# 한국 노인의 비만과 신체적 기능제한과의 관련성

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이 논문을 보건학 석사 학위논문으로 제출함

2001년 12월 일

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# 신용경의 보건학 석사 학위논문을 인준함

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2001년 12월 일

# 감사의 말씀

무엇보다 감사 드릴 분은 부족한 능력으로 학위논문을 완성할 수 있게 도와주시고, 또 나의 마음과 뜻을 움직여 주신 하나님입니다. 그리고 항상 옆에서 바쁜 나를 이해해주고 불평 없이 도와준 아내의 사랑과 시간을 내어 함께 놀아주지 못한 아이들에게 감사를 드립니다.

논문을 준비하는 과정에서 부족한 능력과 여러 어려움이 있어 늦게 준비한 제게 격려해주시고, 또 여러 가지로 배려해 주신 지 선하 교수님께 존경과 감사를 드립니다. 논문의 내용과 방향에 대해 많은 조언과 관심을 보여주시고 도와주신 이 윤환 교수님, 그리고 김 광민 교수님께 깊은 감사를 드립니다. 늦게 준비하여 여러 모로 결례를 끼쳐 드린 것에 대해 너그러이 이해해주시고 지켜봐 주신 것에 또한 감사 드립니다. 또한 자료를 이용할 수 있게 도와 주신 한국 보건사회연구원에 감사 드립니다.

짧지 않은 대학원 과정을 통해 많은 지식을 쌓으려고 노력하였으나 통계에 관한 부분에 대해 여전히 부족한 제게 통계의 어려움을 해결해 주신 정 혜영 선생님께 지면을 빌어 감사 드립니다.

그리고 저를 가르쳐 주셨던 여러 보건대학원 교수님들께 또한 감사를 드리며, 함께 시간을 했던 원우들의 그 동안의 관심과 도움에 감사 드립니다.

저에게 가정의학의 길을 열어주시고, 수련의 기간동안 많은 가르침과 믿음의 길로 인도해주신 존경하는 이 혜리 교수님께 깊은 감사를 드리며, 영동 세브란스 가정의학과 심 재용 교수님과 교실원 여러분께 또한 감사를 드립니다.

비만에 대해 무지한 저에게 학문적으로 이끌어 주시고, 가르쳐 주셨던 김 상만 교수님께 존경과 감사를 드립니다. 그리고 그 동안 관심으로 지켜봐 주시고 도와주셨던 아주대 병원 가정의학과 교실원 모두에게 감사를 드립니다.

끝으로 항상 저희 가정을 믿음의 길로 인도해주시고, 부족한 영작을 고쳐주시느라 애쓰신 Pastor Hanna께 깊은 감사를 드립니다.

감사의 글을 적으면서 이렇게 제 주위에 도와 주시는 분들이 많이 계심을 새삼 느끼게 되어 행복하며, 다시 한번 감사한 마음으로 인사드리며 신앙인으로서, 의사로서 앞으로 더욱 정진하는 모습으로 살아가도록 하겠습니다.

2001년 성탄절이 다가오는 즈음
신 용경 올림

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# 국문요약

본 연구는 1998년 한국보건사회연구원에서 실시한 국민건강 영양조사의 자료를 기초로 한국 노인의 기능제한의 실태를 알아보고자 하였으며 비만지표로서 체질량지수를 이용하여 비만군에서 기능제한이 정상군에 비해 더 증가하는지를 알고자 하였다. 또한  비만군에서 비만과 관련된 질환의 유병율이 정상군에 비해 증가하는지 알고자 하였고, 여러 비만 관련 질환의 동반유무가 기능제한과 어떤 관련성이 있는지를 알아보고 한국 노인에게 있어 기능제한에 영향을 미치는 인자와 가장 잘 예측할 수 있는 비만지표를 알고자 하였다.

본 연구의 대상자는 국민건강 영양조사를 받은 65세 이상 노인 대상자 3084명 중에서 신체검사 및 보건의식 행태의 면접을 함께 받은 대상자 920명을 선택하였다. 그리고 수단적 일상생활 수행능력과 기초 일상생활 수행능력 10가지 항목에서 어느 한 항목이라도 각 각 '매우 어렵다', '전혀 할 수 없다', 또는 '도움이 필요하다', '전혀 할 수 없다'라고 대답한 사람을 기능제한이 있는 것으로 분류하였다.

본 연구에서는 비만 지표로 흔히 쓰이는 체질량지수, 허리 둘레, 및 허리와 둔부 둘레의 비가 각 각에 있어 여섯가지 기초 및 네가지 수단적 일상생활 수행능력 중 한가지 이상의 기능제한 발생위험 정도를 잘 반영하는지를 파악하고, 이들 중에서 어떠한 비만지표가 노인에게 있어 기능제한을 잘 예측할 수 있는지를 분석하였다. 또한 문헌 고찰을 통해 비만관련 질환으로 제 2형 당뇨, 고혈압, 고지혈증, 허혈성 심질환, 중풍, 관절염을 선정

하였고, 그 외 영향을 미칠 수 있는 변수들을 선정하여 기능제한을 예측하는데 도움이 되는 변수를 로지스틱 회귀분석을 통해 파악하였다. 그리고 비만정도에 따라 비만관련질환 중 동반질환의 증가와 기능장애가 서로 상관관계가 있는지를 조사하였다.

이 연구는 노인에게서 삶의 질의 지표인 수단적 일상생활 수행 능력과 일상생활 수행능력의 제한 유무가 과체중이나 비만에 의해 비만과 관련된 동반 질환의 증가와 연관되는지를 알아 기능제한의 예방 및 비만 관련 동반질환의 증가 예방을 위해 노인에게서도 체중조절의 필요성을 제기하고자 하였으며, 다음과 같은 결과를 얻었다.

1. 일반적 특성상 여자는 남자에 비해 교육정도가 낮았으며, 배우자가 없는 사람이 더 많았으며(3명 중 2명), 무직율이 낮았고, 더욱 우울한 경향을 보였으며, 양호한 주관적인 건강인식도가 낮은 것으로 나타났다.

