보건교육건강증진학회지 제37권 제3호(2020. 9) pp.25-37
Korean J Health Educ Promot, Vol.37, No.3 (2020)
https://doi.org/10.14367/kjhep.2020.37.3.25

Relationship between obesity and eating rate: Analyzing the Korean Community Health Survey data

Heui Sug Jo[*], Su Mi Jung[**], Yuliya Dronina[***†]

[*] *Professor, Department of Health Policy and Management, School of Medicine, Kangwon National University*
[**] *Senior researcher, Gangwon Public Health Policy Institute*
[***] *Post-doctoral researcher, Department of Health Policy and Management, School of Medicine, Kangwon National University*

Objectives: There is an increase in the rate of obesity in South Korea as a result of changing dietary habits and decreasing physical activity. This study aimed to evaluate the relationship between eating rate and obesity. **Methods**: Multiple logistic regression analyses were conducted using raw data from the Korean Community Health Survey 2017 for Gangwon Province data to evaluate the relationship between eating rate and obesity. **Results**: Among men, the major factor affecting obesity was an eating rate of ≤0 min (odds ratio=1.16 (1.02, 1.33); p<.05). In women, factors affecting obesity were an eating rate of ≤0 min (odds ratio=1.14 (1.02, 1.28); p<.05), and irregular mealtimes (odds ratio=1.15 (1.02, 1.29); p<.05). Eating out was found to be a significantly important factor among both genders when participants eat-out once a day or less. **Conclusion**: Implementing simple strategies to improve dietary and lifestyle habits may assist in weight and obesity management. These findings provide useful information for developing future strategies in obesity prevention.

Key words: obesity, eating rate, dietary habits, Community Health Survey (CHS)

Ⅰ. Introduction

Obesity is a risk factor for non-communicable diseases (NCDs) among people of all ages and classified by the World Health Organization (WHO) as a disease (World Health Organization, 2020). Increasing of obesity rate for the last three decades was conditioned by different factors, for instance changing dietary habits and decreasing physical activity (Blüher, 2019). The same trend is observed in the population of South Koreans where the prevalence of obesity (body mass index [BMI] ≥ 25) among adults aged 19 years or older was 34.8% in 2016, which was higher than that in 2005 (31.3%), suggesting that over one-third of the population was obese (Korean Statistical Information Services, 2020). According to a study that analyzed treatment costs using national health insurance data from 2016, obesity-related illnesses incurred costs of approximately 7.5 billion USD, and the highest costs on healthcare service utilization were associated with obesity, and these costs are consistently trending upward (Lee, 2019).

International experience shows that national-level efforts are essential for reducing obesity. In particular, the United Kingdom and the United States are working to reduce obesity rates by actively pursuing preventative strategies and launching whole-of-government campaigns at the national level, including promoting healthy foods and improving their accessibility, encouraging physical activity through constructing suitable

Corresponding author: Yuliya Dronina
518, School of Medicine Building #1(N414), Kangwon National University, 1, Kangwondaehak-gil, Chuncheon-si, Gangwon-do, 24341, Republic of Korea
Tel: +82-33-250-8910, Email: julia_dronina@yahoo.com
• Received: June 23, 2020 • Revised: September 7, 2020 • Accepted: September 21, 2020

environments for exercise, and providing personalized obesity management for at-risk groups (Capehorn, Haslam, & Welbourn, 2016; Musingarimi, 2009; Tseng et al., 2018). Although, regional-level strategies also need to be developed due to cultural and habitual factors. Therefore, a "culture-oriented approach" that fits local lifestyles also should be considered.

Obesity is known as a result of an imbalance in energy intake and expenditure; therefore, the emphasis has been placed on either reduced food intake or increased physical activity (Kim, Kim, & Hyun, 2019). A lot of previous studies have focused on the development of education and programs pertaining to the quality and quantity of foods and exercise requirements. However, despite temporarily reduced food intake, the maintenance of a lower-calorie diet is difficult, and compliance is low (Kim, Kim, Kim, Hong, & Chang, 2013). Also, physical activity and weight have a complicated relationship, involving numerous factors, the issue of obesity has not been readily resolved despite multiple intervention programs (Tan, Dunn, Samad, & Feisul, 2011). Therefore, identifying and presenting simple weight-management "strategies" that leads to the natural long-term behavior changes is required additionally to strict behavioral change programs, such as restricting calorie intake and increasing physical activity (Kirk, Penney, McHugh, & Sharma, 2012; Munro, Bore, Munro, & Garg, 2011).

Ford and colleagues (2010) reported the effectiveness of the obesity treatment among adolescence through retraining of the eating rate for long-term behavior changes. The multiply interventions based on the longer-term weight-management have high value for evidence-based intervention in health practices (Kirk et al., 2012). In this regard, it is difficult to continuously maintain the exact number of calories through short-term calorie restrictions programs. Continuous weight-management could be achieved by changing eating habits in the way of consuming food at a slower pace.

An important role in the weight-management plays decreasing in the calory intake. The physiological studies explored the effect of the satiety signals and calorie intake, and provide evidence that the decreasing of eating rate lead to satiety with lower calorie intake (Andrade, Greene, & Melanson, 2008; Benelam, 2009; Kokkinos et al., 2010). Eating slowly facilitates satiation by allowing time for the transmission of the satiety signal to the brain, which takes approximately 20 min (Lee, 2000). Therefore, at least 20 min of mastication is needed for the brain to recognize satiety, thereby preventing overeating that is important in obesity behavioral correction (Ookuma, Yoshimatsu, Sakata, & Adachi, 2000). Considering the so-called "quickly-quickly" (*bballi-bballi*) culture in South Korea, this is important to consider the influence of the eating rate on obesity.

