Original Article

J Prev Med Public Health 2012;45;211-218 • http://dx.doi.org/10.3961/jpmph.2012.45.4.211

pISSN 1975-8375 eISSN 2233-4521

Journal of Preventive Medicine & Public Health

Differences in Obesity Rates Between People With and Without Disabilities and the Association of Disability and Obesity: A Nationwide Population Study in South Korea

Moo-Kyung Oh[1,2], Hyeongap Jang[1,2], Yong-Ik Kim[1,2], Belong Jo[3], Yoon Kim[1,2], Jong-Heon Park[2], Jin-Seok Lee[1,2]

[1]Department of Health Policy and Management, Seoul National University College of Medicine; [2]Institute of Health Policy and Management, Medical Research Center, Seoul National University; [3]Department of Family Medicine, Seoul National University Hospital, Seoul, Korea

Objectives: The objective of this study was to identify the differences in obesity rates among people with and without disabilities, and evaluate the relationship between obesity rates and the existence of disabilities or characteristics of disabilities.

Methods: Mass screening data from 2008 from the National Disability Registry and National Health Insurance (NHI) are used. For analysis, we classified physical disability into three subtypes: upper limb disability, lower limb disability, and spinal cord injury. For a control group, we extracted people without disabilities by each subtype. To adjust for the participation rate in the NHI mass screening, we calculated and adopted the weight stratified by sex, age, and grade of disability. Differences in obesity rates between people with and without disabilities were examined by a chi-squared test. In addition, the effect of the existence of disabilities and grade of disabilities on obesity was examined by multiple logistic regression analysis.

Results: People with disabilities were found to have a higher obesity rate than those without disabilities. The obesity rates were 35.2% and 35.0% (people with disabilities vs. without disabilities) in the upper limb disability, 44.5% and 34.8% in the lower limb disability, 43.4% and 34.6% in the spinal cord injury. The odds for existence of physical disability and grade of disability are higher than the non-disabilities.

Conclusions: These results show that people with physical disability have a higher vulnerability to obesity.

Key words: Disabled persons, Obesity, Physically disabled, Body mass index

INTODUCTION

The obesity rate in South Korea has been steadily on the rise. According to the Korea National Health and Nutrition Examination Survey, South Korea's obesity rate of adults aged 19 or older rose to 31.3% in 2009 from 26.0% in 1998 [1]. It is known that obesity causes chronic diseases and raises overall mortality, with psychological and social side-effects such as lowered self-esteem and impaired social functioning well as negative influences on health-related quality of life [2-4].

One of the groups with a high risk of obesity is people with disabilities, among whom high obesity rates are continuously being reported [5]. The mechanism underlying high obesity rates of the people with disabilities is not clearly known, but it is conjectured that pathophysiological changes in body composition and the energy metabolism due to physical inactivity

Received: August 26, 2011 Accepted: November 14, 2011

Corresponding author: Jin-Seok Lee, MD, PhD
103 Daehak-ro, Jongno-gu, Seoul 110-799, Korea
Tel: +82-2-740-8363, Fax: +82-2-743-2009
E-mail: phealth@snu.ac.kr

and muscle atrophy could cause obesity [6]. It was reported that people with physical disability have an obesity rate approximately 1.2 to 3.9 times higher than that of those without physical disability. In particular, people with disabilities have a noticeably higher rate in the category of severe obesity, with a steadily rising trend [6-8].

Nonetheless, there are many barriers to the prevention and management of obesity in people with disabilities. They have difficulties in performing outdoor activities, and even though they have the same desires as those without disabilities, their desires are often not satisfied because of disabilities in physical and/or linguistic functions, resulting in obstacles to health promoting behaviors [9]. Despite this vulnerability in physical activity, health risks, and resultant lower quality of life, research interest in people with disabilities, specifically regarding problems of obesity, chronic diseases, and other health issues affected by disabilities has been low, with insufficient studies published on this subject [10].

People with disabilities have a greater need for healthcare services because of their vulnerable health conditions, but suffer from unmet needs for healthcare services [11-13]. Also, when a new health problem unrelated their disability arises, it often leads to a secondary dysfunction. Therefore, prevention and management of obesity in people with disabilities should start with identifying the current status of obesity, and how disability characteristics influence obesity problems. In this regard, this study aimed to identify the differences in obesity rates among people with and without disabilities, and evaluated the relationship between obesity rates and the existence of disabilities or characteristics of disabilities.