2. 65세부터 84세까지 한국 노인인구에 있어 수단적 일상생활 수행능력과 기초 일상생활 수행능력 10가지 항목에서 어느 한 항목이라도 기능제한이 있는 것에 대한 전체 유병율은 9%(남자: 7.7%. 여자: 9.8%)였으며, 이는 미국 자료인 11%에 비해 낮은 결과를 보였다.

기초 일상생활 수행능력에서는 남자 5.4%, 여자 3.5%의 기능제한의 유병율을 보였으며 통계학적으로 유의한 차이가 있었다 ($P < .05$). 그러나 수단적 일상생활 수행능력에서는 여자 9.6%, 남자 7.7%로서 여자가 보다 높은 기능제한의 유병율을 보였으나 통계학적인 유의성은 없었다.

3. 남녀의 과체중 및 비만의 유병율을 비교해보면, 체질량지수에 의한 NHLBI 분류기준에 따라 과체중은 남자10.9%, 여자 30.3%로 약 3배 가량 여자가 높았으며, 비만은 여자에게서만 2.6%의 유병율을 보였다. 정상군은 남자 73%, 여자 58.5%였으며, 저체중군은 남자 16.1%, 여자 6.8%였다.

이는 남자에게서는 과체중보다는 저체중이 더 보건학적인 관심사가 되어야겠으나, 여자에게서는 3명중 1명이 과체중이상으로 나타나 이에 대한 보건학적인 관심이 필요함을 보였다.

통계학적인 유의성은 없었지만, 체질량지수에 따른 비만군의 기초 일상생활 수행능력의 기능제한이 생길 수 있는 로지스틱 회귀 분석상의 비차비 즉 위험도가 7.89배 높은 것으로 결과를 보였다. 이는 비만 여성노인에게서 정상체중 유지가 기초 일상생활 수행능력의 기능제한 발생을 예방하는데 관련성이 있음을 시사할 수 있었다.

4. 비만 지표로 흔히 쓰이는 체질량지수, 허리 둘레, 및 허리와 둔부 둘레의 비가 각 각에 있어 여섯가지 기초 및 네가지 수단적 일상생활 수행능력 중 한가지 이상의 기능제한 발생위험 정도를 잘 반영하는지를 파악하였는데, 수단적 일상생활 수행능력과 전체 일상생활 수행능력 중 한가지 이상의 기능제한 발생에 대해서 통계학적으로 유의하게 나온 비만 지표는 체질량지수였다 (표 7, 8). 즉, 수단적 일상생활 수행능력 중 한 가지 이상의 기능제한 발생에 대한 위험도에서 통계학적으로 유의하지 않았지만, 위험도를 잘 반영하는 결과가 나온 비만지표는 체질량지수에 따른 비만군이 4.5배 높은 것을 보여줌으로서 이들 비만 지표 중에서 체질량지수가 비만 노인에게 있어 기능제한을 잘 예측할 수 있음을 알 수 있었다. 그리고 모든

기능제한의 유병율이 가장 낮은 체질량지수는 정상체중군 중 22-24.9군 이였으며, 다른 변수들을 통제한 로지스틱 회귀분석에서도 통계학적인 유의성은 없지만, 22-24.9군이 수단적 일상생활 수행능력에 있어 위험도가 가장 낮았다.

5. 비만정도에 따라 비만관련질환 중 동반질환의 증가와 기능제한이 서로 상관관계가 있는지를 조사하였는데, 체질량지수가 정상보다 증가하면 할수록 비만 관련질환 중 동반질환이 2가지 이상인 경우의 유병율이 점차 증가함을 알 수 있었다. 저체중군과 비교하면 8-10배 가량 높은 것을 알 수 있었으며, 3가지 이상의 동반질환이 있을 경우 기초 일상생활 수행능력에서 기능제한이 올 위험도가 5.4배 높은 것으로 나타났으나, 통계학적인 유의성은 없었다 (표 7, 8).

6. 마지막으로 일상생활 수행능력에서의 기능장애에 대한 예측인자를 로지스틱 회귀분석을 통해 분석하였다 (표 8). 통계학적으로 유의한 예측인자로서 청각 장애가 있는 군이 29.91배, 시각 장애가 있는 군이 14.74배, 비만 관련 질환 중 뇌졸중이 15.47배, 무직군이 직업이 있는 군에 비해 13.53배, 우울한 군이 4.6배 높은 것으로 나타났다. 따라서 이러한 인자에 대한 적극적인 예방 또는 치료 노력이 노인에게서의 기능장애를 예방하거나 늦추는데 중요할 것으로 생각된다. 그리고 통계학적인 유의성은 밝혀지지 않았지만, 비만 관련 질환 중 3가지 이상 동반 될 경우 기능장애의 위험도가 5.4배, 비만인 노인에게서 7.9배 높은 것으로 나타나 비만 노인에게 있어서도 체중조절이 기능제한의 예방 및 지연에 관련성이 있음을 알 수 있었으며,

**또한 기능적인 면을 고려한 한국 노인에 맞는 체질량 지수의 비만 기준이 필요할 것이며 앞으로 이에 대한 보다 규모가 큰 전향적인 연구가 필요 할 것이다.**

# I. Introduction

Obesity, which is the major risk factor of chronic diseases, is becoming a common health problem of elderly in developed countries (National Heart, Lung, and Blood Institute and National Institute of Diabetes and Digestive and Kidney Diseases, 1998), (Seidell JC, 1995), (Gofin J, 1996), (Kuczmarski RJ, 1994), and also one of major concerns of health promotion in Korea as the average life expectancy is increasing and the number of older adults is expanding (Ministry of Health and Welfare, 1999).