Guidelines have been proposed for the adolescent populations of certain countries; however, guidelines on dietary habits for adults are required additional development (Musingarimi, 2009; Weihrauch-Blüher et al., 2018). Also, the previous study reported gender difference in the development of obesity rate and dietary habits that shows need to develop a different approach depending on the gender (Kim & Kim, 2010; Leong, Madden, Gray, Waters, & Horwath, 2011; Yamane et al., 2014). In this study, we aimed to provide an understanding of relationships between eating rate as "cultural phenomena" on obesity among Korean male and female adults.

Ⅱ. Methods

1. Study design

This cross-sectional study analyzed the impact of eating rate on obesity in adults with adjusting by other

dietary habits and physical activities. The secondary data from the Community Health Survey (CHS) 2017 was used and 18 cities and counties of Gangwon province were represented (Korea Centers for Disease Control and Prevention, 2017). The CHS was launched in 2008 under Article 4 of the Regional Public Health Act and has been conducted every year as a basis for community health projects. The study design was complex: samples were first stratified based on district (Dong/Eup/Myeon) subunits and types of residence (e.g., apartment or house) and classified by proportional block/settlement (Tong/Ban/Ri) sizes. Sample households were then selected by systematic sampling, and trained interviewers visited each chosen home to interview adult household members aged 19 years or older using computer workstations (Kim, Oh, & Lee, 2016).

To define obesity based on BMI, we analyzed participants aged 19 years or older who self-reported their height and weight. The prevalence of underweight adults was 3.9%, which was lower than the prevalence of the obese population. However, because being underweight presents other health risks owing to a lack of nutrients, underweight participants were excluded from this study.

2. Study variables

1) Dependent variables

The dependent variable was the obesity status. Participants were divided into two groups according to the WHO definition in the Asian population, those with BMI ≥ 18.5 and < 25 kg/m^2 were assigned to the normal weight group, whereas those with BMI ≥ 25 kg/m^2 were assigned to the obesity group (Kwon, Jang, & Kim, 2018; World Health Organization, 2000). The prevalence of the population in the extreme obesity group was only 4%, which was lower than the prevalence of obesity and normal weight groups, and this group was included in the obesity group.

2) Independent variables

The independent variables included eating time (derived from the amount of time one spends eating one meal), dietary habits (mealtime regularity and eating out of home), and physical activity were used as adjustment variables (Horikawa et al., 2011; Lee et al., 2013; Malik, Willett, & Hu, 2013). Information on dietary habits was collected only in Gangwon Province using additional questions. The eating rate was evaluated based on the following question adapted from Leong et al. (2011), "how many minutes do you typically spend eating meals?" The question, "in the last week, did you typically eat meals at regular set times?", was used to evaluate mealtime regularity. We categorized the eating rate into the following two groups: fast (those who took ≤ 20 min to eat one meal) and normal (those who took >21 min to eat one meal) (Moore, 2016). Mealtime regularity was categorized into regular and irregular groups. Eating out of home was categorized into three categories twice a day or more, once a day or less, and once a month or less (Kim, Oh, Choi, & Park, 2019). Certain variables for physical activity were used as adjustment variables, including moderate-to-intense physical activity (≥ 20 min/day of intense physical activity for ≥ 3 days, or ≥ 30 min/day of moderate physical activity in ≥ 5 days in the last week), walking (≥ 30 min/day for ≥ 5 days in the previous week), and the locally selected questions of regular exercise (regularly performing exercise during the last month).

3) Sociodemographic variables

The sociodemographic variables included gender (male and female), age group (20–29, 30–39, 40–49, 50–59, 60–69, and 70+ years), occupation (professional or administrative, office, sales or service, agriculture, forestry, fishery, technical and simple labor,

homemaking, and others), education (uneducated, elementary school, middle school, high school, and university and higher education), marital status (married, unmarried, and others), and residence area (urban and rural) (Mokdad et al., 2003). After data cleaning and excluding participants with missing data, 7,007 male and 7,566 females were included in the analyses.

3. Statistical analysis

For data analysis, participants were stratified by gender (male and female). Descriptive statistics and chi-square tests were used to evaluate the relationships between obesity, eating rate, and mealtime regularity. Multiple logistic regression analyses were performed to investigate the relationships between several factors simultaneously. Because obesity (the dependent variable) was a dichotomous variable, its odds ratios (ORs) were analyzed based on the adjustment and independent variables during regression analysis. The independent variables were sedentary time, eating rate, and mealtime regularity, and physical activity, and sociodemographic variables were used as adjustment variables. The goodness-of-fit of the logistic regression model was tested by Hosmer & Lemeshow's Goodness-of-Fit test. When a result of the test significant probability of Chi-square is greater than 0.05, it is considered appropriate (Hosmer & Lemesbow, 1980). IBM SPSS Statistics (Ver. 24.0) and SAS (Ver. 9.4) software were used for data analysis.

4. Ethics statement

The study was approved by the K University Institutional Review Board (KWNUIRB -2019-11-007) and was conducted using secondary data from CHS. Accordingly, informed consent was not required.