METHODS

Study Population

First, among those who participating in mass screening provided by the National Health Insurance (NHI) in 2008, the total population of people with disabilities registered in the National Disability Registry in 2008 was determined. Then, those classified as having a 'physical disability' were selected and were classified again into three subtypes as follows: upper-limb disability, lower-limb disability, and spinal cord injury. The data on people without disabilities were constructed by matching the aforementioned data by disability subtype as well as by gender, age, and region, in doubled numbers. The study population of the people with disabilities constructed through these processes was 87 057 people with upper-limb disability, 154 997 people with lower-limb disability, and 92 623 people with spinal cord injury, and was compared with the population of people without disabilities correlated with the people with disabilities in the manner described above, for the final analysis.

The reason that people with 'physical disability' were selected was that there was a need to focus on physical impairment considering different characteristics by different disability types. Furthermore, the proportion of 'physical disability' was the highest, comprising 53.0% of the total population of the people with disabilities, compared with other categories of disabilities.

Definition of Variables

Age was classified into three groups in accordance with the life cycle: age 19 to 44, age 45 to 64, and age 65 or older. As for health insurance contributions, the total study population was divided into 5 categories under employee health insurance plans or self-employed health insurance plans. Health insurance contributions were used as a substitute indicator in the estimation of the financial status of those analyzed in this study. Other sociological factors such as education and family were not used in the analysis because of unavailability of such information in many cases in the National Disability Registry.

For the variables related to health behaviors, interview questions used in the NHI mass screening in 2008 were utilized to obtain information on alcohol, diet, exercise, etc.

Alcohol history was described by considering such factors such as quantity and frequency of drinking; those who had at least one weekly occasion of drinking one bottle or more of Soju at a given drinking session over the past year were classified into the high-risk drinking group. Because of the limitations of the interview questions regarding drinking history, the same criteria were applied regardless of gender. As for diet-related information, those who answered the question, "What kind of food do you usually eat?" with "mostly meat" were defined as 'primarily meat-eaters' and those who answered with "mostly vegetables" or "balanced diet with both vegetables and meat" as 'primarily non meat-eaters.' With regard to the information on physical exercise, the classification criteria were intensity and frequency of exercise. Those who exercised three times or more a week at an intensity great enough to work up a sweat were defined as 'moderate intensity exercise group' and those who exercised less than three

times or not at all as 'non-moderate intensity exercise group.'

Under the Act on the Welfare of the Handicapped, physical disability is defined as a permanent state of physical dysfunction due to a disease or damage to the bone, the muscle, or the nervous system, and is classified into three subtypes in accordance with loss or deformation of the outer body (upper-limb, lower-limb, and spinal cord). The degree of disability is classified into six grades, and it can be used as a substitute indicator of mobility; the degree of mobility impairment in people with disabilities has been re-defined in many studies with reference to the criteria that determine the grade of disability [14]. This study also utilized grade of disability as an analysis variable and as a substitute indicator to show the degree of disability in walking and daily movement.

In this study, the duration of disability represents the period from the first registered year of disability to the year 2008 when the relevant data were entered into the National Disability Registry. Duration was classified into four groups by quartile value.

Statistical Analysis

In this study, a BMI of 25 kg/m^2 or over was defined as obese, in accordance with the BMI criteria presented by the Korean Society for Study of Obesity. In the case of people with disabilities, there is a significant variance in the participation rates in mass screening by gender, age, and grade of disability [15]. Therefore, it is necessary to adjust the obesity rate of the study group such that it represents the obesity rate of the total population of people with disabilities. For this, in order to make the sample conform to the population in terms of the distribution of disability grades, weighted values stratified by gender, age, and grade of disability were calculated. A weighted value was also applied to the group of people without disabilities in accordance with the population structure by gender and by age in the National Disability Registry, for comparison with the people with disabilities group.

