy consumption; kcal/day	1.94	(.55)	1.93	(.61)	1.79	(1.76)	2.11	(.61)	2.03	(.61)	1.85	(.73)
Currently smoking (%)	.38		.73		1.20		2.66		2.55		1.56	
Currently drinking (%)	11.14		13.55		15.94		7.52		8.82		11.18	
Number of cases	790		819		1,506		1,995		1,961		2,119	

[a] The number of cases in Tables 1 and 2 refers to individuals having one or more observations during any given year between 2006 and 2011 and was included in the final fixed-effects linear models. New participants, comprising 616 urban men, 274 rural men, 738 urban women, and 312 rural women, were added in 2011. This accounts for the sample size variation over time.
[b] Standard deviation.

Table 2: Descriptive statistics by geographical location (CHNS, 2006–2011, men)

	Urban						Rural					
	2006		2009		2011		2006		2009		2011	
	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)	Mean or %	(S.D.)
Body mass index (kg/m^2)	23.73	(3.15)	24.03	(3.48)	24.55	(3.90)	23.11	(3.21)	23.17	(3.35)	23.94	(4.09)
Obesity (BMI ≥ 25, %)	33.76		35.31		39.42		25.34		28.48		34.14	
Age (years)	41.03	(9.78)	41.59	(9.65)	40.88	(9.54)	40.44	(9.75)	40.19	(9.76)	40.90	(9.55)
Education												
No/primary education (%)	38.58		39.35		27.29		71.21		76.01		72.03	
Secondary education (%)	43.12		42.05		36.47		25.51		20.54		21.68	
College education and higher (%)	18.30		18.60		36.24		3.28		3.44		6.29	
Household income (RMB, per 10,000/year)	3.35	(4.15)	5.57	(8.64)	7.49	(7.80)	2.57	(2.68)	4.37	(7.26)	5.61	(6.30)
Married (%)	82.41		80.73		84.37		85.52		84.84		86.72	
Activities (metabolic equivalents, METs/week)	2.45	(2.33)	2.60	(2.23)	2.51	(1.95)	4.04	(3.23)	4.01	(3.15)	4.19	(3.10)
Daily food energy consumption; kcal/day	2.33	(.64)	2.31	(.64)	2.22	(2.47)	2.49	(.70)	2.43	(.67)	2.26	(.83)
Currently smoking (%)	54.47		57.55		50.47		58.94		59.80		60.54	
Currently drinking (%)	61.84		64.96		61.90		63.80		65.35		66.94	
Number of cases	705		742		1,286		1,768		1,801		1,845	

Figure 1: ICT screen-viewing activities by gender and geographical location, CHNS 2006–2011]