The aging of Korean society and the concomitant increase in the prevalence of disability have sparked increasing interest in understanding the determinants of physical disability among the aged. Researches conducted over the past decades has established clear evidence of obesity as the major risk factor of developing chronic diseases such as cardiovascular disease (Pinsky JL, 1984). And also these metabolic consequences of obesity in the elderly are associated with a range of chronic diseases such as hypertension, type II diabetes mellitus, hyperlipidemia, ischemic heart disease, stroke, and arthritis (Pi-Sunyer FX. 1991), (Pi-Sunyer FX. 1993), (Han TS, 1997), (Lindeman RD, 1998), (Kotz CM, 1999), (Hazzard WR, 1999). Aging and obesity are both positive determinants of the metabolic syndrome, which

involves hyperinsulinemia or insulin resistance and is associated with glucose intolerance, dyslipidemia, and hypertension (Chan JC,1996). Therefore, they are accepted as the major cause of morbidity and disability in the elderly, and these effects may be intensified by the aging process itself or the change in body composition with age (Chang MY, 1999).

Further more, being overweight in an elderly condition is associated with increased comorbidity, and the presence of multiple chronic diseases is often used as another marker of frailty. Not surprisingly, comorbidity is associated with increased risk of adverse outcomes and significantly increased physical disability compared with those without diseases. Consequently obesity may advance the aging process (Hazzard WR, 1999).

Previously some studies suggested that increased Body Mass Index(BMI) was a weak predictor of death, but a strong predictor of early disability, which increased linearly with BMI. Though being modestly overweight has little impact on mortality, it predicts severe functional impairment. Therefore, a high BMI is an important contributor to disability and should be a major concern in the attempt to compress morbidity in later years (Rissanen A, 1990), (Launer LJ, 1994), (Ensurd KE, 1994). But some other studies suggested that obesity in the elderly is not a significant factor because it does not have a significant effect on total mortality and cardiovascular mortality

(Diehr P, 1998) . Although these findings are important, they did not address what older people value most-the ability to perform daily activities. Why? Because there is a high prevalence of disability in the elderly and the issue of functional status assumes increasing importance. In addition, data on the relationship between comorbidity of obesity-related diseases and functional status in the elderly is sparse.

Therefore, in this study, we examined that obesity effects the functional status of the Korean elderly through comorbidity of obesity related diseases such as hypertension, type II diabetes mellitus, ischemic heart disease, stroke, and arthritis. And we would like to raise the issue that the prevention of obesity which affects the comorbidity of chronic disease and functional status of the elderly, is essential for the preserving of their functional status and the enhancement of their quality of life.

# II. Research Methods

## 1. Research Framework

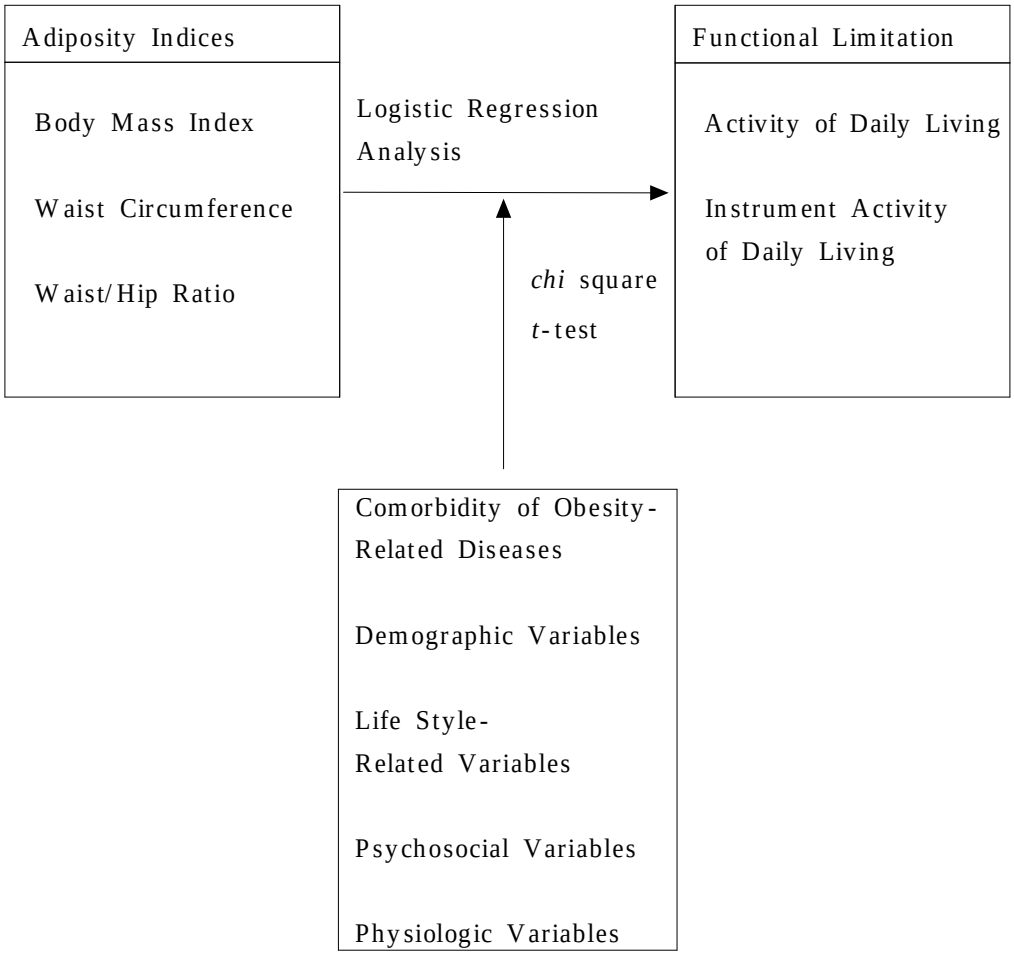


**Fig 1. Research Framework**

## 2. Study Population and Measures

The Korean Health and Nutrition Examination Survey(KHANES) is a large national survey conducted by the Korea Institute for Health and Social Affairs (KIHSA) from November 1 through December 31, 1998, that collected information on the health status of the Korean civilian community from the age 1 and older. KHANES data was collected via standardized questionaires that were administered by interviewers, examiners at participants' homes, and physical examinations and laboratory tests that were conducted at KHANES mobile examination centers. Of the 43,682 people invited to participate, 90.8% completed this survey (Ministry of Health and Welfare, 1999).