Ⅲ. Results

1. General characteristics of participants

The social-demographic characteristics of the study participants were diverse. In the case of gender, women participants were slightly predominant (men, 46.2%; women, 53.8%). The prevalent age group was the older adults age 70 years and older (24.7%), followed by the 50s group (22.1%) and 60s group (20.2%). Distribution of the participants in age group 20s, 30s, and 40s was as followed by 6.8%, 10.4%, and 15.7% respectively. In the case of occupations, 21.1% was employed in technical or simple labor works, 18.4% was homemaking, 18.3% was in the other group, 14.4% represented sales and services workers, 13.8% were employed in agriculture, forestry, or fishery, 7% were professional or administrative workers, and 6.9% were office workers. Thirty-two-point-three percent of participants graduated high school, 23% had university or higher education, 18.6% graduated elementary school, 13.2% finished middle school, and 12.9% were uneducated. Most of the participants were married (71.1%), only 10.7% were unmarried, and the rest of the participants were divorced, widower/widow or separated (18.2%). Sixty-point-two percent of the participants were living in a rural area and 39.8% was the residence of an urban area.

2. Relationship between obesity and lifestyle habits by gender

Distribution of the participants with normal weight and obesity presented in 〈Table 1〉. The relationships between obesity and the independent variables, including eating rate, eating out of home, walking, and moderate-to-intense physical activity showed significant differences among males ($p<.05$). In the case of the female, the eating rate and regular exercise were significantly different ($p<.05$). The presence of the

participants with obesity was prevalent among male participants who have a faster-eating rate and reported no walking but performed moderate-to-intense physical activities (37.4%, 37.4%, and 39.4% respectively). The percentage of obese females was higher among those who have a faster eating rate (31.1%) and performed regular exercise (30.9%).

〈Table 1〉 Bivariate analysis of the independent variables with obesity

unit: N(%)

Variables		Males			Females		
		Normal weight	Obesity	Chi-square	Normal weight	Obesity	Chi-square
	Total	4,448(63.5)	2,559(36.5)		5,303(70.1)	2,263(29.9)	
Eating rate	≤ 20 minutes	3,493(62.6)	2,090(37.4)	9.801**	3,813(68.9)	1,720(31.1)	13.586***
	≥ 21 minutes	954(67.0)	469(33.0)		1,490(73.3)	543(26.7)	
Regular meals	No	939(62.2)	570(37.8)	1.302	1,233(68.3)	571(31.7)	3.412
	Yes	3,509(63.8)	1,989(36.2)		4,069(70.6)	1,692(29.4)	
Eating out of home	Twice a day or more	140(60.6)	91(39.4)	54.521***	66(75.9)	21(24.1)	1.400
	Once a day or less	3,447(61.6)	2,148(38.4)		3,870(70.0)	1,656(30.0)	
	Once a month or less	861(72.9)	320(27.1)		1,367(70.0)	586(30.0)	
Walking	No	2,810(62.6)	1,677(37.4)	3.925*	3,709(69.9)	1,597(30.1)	0.299
	Yes	1,638(65.0)	882(35.0)		1,594(70.5)	666(29.5)	
Moderate to intense physical activity	No	3,298(64.5)	1,812(35.5)	9.254**	4,386(69.7)	1,903(30.3)	2.118
	Yes	1,149(60.6)	747(39.4)		916(71.8)	360(28.2)	
Regular exercise	Yes	1,793(62.5)	1,077(37.5)	2.12	1,895(71.9)	742(28.1)	6.063*
	No	2,655(64.2)	1,482(35.8)		3,408(69.1)	1,521(30.9)	
Age	20s	323(63.7)	184(36.3)	206.716***	375(79.4)	97(20.6)	87.91***
	30s	381(49.0)	397(51.0)		583(77.1)	173(22.9)	
	40s	662(55.6)	529(44.4)		861(72.8)	321(27.2)	
	50s	1,015(62.9)	598(37.1)		1,263(70.5)	529(29.5)	
	60s	948(65.5)	500(34.5)		1,017(62.4)	612(37.6)	
	≥70s	1,119(76.1)	351(23.9)		1,204(69.4)	531(30.6)	
Occupation	Professional/administrative	300(56.1)	235(43.9)	77.199***	428(81.7)	96(18.3)	69.656***
	Office work	294(53.1)	260(46.9)		380(78.7)	103(21.3)	
	Sales and services	440(59.6)	298(40.4)		1,029(71.6)	409(28.4)	
	Agriculture, forestry, and fishery	873(68.0)	410(32.0)		490(65.2)	262(34.8)	
	Technical/simple labor	1,215(62.1)	743(37.9)		804(68.0)	378(32.0)	
	Homemaking	2(100.0)	0(0.0)		1,752(67.8)	832(32.2)	
	Others (military, student, or unemployed)	1,314(68.3)	609(31.7)		417(69.8)	180(30.2)	

Variables		Males			Females		
		Normal weight	Obesity	Chi-square	Normal weight	Obesity	Chi-square
Education	Uneducated	268(76.8)	81(23.2)	101.561***	809(67.3)	393(32.7)	122.516***
	Elementary school	753(72.5)	285(27.5)		1,029(62.5)	618(37.5)	
	Middle school	628(64.2)	350(35.8)		682(66.4)	345(33.6)	
	High school	1,695(62.8)	1,006(37.2)		1,601(72.9)	595(27.1)	
	University or higher	1,099(56.8)	836(43.2)		1,177(79.1)	311(20.9)	
Marital status	Married	3,352(62.7)	1,997(37.3)	16.815***	3,659(69.9)	1,573(30.1)	17.467***
	Unmarried	644(63.0)	378(37.0)		411(77.7)	118(22.3)	
	Divorced/widower/widow/ separated	443(71.0)	181(29.0)		1,229(68.3)	571(31.7)	
Residence	Urban	1,768(64.3)	981(35.7)	1.360	2,214(72.7)	830(27.3)	16.976***
	Rural	2,680(62.9)	1,578(37.1)		3,089(68.3)	1,433(31.7)	

Note. * p<.05, ** p<.01, *** p<.001

The obesity rate was significantly different in four social-demographic variables (age, occupation, education, and marital status) among both genders (p<.001), and obesity was different among females depend on their residence (p<.001). The percentage of the obese male was prevalent in the 30s age group (51%), employed in the office (46.9%), with university or higher degree (43.2%), and married (37.3%). While the female participants aged the 60s, worked in agriculture, forestry, or fishery field (34.8%), with elementary education level, and were divorced, bereaved, or separated (31.7%) shows a higher percentage of the obesity prevalence.