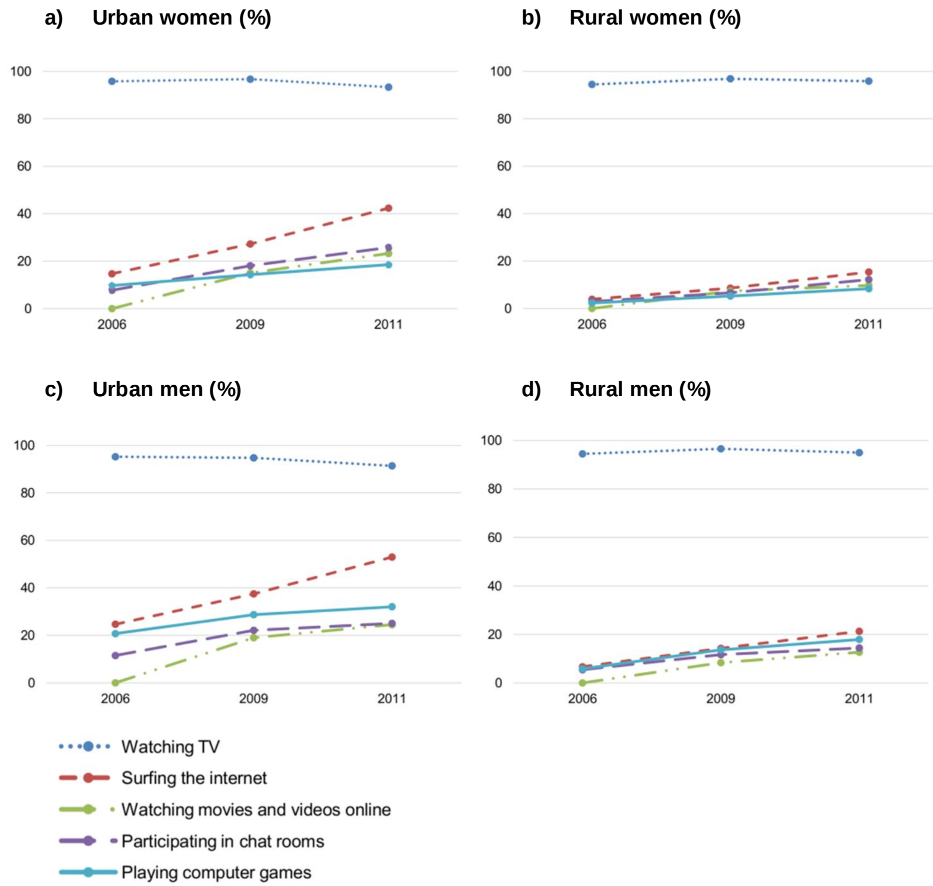

Table 3 presents the percentage change in ICT screen-viewing activities by gender and geographical location during the survey years 2006–2011. The table demonstrates that during 2006–2011, urban men experienced the greatest increases in surfing the Internet and watching movies and videos online, urban women experienced the greatest increases in chat room participation, and rural men experienced the greatest increases in playing computer games. This study also indicates that in urban areas, ICT activity started to move from TVs to computers.

Table 3: Change in ICT screen-viewing activities by gender and geographical location (CHNS, 2006–2011)

	Women (%)		Men (%)	
	Urban	Rural	Urban	Rural
Watching TV	–2.46	1.4	–3.81	.5
Surfing the internet	27.68	11.52	28.27	14.63
Watching movies and videos online	23.24	9.72	24.49	12.68
Participating in chat rooms	18.04	9.27	13.55	8.99
Playing computer games	8.78	6.04	11.33	12.11

4. Results of FE regressions

4.1 Women

In Table 4, Model 1 indicates no significant effects of participation in ICT screen-viewing activities on BMI for urban women, and Model 2 shows that after controlling for the differential of SES among urban women this pattern remained. However, Model 3 shows that the BMI of rural women who actively surfed the Internet decreased significantly by .88 kg/m^2 during the period 2006–2011, and Model 4 indicates that this pattern remained after controlling for SES indicators. The models were merged to compare the impact of ICT screen-viewing activities on BMI by geographic area; however, a significant body weight disparity between rural and urban women was only found for Internet surfing (Model 5).

Numerous studies have demonstrated that increased BMI is significantly associated with the aging process (Gordon-Larsen et al. 2004; Wang and Beydoun 2007); our study also finds age to be an important factor in the increase of BMI. Table 4 shows that while a rural woman's BMI increased by .15 kg/m^2 each year on average between 2006 and 2011, her BMI could have decreased by .88 kg/m^2 if she had surfed the Internet. In other words, a rural woman with an average height of 154.50 cm could gain 1.14 kg (2.51 pounds) of total body weight within a five-year period (2006–2011); however, Internet surfing could buffer her weight by 2.07 kg (4.56 pounds). Further, a significant in difference BMI was seen between urban and rural women (Model 5). As Model 5 in Table 4 shows, on average, urban women have BMIs that are approximately .97 kg/m^2 higher than rural women when both surf the Internet.

Table 4: Fixed-effects linear regression for ICT activities predicting mean BMI by geographical location (CHNS 2006–2011; women)