The sample for our analyses includes 920 of 3084 women and men, age 65 to 84, who completed all the Health Interview Survey, the Health Examination Survey, the Health Behavior Survey. We used the age 65 as our lower age cutoff because it represents an age associated with changes in lifestyle and used the age 84 as our upper age cutoff to minimize differences in comorbidity that occur in very old people (Corti MC, 1999).

### 2.1 Study Variables

With reference to the review article by Stuck et al. (Stuck AE,

1999), six demographical variables, six physiological variables including three obesity indices, two psychosocial variables, three life style-related variables and comorbidity variables (obesity related diseases) were selected in this study as independent variables (Table 1).

### 2.1.1 Sociodemographic variables

Sociodemographic variables were age, gender, living with spouse, education, occupation and income. Age was categorized as 65-69, 70-74, and 75- 84 years, and then finally as young old: 65-74 and old old: 75-84 years. Education was also assessed as the lowest educational level achieved and categorized as less than six years, or seven-twelve years. Occupation was assessed as an unemployed person. Annual income was estimated by a monthly income (WON) for one year converted into US $.

### 2.1.2 Physiological variables

Hearing impairment in this study was defined to include the following survey response: trouble hearing a loud voice or greater. Vision impairment was defined as including the following survey response: can not discriminate a person at a distance of one meter or less, blind. Weight change of 5% during the past year was also defined to include the following survey response: have weight loss about 4-5Kg or more.

### 2.1.3 Psychosocial variables

Self-rated health was defined to include the following survey response: very good, good. Depression was assessed by the following survey response: always depressed.

### 2.1.4 Life style-related variables

We assessed about life style-related variables such as current smoking status, current alcohol drinking status and the percent of no physical activity.

## 2.2. Adiposity Indices

### 2.2.1 Body Mass Index (BMI)

Height and weight were measured using standard tehnique (Ministry of Health and Welfare, 1999). As an index of obesity, body mass index (BMI) was calculated as weight (in kilograms) divided by the square of the height (in meters).

Six categories on the basis of BMI were determined according to the 1998 clinical guidelines for the treatment of overweight and obesity from the National Heart, Lung, and Blood Institute (NHLBI): lower than 18.5, underweight; 18.5 through 24.9, normal; 25.0 through 29.9,

overweight; 30.0 or higher, obesity and so on (National Heart, Lung, and Blood Institute and National Institute of Diabetes and Digestive and Kidney Diseases, 1998). We modified these categories to six categories: lower than 18.5, underweight; 18.5 through 21.9, low normal; 22.0 through 24.9, normal; 25.0 through 26.9, mildly overweight; 27.0 through 29.9, severely overweight; 30.0 or higher, obesity. We divided the normal group (18.5 through 24.9) into 18.5 through 21.9 and 22 through 24.9 based on the study that diagnosed the malnutrition when the BMI was less than 22. And we also divided the overweight group (25 through 29.9) into mildly overweight(25 through 26.9) and severely overweight (27 through 29.9) base on the study that mortality was affected when the BMI was over 27.( Landi F, 1999)

### 2.2.2 Waist Circumference

Waist circumference was also used as the index of the body fat distribution and was measured using a standard technique (Ministry of Health and Welfare, 1999).

Three waist circumference groups were determined according to WHO guidelines, which were derived from the study by Lean et al. (Lean MEJ, 1995). Waist circumference in the Waist Group 1 is <94 cm for men and <80 for women. Waist Group 2 ranged from 94 to 101 cm for men and 80 to 87 cm for women. Waist Group 3 is ≥102 cm for men and ≥88 cm for women. We have designated these three groups

as normal, borderline, and high.

### 2.2.3 Waist Hip Ratio

Waist and hip circumferences were measured using standard techniques.

## 2.3. Comorbidity of Obesity Related Diseases

In the Health Interview Survey, obesity related diseases were determined by asking participants if they had ever been told by a doctor that they had the following : hypertension, type II diabetes mellitus, ischemic heart disease, stroke, and arthritis. But hyperlipidemia was deleted from the history of the Health Interview Survey, therefore it was defined as the total cholesterol count of 240 mg/dL or over in the Health Examination Survey.

A blood sample was collected when the subject was in a fasting state.

## 2.4. Functional status

Functional status was measured by the Katz index of activities of daily living(ADLs): walking, feeding, bathing, toileting, dressing, continence, and instrumental activities of daily living(IADLs): housekeeping, using public transportation(bus), telephone calling, going

out or shopping.

An interviewer administered a questionnaire to determine the participants self-reported difficutly in performing ADLs. The response to each item was designated ; 1) can do it alone, 2) difficult but can do it alone, 3) needs help, 4) can't do it at all in six basic ADLs, 1) not difficult, 2) some difficulty, 3) very difficult, 4) can't do it at all in four IADLs. But the item of continence was assessed to include the following survey response; 1) one or more weekly, 2) 2-3 times monthly, 3) one or less monthly.

Functional independence was defined as needs no assistance or assistance in one activity; partial disability was defined as needs assistance in two to four activities; and total disability was defined as needs assistance in five more activities. Categorization followed Katz's recommendation (Katz, 1963). And functional limitation was defined as needs assistance in any ADLs or any IADLs.

### 3. Statistical Analysis

Data was first analyzed by descriptive statistics. Continuous variables are presented as mean values ± standard deviation. Age- and gender-specific prevalence figures for sociodemographic variables, obesity related diseases, comorbidity, and functional limitation were calculated. *Chi*-square tests were used to determine the statistical significance of the trend of increasing functional limitation with age and

to compare the prevalence between women and men and *t*-tests were used to obtain frequencies, mean, standard deviation, and differences for continuous variables. A $P < .05$ level was chosen for statistical significance. Age was entered as the dichotomous variables (65-74 years vs 75-84 years). Functional limitation was dichotomized into no assistance versus needs assistance in one or more activities. Logistic regression models with any ADL limitation, and any IADL limitation as the dependent variable was used to calculate odds ratios and 95% confidence intervals for the association of factors with functional limitation.