After stratifying participants by gender, we performed multiple logistic regression analyses to find out relationships between obesity, eating rate, mealtime regularity, eating out of home, and sedentary behavior. The results of multiple logistic regression presented in 〈Table 2〉. In male participants, after adjusting, eating rate and eating out of home were significantly associated with the development of obesity. Compared with a normal eating rate, a fast eating rate was significantly associated with a higher rate of obesity in men (OR=1.16, p<.05). Male participants with eating out of home once a day or less have a higher risk of obesity compared to the group who eat-out once a month or less (OR=1.22, p<.01). In the case of female participants, the eating rate had statistically significant associations with the development of obesity. The obesity rates were higher in the fast-eating rate group than in the normal eating rate group (OR=1.14, p<.05), in those with irregular mealtimes than in those with regular mealtimes (OR=1.15, p<.05), and who eat-out once a day or less (OR=1.19, p<.05) compare to group with eating out of home once a month or less. However, the relationship between the obesity rate and physical activities was not found. The result of Hosmer-Lemeshow's goodness-of-fit test for the logistic regression model shows a p-value of more than 0.05 in both gender male (Chi-square=5.737, p=.677) and female (Chi-square=9.666, p=.289), this proves models suitable.

〈Table 2〉 Multiple logistic regression analyses for obesity in male and female participants

Variables (reference)		Obesity (compared with normal weight)			
		Males		Females	
		OR	(95% CI)	OR	(95% CI)
Eating rate (≥ 21 minutes)	≤ 20 minutes	1.16*	(1.02, 1.32)	1.14*	(1.02, 1.28)
Regular meals (yes)	No	1.00	(0.88, 1.14)	1.15*	(1.02, 1.29)
Eating out of home (once a month or less)	Twice a day or more	1.07	(0.79, 1.45)	0.93	(0.56, 1.56)
	Once a day or less	1.22**	(1.05, 1.42)	1.19*	(1.05, 1.34)
Walking (yes)	No	1.10	(0.99, 1.23)	1.01	(0.90, 1.13)
Moderate to intense physical activity (yes)	No	0.91	(0.81, 1.03)	1.08	(0.93, 1.24)
Regular exercise (yes)	No	0.93	(0.83, 1.03)	1.09	(0.98, 1.23)
Age (20s)	30s	1.45**	(1.12, 1.87)	1.27	(0.90, 1.79)
	40s	1.07	(0.83, 1.39)	1.54*	(1.10, 2.16)
	50s	0.79	(0.60, 1.03)	1.35	(0.96, 1.91)
	60s	0.73*	(0.56, 0.97)	1.59*	(1.12, 2.27)
	≥ 70s	0.48***	(0.36, 0.64)	1.09	(0.75, 1.58)
Occupation (professional/ administrative)	Office work	1.06	(0.83, 1.34)	1.10	(0.80, 1.51)
	Sales and services	0.90	(0.72, 1.14)	1.28	(0.98, 1.68)
	Agriculture, forestry, and fishery	0.80	(0.64, 1.02)	1.37*	(1.01, 1.86)
	Technical/simple labor	0.89	(0.72, 1.10)	1.34*	(1.01, 1.78)
	Homemaking			1.54**	(1.19, 2.00)
	Others	0.86	(0.69, 1.06)	1.56**	(1.13, 2.14)
Education (uneducated)	Elementary school	1.04	(0.78, 1.39)	1.10	(0.93, 1.30)
	Middle school	1.34	(1.00, 1.79)	0.89	(0.73, 1.10)
	High school	1.15	(0.86, 1.52)	0.69***	(0.56, 0.85)
	University or higher	1.21	(0.90, 1.64)	0.55***	(0.43, 0.72)
Marital status (married)	Unmarried	0.71***	(0.59, 0.85)	1.05	(0.78, 1.42)
	Divorced/widower/widow/separated	0.79*	(0.66, 0.96)	0.98	(0.86, 1.13)
Residence (urban)	Rural	1.18**	(1.06, 1.31)	1.15*	(1.03, 1.28)

Note. * p<.05, ** p<.01, *** p<.001, † OR=Odds Ratio

Despite the social-demographic factors that were not our target variables, age, married status, and residence have a significant relationship with obesity among male participants. In the case of females, age, education, occupation, education, and residence significantly influenced obesity.

Ⅳ. Discussion

Obesity studies have mainly focused on weight loss methods by reducing food intake or increasing physical activity. However, bodyweight needs to be controlled throughout one's lifetime, not only in the short-term. Therefore, weight control goals must include both weight loss and weight maintenance. It is also necessary to change perspectives related to obesity, and strategies are needed to alter behaviors by changing individual perceptions. For example, health promotion indices are lower in Gangwon Province, and this area had the worst obesity indices (29.7% in 2015 and 34.3% in 2018) in South Korea during the last 5 years (Korea Centers for Disease Control and Prevention, 2018). In this study, we examined the relationships between obesity and eating rate to find strategies that could help prevent obesity in real-life settings.