A chi-squared analysis was conducted to identify the differences in the obesity rates between the people with and without disabilities by disability type and a chi-squared analysis for trend was carried out to identify changes in the obesity rate depending on disability characteristics. Finally, in order to analyze the influence of disability on the obesity rate, a multiple logistic regression analysis was conducted by using the obesity rate as an outcome variable. At the time of the analysis, multicollinearity between variables was identified and variables with 10 variance inflation factors or over were excluded. As for the logistic procedure, a survey-logistic procedure was used for the analysis with a weighted value [16,17].

For the statistical program, SAS version 9.2 (SAS Inc., Cary, NC, USA) was used, and the analysis was conducted after gaining approval of the Institutional Review Board of Seoul National University Hospital.

RESULTS

Characteristics of the subjects of this study by disability type are shown in Table 1. The proportion of males was higher than females for the disability types except spinal cord injury. As for age, the proportion of people aged 45 to 64 was highest in all disability types. In the classification of employee health insurance versus self-employed health insurance, the proportion of

Table 1. General characteristics of the study population by type of disability

Variables	Upper limbs		Lower limbs		Spinal cord	
	D[1]	ND[2]	D	ND	D	ND
No. of study population (n)[3]	87 057	174 114	154 997	309 994	92 623	185 246
Sex (%)[4]						
Male	77.5	77.5	57.3	57.3	49.9	49.9
Female	22.5	22.5	42.7	42.7	50.1	50.1
Age (%)						
19-44	25.6	25.6	20.7	20.7	16.6	16.6
45-64	52.9	52.9	42.2	42.2	52.0	52.0
65≤	21.6	21.6	37.1	37.1	31.4	31.4
Category (%)						
Industrial worker	24.1	21.7	26.7	24.9	26.6	25.8
Self-employed	75.9	78.3	73.3	75.1	73.2	74.2
Health related life-style (%)						
Meat preference diet	7.4	7.3	6.2	5.8	5.4	5.2
Physical inactivity[5]	92.1	91.7	92.8	91.8	91.4	91.5
High risk drinking	14.3	17.1	9.5	12.6	8.3	11.1
Grade of disability (%)						
1st degree (severe)	1.5	-	4.6	-	0.9	-
2nd degree	7.4	-	7.4	-	4.1	-
3rd degree	19.7	-	15.4	-	5.4	-
4th degree	19.0	-	27.4	-	4.0	-
5th degree	17.4	-	26.8	-	46.2	-
6th degree (mild)	34.9	-	18.3	-	39.4	-

[1]People with disabilities. [2]People without disabilities. [3]Number is unweighted. [4]Percentage is weighted. [5]Non-moderate intensity exercise group.

Table 2. The obesity rate and its differences between the people with and without disabilities

Variables	Upper limbs			Lower limbs			Spinal cord		
	D[1]	ND[2]	*p*-value	D	ND	*p*-value	D	ND	*p*-value
All	35.2	35.0	0.58	44.5	34.8	<0.001	43.4	34.6	<0.001
Sex									
Male	35.3	36.1	<0.001	38.4	35.6	<0.001	41.4	35.7	<0.001
Female	34.8	31.5	<0.001	52.6	33.7	<0.001	45.5	33.6	<0.001
Age									
19-44	35.0	32.7	<0.001	36.4	31.2	<0.001	39.4	30.6	<0.001
45-64	36.8	38.1	<0.001	43.6	37.3	<0.001	44.5	36.5	<0.001
65≤	31.5	30.4	0.02	50.1	34.0	<0.001	43.8	33.8	<0.001
Category									
Industrial worker	34.6	34.7	0.44	43.7	34.3	<0.001	42.6	34.0	<0.001
Self-employed	37.0	36.1	0.048	46.4	36.3	<0.001	45.8	36.5	<0.001
Contribution									
1st quartile (low)	35.9	34.8	0.02	43.0	34.0	<0.001	43.1	33.6	<0.001
2nd quartile	33.6	32.3	0.003	41.1	32.3	<0.001	42.1	32.8	<0.001
3rd quartile	34.2	34.6	0.32	43.3	34.3	<0.001	43.8	35.3	<0.001
4th quartile	36.1	36.0	0.93	46.2	36.0	<0.001	44.6	36.2	<0.001
5th quartile (high)	37.0	37.1	0.80	48.3	36.6	<0.001	43.3	35.2	<0.001

Values are presented as %. Weighted analysis.
[1]People with disabilities. [2]People without disabilities.

those under a self-employed health insurance plan was higher than those under an employee health insurance plan for all disability types. With regard to health-related behaviors, the proportion of 'primarily meat-eaters' was highest (7.4%) in the upper-limb disability, and the proportion of high-risk drinking experience was also highest in the same group.