The Statistical Analysis System (SAS Institute, Cary, NC), a statistical package program, was used for analysis of the data.

# III. Results

## 1. Sociodemographic Characteristics

Table 1. Sociodemographic Characteristics Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)

| Variable | Women (n = 571) | | Men (n = 349) | |
|---|---|---|---|---|
| | n | Percent | n | Percent |
| Age (years) | | | | |
| 65-69 | 233 | 40.8% | 156 | 44.7% |
| 70-74 | 184 | 32.2% | 119 | 34.1% |
| 75-84 | 154 | 27.0% | 74 | 21.2% |
| Age (Mean ± SD) | 71.6±5.0 | | 70.8±4.6 | |
| Living with spouse | 184 | 32.2%† | 311 | 89.1% |
| Education | | | | |
| ≤6 years | 535 | 93.7%† | 240 | 68.8% |
| 7-12 years | 36 | 6.3% | 109 | 31.2% |
| Occupation (not being engaged in work) | 252 | 44.1%† | 188 | 53.9% |
| Annual income (< 10,000 US$) | 381 | 67.7% | 254 | 72.8% |
| Self-rated health (good or more)* | 179 | 32.9%† | 144 | 42.6% |
| Depression* | 136 | 25.0%† | 41 | 12.1% |
| Current smoking status* | 92 | 16.9%† | 177 | 52.4% |
| Current alcohol drinking status* | 72 | 13.2%† | 162 | 47.9% |
| Physical activity (no exercise) | 77 | 14.2% | 68 | 20.1% |
| Visual impairment | 37 | 6.5% | 16 | 4.6% |
| Hearing impairment | 21 | 3.7% | 10 | 2.9% |
| Weight change of 5% or over during the past 1 year | 92 | 16.9% | 48 | 14.2% |
| Any functional limitation | 56 | 9.8% | 28 | 8.0% |
| Any limitation in ADLs‡ | 20 | 3.5% | 19 | 5.4% |
| Any limitation in IADLs | 55 | 9.6% | 27 | 7.7% |
| BMI Kg/㎡ (Mean ± SD)¶ | 23.7±3.5 | | 21.5±2.8 | |
| Waist circumference (Mean ± SD) | 82.9±9.9† | | 81.2±8.7 | |
| Waist/Hip ratio (Mean ± SD) | 0.89±0.07 | | 0.91±0.07 | |
| ADL score (Mean ± SD) | 0.1±0.5 | | 0.2±0.9 | |
| IADL score (Mean ± SD) | 0.3±0.8 | | 0.2±0.9 | |
| Number of Comorbidity (Mean ± SD) | 1.1±0.9 | | 0.6±0.8 | |

* Missing data for 38 persons: 27 women and 11 men

ADL: Activity of Daily Living (range 0-6); IADL: Instrumental Activity of Daily Living (range 0-4); Number of Comorbidity (range 0-6). For all these scores, a higher number indicates higher dependent.

† $P < .01$ ‡ $P < .05$ ¶ $P < .0001$

Weight change of 5% during the past year was defined as had weight loss about 4-5Kg or

more.

## 2. Prevalence Rates of Obesity Related Diseases by Age and Gender

Table 2. Prevalence per 100 Population of Self-Reported History of Obesity Related Diseases Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)

| Obesity related diseases | Women (n = 571) | | | Men (n = 349) | | |
|---|---|---|---|---|---|---|
| | 65-74 Years | 75-84 Years | All | 65-74 Years | 75-84 Years | All |
| Type II diabetes mellitus | 9.8 | 8.9 | 9.5 | 10.5 | 6.8 | 9.7 |
| Hypertension* | 27.1 | 20.5 | 25.0 | 16.7 | 17.6 | 16.9 |
| Hyperlipidemia† | 18.7 | 17.1 | 18.4 | 5.1 | 8.1 | 5.4 |
| Ischemic heart disease | 2.4 | 2.1 | 2.3 | 2.9 | -‡ | 2.3 |
| Stroke | 4.1 | 5.5 | 4.4 | 5.1 | 8.1 | 5.7 |
| Arthritis† | 54.9 | 49.3 | 53.1 | 22.2 | 27.0 | 23.2 |
| None of disease† | 24.0 | 30.8 | 26.3 | 49.8 | 52.7 | 50.4 |
| One of six diseases† | 44.6 | 41.1 | 43.4 | 39.3 | 35.1 | 38.4 |
| Two of six diseases† | 23.5 | 21.9 | 22.9 | 9.5 | 9.5 | 9.5 |
| Three or more of six diseases† | 7.9 | 6.2 | 7.4 | 1.5 | 2.7 | 1.7 |

* P=0.004 when women compared with men

† P=0.001 when women compared with men

‡ No men had ishemic heart disease in 75-84 years

Hyperlipidemia was deleted from the history in the Health Interview Survey, it was defined as total cholesterol 240 mg/dL or over in health examination survey.