	Urban		Rural		All residents [3] (Urban and Rural)
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
TV viewing	0.06	0.09	–0.09	–0.09	–0.06
	(0.65)	(0.64)	(0.16)	(0.16)	(0.23)
Surfing internet	0.20	0.16	–0.88***	–0.87***	–0.89**
	(0.36)	(0.36)	(0.21)	(0.22)	(0.30)
Watching movies and videos online	0.15	0.15	–0.25	–0.25	–0.23
	(0.38)	(0.38)	(0.17)	(0.17)	(0.24)
Participating in chat rooms	0.32	0.38	0.23	0.23	0.25
	(0.42)	(0.42)	(0.22)	(0.22)	(0.31)
Playing computer games	–0.15	–0.12	–0.14	–0.15	–0.11
	(0.40)	(0.40)	(0.20)	(0.20)	(0.29)
Age	0.07	0.10†	0.14***	0.15***	0.14***
	(0.05)	(0.06)	(0.01)	(0.01)	(0.02)
Log household income	–	–0.48*	–	–0.04	–0.16*
		(0.23)		(0.06)	(0.08)
Education (ref.=no/primary)					
Secondary	–	–0.37	–	0.05	.002
		(0.90)		(0.13)	(0.17)
College and higher	–	0.74	–	–0.20	0.68*
		(1.01)		(0.45)	(0.32)
Married	5.01***	5.33***	–0.03	–0.02	1.54***
	(0.90)	(0.91)	(0.27)	(0.27)	(0.32)
TV viewing × urban	–	–	–	–	0.20
					(0.48)
Surfing internet × urban	–	–	–	–	0.97*
					(0.38)
Watching movies and videos online × urban	–	–	–	–	0.28
					(0.34)
Participating in chat rooms × urban	–	–	–	–	0.10
					(0.41)
Playing computer games × urban	–	–	–	–	–0.03
					(0.39)
Activitiy (metabolic equivalents/week)	–0.03	–0.02	–0.003	–0.003	–0.01
	(0.07)	(0.07)	(0.01)	(0.01)	(0.02)
Daily food energy consumption (kcal/day)	–0.18	–0.15	–0.02	–0.02	–0.06
	(0.20)	(0.20)	(0.05)	(0.05)	(0.07)
Currently smoking	–0.08	–0.23	–0.31	–0.30	–0.28
	(1.65)	(1.65)	(0.34)	(0.34)	(0.44)
Currently drinking	0.23	0.18	–0.07	–0.07	0.02
	(0.38)	(0.38)	(0.13)	(0.13)	(0.14)
Constant	16.24***	15.26***	17.74***	17.61***	16.60***
	(2.36)	(2.66)	(0.63)	(0.66)	(0.81)
Observations	3,115	3,115	6,075	6,075	9,190
R–squared	0.81	0.81	0.92	0.92	0.87

Standard errors in parentheses *** p<.001, ** p<.01, * p<.05, †p<.10.

[3] As Allison (2009) demonstrated, when including interactions between time-varying and time-invariant variables in FE regressions, there will be no main effects of the time-invariant variables on the dependent variable, because time-invariant variables have no variation within individuals; this explains why the main effects of geographic area on BMI have been dropped from Model 5 in Tables 4 and 5.

Table 5: Fixed-effects linear regression for ICT activities predicting mean BMI, by geographical location (CHNS 2006-2011; men)

	Urban		Rural		All residents (Urban and Rural)
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
TV viewing	–0.45	–0.44	–0.22	–0.22	–0.23
	(0.34)	(0.34)	(0.23)	(0.23)	(0.23)
Surfing internet	–0.02	–0.02	–0.15	–0.15	–0.16
	(0.22)	(0.22)	(0.20)	(0.20)	(0.20)
Watching movies and videos online	–0.15	–0.15	0.07	0.07	0.06
	(0.23)	(0.23)	(0.20)	(0.20)	(0.20)
Participating in chat rooms	0.39	0.39	0.17	0.17	0.17
	(0.25)	(0.25)	(0.23)	(0.23)	(0.23)
Playing computer games	0.01	0.02	0.42*	0.42*	0.41*
	(0.22)	(0.22)	(0.20)	(0.20)	(0.20)
Age	0.20***	0.19***	0.17***	0.17***	0.18***
	(0.03)	(0.04)	(0.02)	(0.02)	(0.02)
Log household income	–	0.10	–	0.01	0.03
		(0.15)		(0.08)	(0.07)
Education (ref.=no/primary)					
Secondary	–	–0.34	–	0.17	0.11
		(0.63)		(0.23)	(0.22)
College and higher	–	–0.29	–	0.36	0.23
		(0.69)		(0.42)	(0.31)
Married	0.31	0.30	0.62**	0.61*	0.53**
	(0.39)	(0.39)	(0.24)	(0.24)	(0.20)
TV viewing × urban	–	–	–	–	–0.19
					(0.40)
Surfing Internet × urban	–	–	–	–	0.16
					(0.29)
Watching movies and videos online × urban	–	–	–	–	–0.20
					(0.29)
Participating in chat rooms × urban	–	–	–	–	0.22
					(0.34)
Playing computer games × urban	–	–	–	–	–0.38
					(0.29)
Activities (metabolic equivalents/week)	0.01	0.01	–0.004	–0.004	–0.003
	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)
Daily food energy consumption (kcal/day)	0.03	0.02	–0.11†	–0.11	–0.02
	(0.04)	(0.04)	(0.06)	(0.06)	(0.03)
Currently smoking	–0.07	–0.07	–0.31*	–0.31*	–0.24*
	(0.23)	(0.24)	(0.14)	(0.14)	(0.12)
Currently drinking	0.39*	0.40*	0.17	0.17	0.23*
	(0.19)	(0.19)	(0.11)	(0.11)	(0.10)
Constant	15.75***	16.39***	16.42***	16.27***	16.12***
	(1.42)	(1.62)	(0.77)	(0.84)	(0.73)
Observations	2,733	2,733	5,414	5,414	8,147
R-squared	0.90	0.90	0.88	0.88	0.89