The obesity rates of the people with physical disability were higher than those of the people without disabilities for all subtypes (Table 2). A univariate analysis showed that the obesity rates of people with lower-limb disability or spinal cord injury were higher than those of the people without disabilities, and demographic and sociological factors showed a significant difference between the people with and without disabilities. The obesity rate of people with upper-limb disability was also higher than that of people without disabilities, but without statistical significance.

All three subtypes showed significant variances in obesity rates depending on grade of disability (Table 3). In the case of upper-limb disability, the obesity rates showed an increasing trend in accordance with mildness of disability, and in the case of lower-limb and spinal cord injury, obesity rates showed a decreasing trend from grade 4 after showing an increasing trend in accordance with mildness of disability. As for the obesity rates by duration of disability, there were significant variances by period among those with lower-limb or spinal cord injury. In the case of lower-limb disability, the longer the duration of disability was, the lower the obesity rate.

Table 3. The obesity rate and its differences among the people with disabilities according to factors of disabilities

Variable	Upper limbs		Lower limbs		Spinal cord	
	Obesity rate	*p*-value[1]	Obesity rate	*p*-value	Obesity rate	*p*-value
Grade of disability (%)						
1st degree (severe)	28.5	<0.001	27.1	<0.001	31.9	0.012
2nd degree	32.3		33.0		42.8	
3rd degree	34.5		41.4		44.6	
4th degree	34.7		52.2		46.6	
5th degree	36.0		45.5		44.4	
6th degree (mild)	36.2		43.1		42.1	
Duration of disability (%)						
1st quartile	34.9	0.51	54.2	<0.001	44.3	<0.001
2nd quartile	35.5		51.3		43.9	
3rd quartile	34.8		42.0		44.1	
4th quartile	35.3		35.8		42.1	

Weighted analysis. [1]Mantel-Haenszel chi-squared.

Multiple logistic regression with adjustments made to take into consideration demographic and sociological factors as

Table 4. ORs of the factors affecting the obesity of the people with physical disability by multiple logistic regression

Variable	Upper limbs		Lower limbs		Spinal cord	
	OR	95% CI	OR	95% CI	OR	95% CI
Disability[1]						
None	ref		ref		ref	
Existence	0.984	0.969, 1.001	1.471	1.452, 1.490	1.413	1.390, 1.437
Grade of disability[2]						
No disability	ref		ref		ref	
1st degree (severe)	0.712	0.529, 0.959	0.705	0.617, 0.805	0.867	0.594, 1.264
2nd degree	0.901	0.822, 0.988	0.893	0.831, 0.960	1.441	1.286, 1.613
3rd degree	0.976	0.931, 1.023	1.296	1.247, 1.347	1.447	1.330, 1.574
4th degree	0.967	0.925, 1.011	1.902	1.850, 1.954	1.548	1.407, 1.702
5th degree	1.033	0.988, 1.080	1.511	1.470, 1.553	1.489	1.446, 1.533
6th degree (mild)	1.053	1.020, 1.087	1.493	1.448, 1.540	1.377	1.335, 1.420
Duration of disability[3]						
No disability	ref		ref		ref	
1 quartile	1.000	0.958, 1.044	2.051	1.981, 2.124	1.395	1.321, 1.473
2 quartile	0.999	0.956, 1.044	1.831	1.781, 1.882	1.428	1.374, 1.485
3 quartile	0.964	0.925, 1.006	1.348	1.306, 1.392	1.439	1.391, 1.490
4 quartile	0.964	0.932, 0.997	1.039	1.009, 1.069	1.338	1.290, 1.387

Weighted analysis.
OR, odds ratio; CI, confidence interval; ref, reference.
[1]Adjusted for sociodemographics, health related behavior, and existence of disability. [2]Adjusted for sociodemographics, health related behavior, and grade of disability. [3]Adjusted for sociodemographics, health related behavior, and duration of disability.

well as health-related behaviors showed that the existence of disability exerts a significant influence on the obesity rate of people with physical disability (Table 4). In particular, in the case of lower-limb disability, there was a high odds ratio (1.471). As for the grade of disability, those with mild disability (grades 4, 5, and 6) showed a higher odds ratio than those with severe dis ability (grades 1, 2, and 3) for all subtypes.