## 3. Prevalence Rates of Functional Limitation by Age and Gender

Table 3. Prevalence per 100 Population of Self-Reported Functional Limitation and Disability in Activities of Daily Living According to the Katz ADL Index Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)

| | Women (n = 571) | | | Men (n = 349) | | |
|---|---|---|---|---|---|---|
| | 65-74 Years | 75-84 Years | All | 65-74 Years | 75-84 Years | All |
| Limitation in ADL[§] | | | | | | |
| Bathing[†] | 0.5 | 2.0 | 0.9 | 1.5 | 9.5 | 3.2 |
| Dressing* | 0.7 | 2.0 | 1.1 | 1.8 | 10.8 | 3.7 |
| Going to toilet[‡] | 0.7 | 3.3 | 1.4 | 0.4 | 9.5 | 2.3 |
| Walking | 1.2 | 3.3 | 1.8 | 1.1 | 10.8 | 3.2 |
| Continence[¶] | 0.5 | 6.5 | 2.1 | 0.4 | 12.2 | 2.9 |
| Feeding[†] | 0.2 | 2.0 | 0.7 | 0.7 | 9.5 | 2.6 |
| Disability (Katz index) | | | | | | |
| No disability[¶] | 99.0 | 96.1 | 98.1 | 98.5 | 87.8 | 96.2 |
| None | 98.3 | 91.6 | 96.5 | 97.1 | 85.1 | 94.5 |
| One | 0.7 | 4.5 | 1.6 | 1.4 | 2.7 | 1.7 |
| Partial disability[¶] | 0.7 | 2.6 | 1.3 | 1.5 | 2.7 | 1.8 |
| Two | 0.5 | 1.3 | 0.7 | 0.7 | 2.7 | 1.2 |
| Three | - | 0.65 | 0.2 | - | - | - |
| Four | 0.2 | 0.65 | 0.4 | 0.7 | - | 0.6 |
| Disability[¶] | 0.2 | 1.3 | 0.6 | - | 9.5 | 2.0 |
| Five | 0.2 | 0.65 | 0.4 | - | 2.7 | 0.6 |
| Six | - | 0.65 | 0.2 | - | 6.8 | 1.4 |

*$P < .01$ when women compared with men

[†] $P < .05$ when women compared with men

[‡] $P < .05$ when old old compared with young old in women

[¶] $P < .01$ when old old compared with young old in women and men.

[§] $P < .01$ when old old compared with young old in men.

There is no significant statistical difference between women and men in Katz index of ADL

**Table 4. Prevalence per 100 Population of Self-Reported Functional Limitation in Single Instrumental Activities of Daily Living Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)**

| | Women (n = 571) | | | Men (n = 349) | | |
|---|---|---|---|---|---|---|
| | 65-74 Years | 75-84 Years | All | 65-74 Years | 75-84 Years | All |
| **Functional Limitation in IADL** | | | | | | |
| Housekeeping | 4.1 | 5.8 | 4.6 | 3.3 | 16.2¶ | 6.0 |
| Telephone calling | 2.6 | 12.3* | 5.3 | 2.2 | 13.5¶ | 4.6 |
| Using public transportation | 7.0 | 14.3† | 8.9 | 4.7 | 18.9¶ | 7.7 |
| Outgoing or Shopping | 5.8 | 8.4 | 6.5 | 2.9 | 16.2¶ | 5.7 |
| **Number of Functional Limitation in IADL‡** | | | | | | |
| None | 92.8% | 83.7 | 90.6% | 95.3 | 81.1¶ | 92.3 |
| 1 | 1.2% | 3.4% | 1.8% | 0.7 | 1.4¶ | 0.9 |
| 2 | 1.4% | 4.1% | 2.1% | 1.1 | 2.7¶ | 1.4 |
| 3 | 2.9% | 4.1% | 3.2% | 1.45 | 1.4 | 1.4 |
| 4 | 1.7% | 4.1% | 2.3% | 1.45 | 1.4 | 4.0 |

*P=0.001 when old old compared with young old in women

† P=0.006 when old old compared with young old in women

‡ P=0.009 when old old compared with young old in women

¶ P=0.001 when old old compared with young old in men

There is no significant statistical difference between women and men in IADL

## 4. Sex Specific Prevalence Rates of Functional Limitation and Comorbidity of Obesity Related Diseases by Adiposity Indices

Table 5. Prevalence per 100 Population of Self-Reported Funtional Limitation and Comorbidity by Adiposity Indices Among 349 Community Dwelling Men Aged 65-84 Years (KHANES, 1998)

| | n | Any Limitation in ADLs | Any Limitation in IADLs | Any Functional Limitation | 5+ Functional Limitation | Morbidity (n = 1) | Co-morbidity (n ≥ 2) |
|---|---|---|---|---|---|---|---|
| **Body Mass Index** | | | | | | | |
| < 18.5 | 56 (16.1%) | 5.4 | 10.7 | 10.7 | 3.6 | 11.9 | 5.4 |
| 18.5-21.9 | 154 (44.1%) | 6.5 | 7.8 | 7.8 | 5.2 | 37.7 | 8.5 |
| 22-24.9 | 101 (28.9%) | 4.0 | 5.0 | 5.0 | 4.0 | 41.6 | 13.9 |
| 25-26.9 | 29 (8.3%) | 6.9 | 10.3 | 13.8 | 3.6 | 41.4 | 24.1 |
| 27-29.9 | 9 (2.6%) | - | 11.1 | 11.1 | - | 66.7 | 22.2 |
| ≥ 30 | - | - | - | - | - | - | - |
| **Waist Circumference** | | | | | | | |
| < 94 | 317 (90.8%) | 5.1 | 7.3 | 7.3 | 4.1 | 36.6 | 10.7 |
| 94-101 | 28 (8.0%) | 10.7 | 14.3 | 17.9 | 7.1 | 53.6 | 17.9 |
| ≥ 102 | 4 (1.2%) | - | - | - | - | 75 | - |
| **Waist/Hip Ratio** | | | | | | | |
| < 0.9 | 166 (47.6%) | 4.8 | 7.2 | 7.2 | 3.6 | 34.3 | 7.8 |
| ≥ 0.9 | 183 (52.4%) | 6.0 | 8.2 | 8.7 | 4.9 | 42.1 | 14.2 |