Standard errors in parentheses *** p<.001, ** p<.01, * p<.05, †p<.10.

4.2 Men

In Table 5, Model 1 shows that participation in an ICT screen-viewing activity was not related to BMI for men in urban areas, and this pattern remains after controlling for SES indicators (Model 2). Model 3 shows that playing computer games was related to higher BMIs for rural men, and this pattern remains after controlling for SES indicators (Model 4). Model 5 merged urban and rural residents into the same model and tested the interaction between geographical location and ICT screen-viewing activities; however, no significant effect was found for the interactions between geographical location and ICT screen-viewing activities.

Our findings indicate that a rural man who played computer games during the period 2006–2011 had significant BMI increases of .42 kg/m^2 (Model 4). In other words, in China, a rural man with an average height of 164.8 cm could gain 2.34 kg (5.16 pounds) in body weight during a five-year period (2006–2011); however, playing computer games could add an additional 1.15 kg (2.54 pounds) to his body weight.

As a final point, like the aging process, which has been shown to be an important factor associated with weight gain and increased BMI, the effect of surfing the Internet or playing online video games on changing BMI was significant in rural areas. However, in this study these effects were found to be insignificant in urban areas.

5. Discussion

Over the past three decades, as China experienced astonishing social and economic progress, the population of obese adults has increased considerably (Jiang et al. 2015). This study aims to investigate the relationship between ICT activities and body weight disparities in China, where a rapid ICT transition continues to develop. The results show that TV viewing activities have reached the universal criterion of 90% to 95% penetration rates (Norris 2001); however, there is a substantial gap in Internet activities according to gender and geographical location. Therefore, while people with Internet access have become increasingly knowledgeable about the health consequences of obesity, people without access to the abundant health information on the Web are left behind, thus increasing the disparities in body weight between people with and without Internet access. While the ability to access the Internet may correlate with other factors such as income and education, which confound a potential influence between Internet access and obesity outcomes, past findings indicate that obesity disparities resulting from unequal access to health information could be greatly improved by widely available Internet access (Brodie et al. 2000; Murray et al. 2003). Huang, Yabiku, and Kronenfeld (2015) find that modern household technologies launched in China during the past two decades have the potential to increase BMI in the Chinese population. Our study provides a perspective on issues related to the digital divide in body weight disparity by geographic area and gender in China. The results show that online chatting, watching movies and videos online, and TV viewing were not linked to BMI, regardless of gender or geographic location.

This study has a number of limitations that must be considered. First, as the FE method exploits within-group variation over time, the FE estimates might be imprecise because there were no major within-individual variations in terms of TV-viewing activities during the period 2006–2011. In addition, the lack of information related to time spent on these activities prevents us from obtaining a clear picture of the degree to which individuals engaged in these sedentary activities. Nevertheless, our research focuses on how initial involvement in ICT activities triggers obesity disparities. Thirdly, although the current study distinguishes between ICT activities by gender, we did not provide direct evidence regarding gender differences in seeking resources of healthy weight information. In addition, as one of the fastest-adopted ICTs in recent years in China, smartphones enable individuals to access health information with high-speed browsing capabilities, without using their computer. In other words, owning a smartphone could influence obesity disparities and confound the association between the digital divide and obesity. However, the CHNS survey did not contain information about whether individuals had a smartphone.

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