The result of our study illuminates that obesity rates were 36.5% in men and 29.9% in women, demonstrating a higher prevalence of obesity in men. Obesity prevalence was higher among those participants who spend less than 20 minutes for one meal intake. After controlling for adjustment variables, male participants with an eating rate of ≤ 20 min had a higher obesity rate. Among women, the obesity rate was higher in participants with an eating rate of ≤ 20 min and irregular mealtimes. Regardless of gender, an eating rate of ≤ 20 min was correlated with obesity that coincides with previous studies which showed similar results (Lee et al., 2013; Leong et al., 2011). Regardless, Paz-Graniel, Babio, Mendez, and Salas-Salvadó (2019) did not report a relationship between eating rate and obesity. It is important to highlight that studies on the physiological effect of the eating rate and calorie intake showed a relationship between satiation, satiety, and health behavior (Benelam, 2009; Maljaars, Peters, & Masclee, 2007; Ohkuma et al., 2015). Particularly, Andrade et al. (2008) reported that the individuals who spend more time on one meal intake have a higher level of satiety and satisfaction with food intake less weight and calories than the individuals who eat a meal within 20 minutes.

The previous study reported similar findings, particularly, Ahn, Chang, and Kim (2007) found that the mean durations of university students with obesity were significantly shorter than those with a healthy weight. In another study of university students of both genders, students in the obese group were found to have a faster eating rate than those in the healthy group (Jun et al., 2013). Besides, it was found that shorter meal durations were associated with BMI, independent of overall energy intake (Kamath & D'Souza, 2013). Those findings further indicate the relationship between a fast eating rate and obesity. Remarkably, the eating rate is impacted by South Korean "quickly-quickly" culture that permeates every aspect of the South Korean lifestyle, and meals are no exception (Kang, 2010). Despite this, according the OECD data Korean population spent more time for eating and drinking (1 hour 43 minutes) that OECD average (1 hour 31 minutes), however it can be commented more to the eating out of home (OECD, 2020).

Also, eating out of home shows the high prevalence of obesity in both genders. However previous study among Korean adults reported a significant relationship on eating-out among men (Kim et al., 2019). Previous studies reported the eating out of home influenced the anthropological changes and associated with the high-calorie intake (Bezerra, Curioni, & Sichieri, 2012; Lachat et al., 2012). Eating out of home is associated with the cultural aspect of the Korean society that choice of food is influenced by the collectivism, paternalism, and hierarchical culture (Koo & Park, 2013; Park et al., 2017).

Previous studies on middle-aged obesity showed that obese women had more irregular dietary habits and higher intakes of animal fat than did non-obese women (Lee, Oh, & Ahn, 2008; Leong et al., 2011), and irregular breakfast habits contributed greatly to obesity (Kim & Kim, 2010). Consistently, in the present study, obese women were more likely than healthy-weight women to eat irregular meals. These findings suggest that irregular meals may promote binge eating, leading to faster eating rates, and are linked to obesity. However, in Sohn and Jin (2008) study, obesity was not associated with meal regularity or eating three meals per day among women aged 20 years or older. These inconsistent findings suggest that age might be an important factor contributing to obesity.

Programs and treatments for weight control based on behavioral correction require extensive time. However, many individuals desire to reduce weight within a short time (Choi & Kim, 2011). Changing personal dietary habits do not produce rapid weight loss, although lifestyle habits for weight management play an essential role in obesity prevention and control (Phillips et al., 2013). Notably, previous studies emphasized the need to increase non-exercise activity thermogenesis (NEAT) rather than exercise (Healy et al., 2007). For instance, a study comparing energy expenditure between obese and non-obese groups found lower NEAT due to sedentary behavior, resulting in reduced overall energy expenditure, in the obese group (Levine et al., 2005). This observation supports our findings that introducing simple habits into daily life may impact obesity prevention.

Despite that our study does not aim to explore the influence of the social-demographic factors on the obesity rate, our findings contributed to previous studies were age, education level, occupation, marital status, and residence were significant factors (Malik et al., 2013; Molarius, 2003; Sobal, 2001). Middle age men were more predisposed to obesity rather than older adults, while women developed obesity with increasing age (Sobal, 2001). The prevalence of obesity was higher among women who were involved in unskilled work rather than professional workers. However, this patent is closely related to the level of education, and women with higher education might have more access and knowledge about a healthy lifestyle (Aekplakorn et al., 2014). Marital status was significant factors to develop obesity among married men, which is similar to the previous studies (Harcourt, Appleton, Clegg, & Hunter, 2020; Sobal, Rauschenbach, & Frongillo Jr, 1992). Participants from a rural area have a high risk of the obesity that those who live in an urban area that similar to the Global trends and mostly caused by lifestyle pattern (Befort, Nazir, & Perri, 2012; Cummins & Macintyre, 2006; Parks, Housemann, & Brownson, 2003).

Follow implications can be suggested based on the study findings. Intervention is a necessity for the prevention of obesity, and the health education program should direct to the modification of the cultural eating aspect of the “quickly-quickly” and the importance of the slowly eating rate (more than 20 minutes). Another intervention is necessary to address the influence of eating out of home behavior, where individual dietary preferences should be considered for weight management.