**Table 6. Prevalence per 100 Population of Self-Reported Funtional Limitation and Comorbidity by Adiposity Indices Among 571 Community Dwelling Women Aged 65-84 Years (KHANES, 1998)**

| | n | Any Limitation in ADLs | Any Limitation in IADLs | Any Functional Limitation | 5+ Functional Limitation | Morbidiy (n = 1) | Co-morbidity (n ≥ 2) |
|---|---|---|---|---|---|---|---|
| **Body Mass Index** | | | | | | | |
| < 18.5 | 39 (6.8%) | 2.6 | 5.1 | 7.7 | 2.6 | 38.5 | 2.6 |
| 18.5-21.9 | 152 (26.6%) | 2.6 | 8.6 | 8.6 | 1.3 | 40.1 | 21.0 |
| 22-24.9 | 182 (31.9%) | 2.8 | 8.8 | 8.8 | 1.1 | 41.2 | 33.0 |
| 25-26.9 | 102 (17.9%) | 2.0 | 6.9 | 6.9 | 1.0 | 43.1 | 45.1 |
| 27-29.9 | 72 (12.6%) | 5.6 | 13.9 | 13.9 | 2.8 | 58.3 | 34.7 |
| ≥ 30 | 24 (4.2%) | 16.7 | 29.2 | 29.2 | 16.7 | 45.8 | 37.5 |
| **Waist Circumference** | | | | | | | |
| < 80 | 235 (41.2%) | 4.3 | 10.6 | 11.1 | 2.1 | 40.9 | 18.7 |
| 80-87 | 149 (26.1%) | 2.0 | 5.4 | 5.4 | 1.3 | 43.6 | 34.9 |
| ≥ 88 | 187 (32.8%) | 3.7 | 11.8 | 11.8 | 2.7 | 46.5 | 41.2 |
| **Waist/Hip Ratio** | | | | | | | |
| < 0.8 | 61 (10.7%) | 4.9 | 6.6 | 8.2 | 1.6 | 44.3 | 18.0 |
| ≥ 0.8 | 510 (89.3%) | 3.3 | 10.0 | 10.0 | 2.2 | 43.3 | 31.8 |

## 5. Relationship between Obesity and Fuctional Limitations, and Relationship between Comorbidity and Fuctional Limitations

Table 7. Prevalence per 100 Population of Self-Reported Funtional Limitation and Comorbidity by Adiposity Indeces Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)

| | n | Any Limitation in ADLs | Any Limitation in IADLs | Any Functional Limitation | 5+ Functional Limitation | Morbidity (n = 1) | Co-morbidity (n ≥ 2) |
|---|---|---|---|---|---|---|---|
| **Body Mass Index** | | | | | | | |
| < 18.5 | 95 (10.3%) | 3.2 | 8.4† | 9.5‡ | 3.2 | 32.6* | 4.2* |
| 18.5-21.9 | 306 (33.3%) | 4.6 | 8.2† | 8.2‡ | 3.3 | 38.9* | 14.7* |
| 22-24.9 | 283 (30.8%) | 3.2 | 7.4† | 7.4‡ | 2.1 | 41.3* | 26.1* |
| 25-26.9 | 131 (14.2%) | 3.1 | 7.6† | 8.4‡ | 1.5 | 42.8* | 40.5* |
| 27-29.9 | 81 (8.8%) | 4.9 | 13.6† | 13.6‡ | 2.5 | 59.3* | 33.3* |
| ≥ 30 | 24 (2.6%) | 16.7 | 29.2† | 29.2‡ | 16.7 | 45.8* | 37.5* |
| **Waist Circumference** | | | | | | | |
| <80(women) <94(men) | 552 (60.0%) | 4.7 | 8.7 | 8.9 | 3.3 | 55.5 | 14.1 |
| 80-87(women) 94-101(men) | 177 (19.2%) | 3.4 | 6.8 | 6.8 | 2.3 | 45.2 | 32.2 |
| ≥ 88(women) ≥ 102(men) | 191 (20.8%) | 3.7 | 11.5 | 11.5 | 2.6 | 47.1 | 40.3 |
| **Waist/Hip Ratio** | | | | | | | |
| <0.8(women) <0.9(men) | 227 (24.7%) | 5.1 | 4.0 | 7.5 | 3.1 | 37.0 | 10.6 |
| ≥ 0.8(women) ≥ 0.9(men) | 693 (75.3%) | 3.2 | 5.9 | 9.7 | 2.9 | 43.0 | 27.1 |

* P= .001

† When any limitation in IADL estimated, BMI was only significant obesity index in three obesity indices ($P < .01$).

‡ When any functional limitation estimated, BMI was only significant obesity index in three obesity indices ($P < .05$).

## 6. Predictors for Functional Limitations

Table 8. Multivariate-Adjusted Odds of Self-Reported Functional Limitation in ADL and IADL Among 920 Community Dwelling Women and Men Aged 65-84 Years (KHANES, 1998)