DISCUSSION

In this study, the obesity rates of the people with physical disability were higher than those of the people without disabilities. And the obesity rate can manifest in different ways depending on the disability types. This is because the body functions that are maintained, the range of movements, and the extent of dietary restrictions due to impairment vary by disability type. In other words, while the odds ratio of the obesity rate for those with an upper-limb disability, who have few restrictions on physical activities but some limitations in dietary activities, was low, the odds ratio of the obesity rate for those with a lower-limb or spinal cord injury, who have many restrictions on physical activities but maintain functions required for dietary activities, was high. According to a 2008 report of the Ministry of Health and Welfare, while the basic activities of daily living (ADLs) of those with spinal cord injury stayed at a low level, ranging from 36.3% to 76.9%, the ADLs of those with upper-limb disability was maintained at a relatively high level, ranging from 85.4% to 97.2%. Also, in the case of upper-limb disability, the proportion of those with amputation and/or deformation below the elbow as well as joint dysfunctions, and therefore relatively few restrictions on physical activities, stood at 76.4%. That is, in the case of those with upper-limb disability, the extent of physiological changes and decrease in physical activity due to disability is considered to be not great enough to have a significant impact relative to people without disabilities. Also, considering the positive correlation between the degree of physical activity and energy metabolism, it is deemed that the energy metabolism of those with upper-limb disability is not substantially different from that of people without disabilities [18]. Meanwhile, restrictions on physical activities in the case of those with upper-limb disability can lead to limitations in dietary activities, which can also mitigate the influence of upper-limb disability on obesity rate. The results of this study did not reveal a significant differ-

ence between the obesity rates of people with upper-limb disability and those of the people without disabilities, and showed that the influence of disability on obesity was not statistically significant in this group. This is likely due to the characteristics of upper-limb disability, which allow relative ease in performing whole-body physical activities while imposing limitations on dietary activities.

On the other hand, the obesity rates of people with lower-limb disability or spinal cord injury were significantly higher than those of the people without disabilities. People with lower-limb disability maintain physical functions for eating but their physical activities are restricted in many ways. People with spinal cord injury, who are mostly wheelchair-bound in daily living, also have low-level abilities to perform physical activities, with weaker muscle strength and flexibility than people without disabilities [19]. Even in the case of acquired disabilities, it was observed that most people with spinal cord injury are noticeably weaker than people without disabilities of the same gender and the same age groups in terms of muscle strength, flexibility, cardiopulmonary functioning, and so forth, which may indicate lower energy metabolism due to disability [7]. In other words, people with lower-limb disability or spinal cord injury are more vulnerable to obesity since their overall physical activity is largely restricted, together with low energy metabolism, while they more or less maintain physical functions for eating. High obesity rates of those with lower-limb disability and wheelchair-bound people with spinal cord injury have already been reported in many studies, supporting the results of this study [20,21].