This study has several limitations. First, the study was designed as cross-sectional and focused on association between obesity and eating rate, so causal relationships between obesity and dietary behavior (such as calorie intake, composition of diet, etc.) were not evaluated. The second limitation is that we could not measure the participants’ actual heights and weights or confirm their precise meal as data was self-reported based, and the extremely obese group was lower. Third, data on the eating rate presented in this study was obtained from CHS’s participants in Gangwon province. Despite these limitations, the CHS

provides large-scale research data at the local government level in South Korea using representative samples. Therefore, the relationships observed between obesity and eating rate are valid. The factors affecting obesity are considerably complex, and further studies are needed to explain the personal behaviors implicated in this study to the entire population, as well as a longitudinal study is necessary to evaluate the continuous effect of the eating rate on obesity development. Notably, this study provided valuable data and findings by including multiple factors that could be used to distinguish between individual eating rate, other dietary habits, and physical activity. Therefore, the present findings will contribute to planning future obesity management programs. Weight control requires persistent behavioral changes and motivation, and obesity programs considering these factors need to be developed in the future.

Ⅴ. Conclusion

We examined the relationships between eating rate and obesity to provide evidence for obesity prevention strategies. The primary factor affecting obesity among male and female participants was an eating rate of ≤ 20 min; additionally, irregular meals were significant factors to develop obesity among female participants, and eating out of home was significant for both genders. These findings strongly suggest that obesity could be prevented by simple changes in dietary and lifestyle habits. Based on these findings, behavioral correction strategies adjusting for the eating rate should be introduced to improve the impact of existing obesity prevention and management programs. The findings in this study could be used to establish strategies for obesity prevention programs by modifying lifestyle habits. Further studies with more extensive and diverse cohorts are needed to validate our findings.

References

Aekplakorn, W., Inthawong, R., Kessomboon, P., Sangthong, R., Chariyalertsak, S., Putwatana, P., & Taneepanichskul, S. (2014). Prevalence and trends of obesity and association with socioeconomic status in Thai adults: National health examination surveys, 1991–2009. *Journal of Obesity, 2014,* 410259. doi: 10.1155/2014/410259.

Ahn, M.-S., Chang, I.-Y., & Kim, K.-H. (2007). Comparisons of UCP2 polymorphism, dietary habits, and obesity index in normal and obese university students. *Journal of the Korean Society of Food Culture, 22*(4), 404-413.

Andrade, A. M., Greene, G. W., & Melanson, K. J. (2008). Eating slowly led to decreases in energy intake within meals in healthy women. *Journal of the American Dietetic Association, 108*(7), 1186-1191. doi: 10.1016/j.jada.2008.04.026.

Befort, C. A., Nazir, N., & Perri, M. G. (2012). Prevalence of obesity among adults from rural and urban areas of the United States: findings from NHANES (2005-2008). *The Journal of Rural Health, 28*(4), 392-397. doi: 10.1111/j.1748-0361.2012.00411.x.

Benelam, B. (2009). Satiation, satiety, and their effects on eating behaviour. *Nutrition Bulletin, 34*(2), 126-173. doi: 10.1111/j.1467-3010.2009.01753.x.

Bezerra, I. N., Curioni, C., & Sichieri, R. (2012). Association between eating out of home and body weight. *Nutrition reviews, 70*(2), 65-79. doi: 10.1111/j.1753-4887.2011.00459.x.

Blüher, M. (2019). Obesity: Global epidemiology and pathogenesis. *Nature Reviews Endocrinology, 15*(5), 288-298. doi: 10.1038/s41574-019-0176-8.

Capehorn, M. S., Haslam, D. W., & Welbourn, R. (2016). Obesity treatment in the UK health system. *Current obesity reports, 5*(3), 320-326. doi: 10.1007/s13679-016-0221-z.

Choi, J. M., & Kim, C.-B. (2011). Obesity management and scientific evidence. *Journal of the Korean Medical Association, 54*(3), 250-265. doi: 10.5124/jkma.2011.54.3.250.

Cummins, S., & Macintyre, S. (2006). Food environments and obesity - Neighbourhood or nation? *International journal of epidemiology, 35*(1), 100-104. doi: 10.1093/ije/dyi276.

Ford, A. L., Bergh, C., Södersten, P., Sabin, M. A.,

Hollinghurst, S., Hunt, L. P., & Shield, J. P. (2010). Treatment of childhood obesity by retraining eating behaviour: Randomised controlled trial. *BMJ, 340,* b5388. doi: 10.1136/bmj.b5388.

Harcourt, K. A., Appleton, J., Clegg, M. E., & Hunter, L. (2020). The influence of social relationships on men's weight. *Journal of Nutrition Education and Behavior, 52*(2), 106-113. doi: 10.1016/j.jneb.2019.08.009.

Healy, G. N., Dunstan, D. W., Salmon, J., Cerin, E., Shaw, J. E., Zimmet, P. Z., & Owen, N. (2007). Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. *Diabetes Care, 30*(6), 1384-1389. doi: 10.2337/dc07-0114.

Horikawa, C., Kodama, S., Yachi, Y., Heianza, Y., Hirasawa, R., Ibe, Y., . . . Sone, H. (2011). Skipping breakfast and prevalence of overweight and obesity in Asian and Pacific regions: A meta-analysis. *Preventive medicine, 53*(4-5), 260-267. doi: 10.1016/j.ypmed.2011.08.030.

Hosmer, D. W., & Lemesbow, S. (1980). Goodness of fit tests for the multiple logistic regression model. *Communications in statistics-Theory and Methods, 9*(10), 1043-1069.

Jun, S.-C., Kim, Y.-J., Kim, Y.-S., Kim, S.-K., Kim, D.-G., & Chang, U.-J. (2013). The relationships of chewing frequency, eating rates, and food consumption with the body mass index and gender of college students. *Journal of the Korean Dietetic Association, 19*(2), 103-111. doi: 10.14373/JKDA.2013.19.2.103.

Kamath, S., & D'Souza, J. (2013). Prevalence of obesity among the medical students: a cross sectional study in a south Indian medical college. *Al Ameen Journal of Medicine Sciences, 6*(1), 93-95.

Kang, J.-M. (2010). The cultural politics of 'ppallippalli': A study on the 'speed communication' in Korea. *Journal of Communication Science, 10*(3), 47-80.

Kim, B., Kim, G. S., & Hyun, H. S. (2019). Development and validation of a tool to assess the rural neighborhood environment for obesity in Korean adults. *Public Health Nursing, 36*(5), 752-762. doi: 10.1111/phn.12621.

Kim, H.-K., & Kim, M.-J. (2010). Effects of weight control program on dietary habits and blood composition in obese middle-aged women. *Korean Journal of Nutrition, 43*(3), 273-284. doi: 10.4163/kjn.2010.43.3.273.

Kim, H. J., Oh, S. Y., Choi, D.-W., & Park, E.-C. (2019). The Association between Eating-Out Rate and BMI in Korea. *International Journal of Environmental Research and Public Health, 16*(17), 3186. doi: 10.3390/ijerph16173186.

Kim, M., Oh, G.-J., & Lee, Y.-H. (2016). Gender-specific factors associated with suicide attempts among the community-dwelling general population with suicidal ideation: the 2013 Korean community health survey. *Journal of Korean Medical Science, 31*(12), 2010-2019. doi: 10.3346/jkms.2016.31.12.2010.

Kim, Y.-S., Kim, S.-K., Kim, S.-Y., Hong, I.-S., & Chang, U.-J. (2013). The effect of nutrition education and the diet rice bowl on weight control. *Journal of the Korean Dietetic Association, 19*(3), 287-297. doi: 10.14373/JKDA.2013.19.3.287.

Kirk, S., Penney, T., McHugh, T.-L., & Sharma, A. (2012). Effective weight management practice: A review of the lifestyle intervention evidence. *International journal of obesity, 36*(2), 178-185. doi: 10.1038/ijo.2011.80.

Kokkinos, A., le Roux, C. W., Alexiadou, K., Tentolouris, N., Vincent, R. P., Kyriaki, D., . . . Katsilambros, N. (2010). Eating slowly increases the postprandial response of the anorexigenic gut hormones, peptide YY and glucagon-like peptide-1. *The Journal of Clinical Endocrinology & Metabolism, 95*(1), 333-337. doi: 10.1210/jc.2009-1018.

Koo, S., & Park, K. (2013). Dietary behaviors and lifestyle characteristics related to frequent eating out among Korean adults. *Journal of the Korean Society of Food Science and Nutrition, 42*(5), 705-712. doi: 10.3746/jkfn.2013.42.5.705.

Korea Centers for Disease Control and Prevention. (2017). *Community Health Survey*. Retrieved from https://chs.cdc.go.kr/chs/rdr/rdrInfoDownMain.do

Korea Centers for Disease Control and Prevention. (2018). *2008-2018 Community Health Statistics at a glance*. Retrieved from https://chs.cdc.go.kr/chs/stats/statsMain.do

Korean Statistical Information Services. (2020). *Statistical Database. Obesity: ≥19 years*. Retrieved from: http://kosis.kr/eng/statisticsList/statisticsListIndex.do?menuId=M_01_01&vwcd=MT_ETITLE&parmTabId=M_01_01&statId=1973001&themaId=#SelectStatsBoxDiv

Kwon, M. S., Jang, J. H., & Kim, S.-J. (2018). Health locus of control and eating behavior of obese in adults. *Korean Journal of Health Education and Promotion, 35*(1), 55-67. doi:10.14367/kjhep.2018.35.1.55.

Lachat, C., Nago, E., Verstraeten, R., Roberfroid, D., Van Camp, J., & Kolsteren, P. (2012). Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obesity Reviews, 13*(4), 329-346. doi: 10.1111/j.1467-789X.2011.00953.x.

Lee, K., Kim, D.-H., Jang, J., Nam, G., Shin, Y., Bok, A., . . . Cho, K.-H. (2013). Eating rate is associated with cardiometabolic risk factors in Korean adults. *Nutrition, Metabolism and Cardiovascular Diseases, 23*(7), 635-641. doi: 10.1016/j.numecd.2012.02.003.

Lee, S. (2019). *Analysis of the impact of health behavior on*

health insurance. Paper presented at the 1st Medical Public BIG DATA Research Conference, Seoul, Korea.

Lee, S. M., Oh, A. R., & Ahn, H. S. (2008). Major dietary patterns and their associations with socio-demographic, psychological, and physical factors among generally healthy Korean middle-aged women. *Korean Journal of Community Nutrition, 13*(3), 439-452.

Lee, Y. (2000). A study on the eating behavior, nutritional status, and health condition of obese adult attending a weight control exercise. *The Korean Journal of Food and Nutrition, 13*(2), 125-132.

Leong, S. L., Madden, C., Gray, A., Waters, D., & Horwath, C. (2011). Faster self-reported speed of eating is related to higher body mass index in a nationwide survey of middle-aged women. *Journal of the American Dietetic Association, 111*(8), 1192-1197. doi: 10.1016/j.jada.2011.05.012.

Levine, J. A., Lanningham-Foster, L. M., McCrady, S. K., Krizan, A. C., Olson, L. R., Kane, P. H., . . . Clark, M. M. (2005). Interindividual variation in posture allocation: possible role in human obesity. *Science, 307*(5709), 584-586. doi: 10.1126/science.1106561.