This study has identified characteristic changes in the obesity rate by grade of disability. The odds ratio of the obesity rate was low in the case of severe disabilities (grades 1, 2, and 3) but higher in the case of mild disabilities (grades 4, 5, and 6), confirming vulnerability to obesity in the case of those with mild disabilities. It was found that even in the case of those with the same disability type, the influence on obesity rate varies, depending on the extent of restrictions on physical and dietary activities as well as differences in energy metabolism in accordance with grade of disability. In the case of people with severe disabilities, they tend to exert more energy during physical activities due to activity impairment caused by combinations of problems in vision, hearing, and static sense, and have difficulties in eating due to lowered cognitive function and a weakened state of consciousness [22-24]. In other words, people with severe disability show low obesity rates because of decreased calorie intake due to restrictions on physical activities and increased consumption of energy during physical activities. On the other hand, people with mild disabilities show high obesity rates because they maintain dietary activities with relatively few restrictions on physical activities and consume less energy during physical activities due to metabolism adjusted to disability. The reason why the odds ratio of the obesity rate is higher in the case of those with mild disabilities appears to be that there is a qualitative change in energy metabolism in addition to a quantitative decrease in physical activities due to physical disability. However, it is notable that the odds ratio of the obesity rate among people with lower-limb disability or spinal cord injury is lower in the case of grade 4 or milder disabilities while the odds ratio of the obesity rate among people with upper-limb disability tends to be higher as the degree of disability becomes milder. This appears to be because, in the case of people with lower-limb disability or spinal cord injury, while maintaining abilities for dietary activities regardless of grade of disability, those with grade 4 or milder disabilities tend to recover abilities for physical activity. In contrast, those with upper-limb disability, tend to recover abilities for dietary activities as the degree of disability is milder.

Obesity rates showed a decreasing trend as the duration of disability becomes longer, and this trend was more prevalent in the case of those with lower-limb disability. We can consider three possibilities for these observations. First, 97% of physical disability is due to acquired factors. That is, there is a possibility of increased health vulnerability due to disability, when we consider that temporary or permanent impairment in physical, mental, behavioral, cognitive, and/or social functions is caused by acquired damage and increases the need for healthcare services. Second, there is a possibility that the obesity rate is lowered as the difference from people without disabilities in terms of health-promoting behaviors becomes smaller with stabilization of the disabled state. Third, there is a possibility of an increased obesity rate due to characteristics of BMI, which tend to increase with age, and changes that come with aging. In the case of people aged 65 or older, a significant difference in obesity rates was not observed between the people with and without disabilities.

In this study, it was observed that the obesity rates of people with physical disability tend to be higher as the grade of health insurance contributions becomes higher; in other words, as the income level rises. However, the difference in the

obesity rates between the people with and without disabilities was greater in the low-income group and the group with poor health behaviors. Considering that low levels of education and household income increase restrictions on the physical activity of elderly people and that the socioeconomic status of people with disabilities tends to be relatively lower than that of people without disabilities, a combination of disabilities and low socioeconomic status can have a synergistic effect on obesity rate. The phenomenon of increasing obesity rate in accordance with income level has already been reported in many studies, and in this study, statistically significant differences in obesity rate were observed between those under an employee health insurance plan and those under a self-employed health insurance plan, with the employees showing higher obesity rates than the self-employed.

In this study, high obesity prevalence of people with disabilities was identified, and the influence of existence and degree of disability on obesity was evaluated. Furthermore, the need to consider metabolic and behavioral changes by type of disability and by grade of disability for understanding obesity in the people with disabilities was confirmed. This study has laid a foundation for establishing an effective strategy of intervention by identifying an intervention point to prevent obesity in the disabled through an analysis considering socioeconomic factors and characteristics by disability type.

While the data used in this study encompass the nation's whole population and provide objective information such as measurements of weight and height, they have the following limitations:

First, we need to acquire data on people with disabilities who were excluded from the NHI mass screening. Participation rates in the mass screening in 2008 were 67.4% in those with spinal cord injury, 63.6% in those with upper-limb disability, 59.9% in those with lower-limb disability. The rates also depend on socioeconomic factors and grade of disability. Considering the results of previous studies that showed that the participation rates in the NHI mass screening are lower in women, elderly people, and people with mobility impairment and/or severe disability, more effort will be required in future studies to acquire broader mass screening data that includes the recipients of healthcare services who were excluded from the NHI mass screening.

Second, given the restriction of resources, only some limited information on physical activities and dietary habits could be utilized without access to more specific information. In addition, there was a failure to consider various factors related to physical activities that include socioeconomic factors such as lack of resources to improve health and restricted accessibility, which are known to be major factors that restrict physical activity.