Malik, V. S., Willett, W. C., & Hu, F. B. (2013). Global obesity: trends, risk factors, and policy implications. *Nature Reviews Endocrinology, 9*(1), 13-27. doi: 10.1038/nrendo.2012.199.

Maljaars, J., Peters, H., & Masclee, A. (2007). The gastrointestinal tract: Neuroendocrine regulation of satiety and food intake. *Alimentary pharmacology & therapeutics, 26*, 241-250. doi: 10.1111/j.1365-2036.2007.03550.x.

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S., & Marks, J. S. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *Jama, 289*(1), 76-79. doi:10.1001/jama.289.1.76.

Molarius, A. (2003). The contribution of lifestyle factors to socioeconomic differences in obesity in men and women –a population-based study in Sweden. *European Journal of Epidemiology, 18*(3), 227-229. doi: 10.1023/A:1023376012627.

Moore, M. C. (2016). *Mosby's pocket guide to nutritional assessment and care-e-book*. St Louis: Elsevier Health Sciences.

Munro, I. A., Bore, M. R., Munro, D., & Garg, M. L. (2011). Using personality as a predictor of diet induced weight loss and weight management. *International Journal of Behavioral Nutrition and Physical Activity, 8*(1), 129. doi: 10.1186/1479-5868-8-129.

Musingarimi, P. (2009). Obesity in the UK: A review and comparative analysis of policies within the devolved administrations. *Health policy, 91*(1), 10-16. doi: 10.1016/j.healthpol.2008.11.004.

Ohkuma, T., Hirakawa, Y., Nakamura, U., Kiyohara, Y., Kitazono, T., & Ninomiya, T. (2015). Association between eating rate and obesity: A systematic review and meta-analysis. *International journal of obesity, 39*(11), 1589-1596. doi: 10.1038/ijo.2015.96.

Ookuma, K., Yoshimatsu, H., Sakata, T., & Adachi, K. (2000). The effect of chewing chart recording in the treatment of obesity. *Japanese Journal of Psychosomatic Medicine, 40*, 247-253.

Organisation for Economic Co-operation and Development. (2020). *Gender Equality. Balancing paid work, unpaid work and leisure*. Retrieved from: https://www.oecd.org/gender/balancing-paid-work-unpaid-work-and-leisure.htm

Park, S., Sung, E., Choi, Y., Ryu, S., Chang, Y., & Gittelsohn, J. (2017). Sociocultural factors influencing eating practices among office workers in urban South Korea. *Journal of Nutrition Education and Behavior, 49*(6), 466-474. e461. doi: 10.1016/j.jneb.2017.02.005.

Parks, S., Housemann, R. A., & Brownson, R. C. (2003). Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology & Community Health, 57*(1), 29-35.

Paz-Graniel, I., Babio, N., Mendez, I., & Salas-Salvadó, J. (2019). Association between eating speed and classical cardiovascular risk factors: A cross-sectional study. *Nutrients, 11*(1), 83. doi: 10.3390/nu11010083.

Phillips, C. M., Dillon, C., Harrington, J. M., McCarthy, V. J., Kearney, P. M., Fitzgerald, A. P., & Perry, I. J. (2013). Defining metabolically healthy obesity: role of dietary and lifestyle factors. *PloS One, 8*(10). doi: 10.1371/journal.pone.0076188.

Sobal, J. (2001). Social and cultural influences on obesity. *International textbook of obesity* (pp. 305-322). Chichester : John Wiley & Sons. doi: 10.1002/0470846739.ch21.

Sobal, J., Rauschenbach, B. S., & Frongillo Jr, E. A. (1992). Marital status, fatness, and obesity. *Social Science & Medicine, 35*(7), 915-923. doi: 10.1016/0277-9536(92)90106-Z.

Sohn, A.-R., & Jin, K.-Y. (2008). The difference of socio-demographic variables and health-related behaviors among groups of body mass index. *Korean Journal of health education and promotion, 25*(4), 1-11.

Tan, A. K., Dunn, R. A., Samad, M. I. A., & Feisul, M. I. (2011). Sociodemographic and health-lifestyle

determinants of obesity risks in Malaysia. *Asia Pacific Journal of Public Health, 23*(2), 192-202. doi: 10.1177/1010539509359535.

Tseng, E., Zhang, A., Shogbesan, O., Gudzune, K. A., Wilson, R. F., Kharrazi, H., . . . Bennett, W. L. (2018). Effectiveness of policies and programs to combat adult obesity: A systematic review. *Journal of General Internal Medicine, 33*(11), 1990-2001. doi: 10.1007/s11606-018-4619-z.

Weihrauch-Blüher, S., Kromeyer-Hauschild, K., Graf, C., Widhalm, K., Korsten-Reck, U., Jödicke, B., . . . Wabitsch, M. (2018). Current guidelines for obesity prevention in childhood and adolescence. *Obesity Facts, 11*(3), 263-276. doi: 10.1159/000486512.

World Health Organization. (2000). The Asia-Pacific perspective: redefining obesity and its treatment.

World Health Organization. (2020, April 2020). Obesity and Overweight. Retrieved from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Yamane, M., Ekuni, D., Mizutani, S., Kataoka, K., Sakumoto-Kataoka, M., Kawabata, Y., . . . Iwasaki, Y. (2014). Relationships between eating quickly and weight gain in Japanese university students: A longitudinal study. *Obesity, 22*(10), 2262-2266. doi: 10.1002/oby.20842.

■ Heui Sug Jo http://orcid.org/0000-0003-0245-3583
■ Su Mi Jung http://orcid.org/0000-0003-0536-4914
■ Yuliya Dronina http://orcid.org/0000-0002-5912-3553