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

REFERENCES

1. Korea Centers for Disease Control and Prevention. Korea health statistics 2009: Korea National Health and Nutrition Examination Survey (KNHANESIV-3). Seoul: Ministry of Heath and Welfare; 2010, p. 48 (Korean).
2. Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J, et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA 2002;288(21):2709-2716.
3. Foreyt J, Goodrick K. The ultimate triumph of obesity. Lancet 1995;346(8968):134-135.
4. Ford ES. The metabolic syndrome and mortality from cardiovascular disease and all-causes: findings from the National Health and Nutrition Examination Survey II Mortality Study. Atherosclerosis 2004;173(2):309-314.
5. World Health Organization; World Bank. World report on disability. Geneva: World Heath Organization; 2011, p. 61.
6. Liou TH, Pi-Sunyer FX, Laferrere B. Physical disability and obesity. Nutr Rev 2005;63(10):321-331.
7. Bruffaerts R, Demyttenaere K, Vilagut G, Martinez M, Bonnewyn A, De Graaf R, et al. The relation between body mass index, mental health, and functional disability: a European population perspective. Can J Psychiatry 2008;53(10):679-688.
8. Doshi JA, Polsky D, Chang VW. Prevalence and trends in obesity among aged and disabled U.S. Medicare beneficiaries, 1997-2002. Health Aff (Millwood) 2007;26(4):1111-1117.
9. Kim HS, Kim YS. The effect of depression on the quality of life in elderly with disability. J Hum Soc Sci 2009;22:183-215 (Korean).
10. Lee EK. Effects of art therapeutic education for children with severe cerebral palsy [dissertation]. Seoul: Kookmin University; 2002 (Korean).

11. Havercamp SM, Scandlin D, Roth M. Health disparities among adults with developmental disabilities, adults with other disabilities, and adults not reporting disability in North Carolina. Public Health Rep 2004;119(4):418-426.
12. Diab ME, Johnston MV. Relationships between level of disability and receipt of preventive health services. Arch Phys Med Rehabil 2004;85(5):749-757.
13. Kim HO, Joung KH. A Study on the needs of health & community services among the disabled at home in rural areas. J Korean Acad Community Health Nurs 2007;18(3):480-491 (Korean).
14. National Health Insurance. The analysis of medical benefits in the people with disability and development of stratigies for strenthening the medical insurance. Seoul: Ministry of Health and Welfare; 2005, p. 94 (Korean).
15. Park JH. Factors affecting the participation rate of the mass screenings of the disabled of national health insurance [dissertation]. Seoul: Seoul National University; 2006 (Korean).
16. Korea Centers for Disease Control and Prevention. Sample design: Korea National Health and Nutrition Examination Survey (KNHANESIV-4). Seoul: Ministry of Health and Welfare; 2007, p. 23 (Korean).
17. Hong SW. Factors influencing Health-related quality of life in Korean medicaid beneficiaries. J Korean Acad Nurs 2009; 39(4):480-489 (Korean).
18. Kim MS. Regulators of enegy metabolism. Korean J Obes 2000;9(3):6-11 (Korean).
19. Buffart LM, van den Berg-Emons RJ, van Wijlen-Hempel MS, Stam HJ, Roebroeck ME. Health-related physical fitness of adolescents and young adults with myelomeningocele. Eur J Appl Physiol 2008;103(2):181-188.
20. Manns PJ, McCubbin JA, Williams DP. Fitness, inflammation, and the metabolic syndrome in men with paraplegia. Arch Phys Med Rehabil 2005;86(6):1176-1181.
21. Kim IA, Kim DM, Han MK. Effects of physical activity participation and sedentary life style on obesity in individuals with spinal cord injury. J Adapt Phys Act 2010;18(1):67-77 (Korean).
22. Kashihara M, Nakao S, Kawasaki J, Takata S, Nagahiro S, Kaji R, et al. Long-term outcome of severe stroke patients: is the ADL status at discharge from a stroke center indicative of the long-term outcome? J Med Invest 2011;58(3-4):227-234.
23. Oh AR, Min JH. Search for components of rehabilitation program for stroke disabled person. Korean J Exerc Rehabil 2005; 1(2):65-73 (Korean).
24. Kuo HK, Leveille SG, Yu YH, Milberg WP. Cognitive function, habitual gait speed, and late-life disability in the National Health and Nutrition Examination Survey (NHANES) 1999-2002. Gerontology 2007;53(2):102-110.