| Characteristics | Functional Limitation in ≥1 Ativity of ADL OR (95% CI) | | Functional Limitation in ≥1 Activity of IADL OR (95% CI) | |
|---|---|---|---|---|
| Age | | | | |
| 65-74 | 1.0 | | 1.0 | |
| 75-84 | 2.87 | (0.88-9.32) | 1.31 | (0.54-3.18) |
| Sex | | | | |
| Women compared with men | 0.39 | (0.07-2.08) | 1.38 | (0.47-4.00) |
| Living with spouse (without spouse) | 5.31 | (1.02-27.48) | 4.78 | (1.68-11.94) |
| Occupation (Unemployed) | 13.53 | (2.17-84.42) | 8.42 | (2.98-23.77) |
| Self-rated health (good or more) | 0.51 | (0.12-2.21) | 0.87 | (0.36-2.10) |
| Depression | 4.60 | (1.50-14.33) | 5.59 | (2.52-12.40) |
| Visual impairment | 14.74 | (3.89-55.90) | 82.07 | (27.23-247.38) |
| Hearing impairment | 29.91 | (5.58-160.37) | 66.81 | (11.40-391.59) |
| Current alcohol drinking status | 0.66 | (0.16-2.72) | 0.70 | (0.25-1.95) |
| Obesity related disease | | | | |
| Type II diabetes mellitus | 0.64 | (0.11-3.87) | - | |
| Hypertension | 0.76 | (0.17-3.40) | - | |
| Hyperlipidemia | 0.31 | (0.03-2.88) | - | |
| Ischemic heart disease | - | | - | |
| Stroke | 15.47 | (3.78-63.36) | - | |
| Arthritis | 0.52 | (0.14-1.97) | - | |
| Number of comorbidity | | | | |
| None | 1.0 | | - | |
| One of six disease | 1.96 | (0.56-6.89) | - | |
| Two of six disease | 0.25 | (0.03-2.12) | - | |
| Three or more of six disease | 5.35 | (0.78-36.69) | - | |
| BMI | | | | |
| <18.5 | 0.13 | (0.01-2.61) | 0.36 | (0.06-2.04) |
| 18.5-21.9 | 1.63 | (0.24-11.15) | 0.75 | (0.24-2.32) |
| 22-24.9 | 0.39 | (0.05-3.01) | 0.42 | (0.12-1.44) |
| 25-26.9 | 1.0 | | 1.0 | |
| 27-29.9 | 1.29 | (0.12-14.33) | 1.19 | (0.32-4.42) |
| ≥30 | 7.89 | (0.77-81.00) | 4.49 | (0.91-22.24) |
| Waist Circumference | | | | |
| Group 1 | 0.95 | (0.15-6.00) | 1.68 | (0.52-5.45) |
| Group 2 | 1.0 | | 1.0 | |
| Group 3 | 1.17 | (0.15-9.29) | 1.98 | (0.58-6.84) |
| Waist/Hip Ratio | | | | |
| <0.8(female) or <0.9(male) | 1.0 | | - | |
| ≥0.8(female) or ≥0.9(male) | 1.23 | (0.36-4.25) | - | |

* Missing data for 38 persons: 27 women and 11 men

OR; Odds ratio, CI; Confidence Interval

Sociodemographic characteristics are presented in Table 1. Half of the subjects were still living with their spouse, with a significantly percentage higher (about 60%) of men when compared to women ($P <$ .001). There were significant differences in the level of education, therefore, men had a higher education level than did women ($P <$ .01). Women had a significantly lower self-rated health level than did men, and were more depressed and showed lower current smoking status and current alcohol drinking status ($P <$ .01).

As shown in the Table 1, the mean BMI of women was significantly higher than that of men ($P <$ .0001). And the mean waist circumference of men was significantly lower than the cutoff points of action level 1 (94 cm for men), but that of women was higher than the cutoff points of action level 1 (80 cm for women) ($P <$ .01) (Lean MEJ, 1995).

Prevalence of any limitation in ADLs of men was significantly higher than those of women ($P <$ .05). The overall prevalences of visual impairment and hearing impairment were 5.8% and 3.5% respectively.

Among the 920 persons included in the study population, 27 women and 11 men were missing from the data of sociodemographic characteristics on self-rated health, depression, current smoking status and current alcohol drinking status.

Prevalences of obesity related diseases are presented in Table 2. Women were more prevalent in hypertension, hyperlipidemia and

arthritis than were men ($P < .01$). And there was significantly higher comorbidity of obesity related diseases when women were compared with men ($P < .01$). When there was a prevalence of two or more obesity related diseases in women, comorbidity rates were significantly higher (about three fold) than those of men ($P < .01$). The prevalence of six obesity related diseases such as diabetes, hypertension, stroke, ischemic heart disease, arthritis, and hyperlipidemia did not change signifiacantly with age in either gender. Although not significant statistically, the proportion with three or more obesity related diseases did not change with age in women, but increased in men.

Table 3 shows the prevalence of limitation in single activities of the Katz ADL scale and disability of Katz. The prevalence of partial disability in ADL increased with age: 0.7% for young old women (aged 65 to 74 years); 2.6% for old old women(aged 75 to 84 years) and 1.5% for young old men; 2.7% for old old men ($P < .01$). The men were more limited in dressing ($P < .01$), bathing and feeding ($P < .05$). But when men were compared with women, the prevalence of disability of the Katz index was not significantly different statistically because the population of each disability group was few in number.

The prevalence of limitation in all single activities of IADL scale are presented in Table 4. When old old women compared with young old women, old old women were more dependent than were young old women in activities such as telephone calling ($P < .01$), using public

transportation ($P < .05$). And in each number of IADL limitation, there were significant statistical differences in each age group of women ($P < .01$). In men, the prevalences of limitations in all single activities of IADLs and the numbers of functional limitation in IADL were increased with age ($P < .01$). But there was no significant difference statistically between women and men in IADL.

As shown in the tables 5 and 6, the gender-specific prevalence, per 100 population, for self-reported limitation in ADL and IADL, comorbidity by the adiposity index are presented. When women compared with men in BMI as an obesity index, women were overweight one in three and more obese than men. But three in four men were normal and one in six was underweight. Being underweight in men was a more common health problem than obesity because no men were obese.

Table 7 shows the overall prevalence, per 100 population, for self-reported limitation in ADL and IADL, and comorbidity by the adiposity indices. As BMI increased, the prevalence, per 100 population, of any functional limitation in a major activity increased and two or more comorbidity of obesity related diseases was increased.

The results of the multivariate adjusted odds of ADL limitation and IADL limitation are shown in table 8. Logistic regression analysis was performed to examine the predictor and the effect of potential confounders in the relationship between body mass index and functional

limitation. The significant predictors in ADL limitation and odds (95% CI) were 1) hearing impairment; 29.91 (5.58-160.37), 2) visual impairment; 14.74 (3.89-55.90), 3) a history of stroke; 15.47 (3.78-63.36), 4) occupation (unemployed status); 13.53 (2.17-84.42), 5) living without spouse; 5.31 (1.02-27.48), 6) depression; 4.60 (1.50-14.33).

And the significant predictors in IADL limitation and odds (95% CI) were 1) visual impairment; 82.07 (27.23-247.38), 2) hearing impairment; 66.82 (11.40-391.59), 3) occupation (unemployed status); 8.42 (2.98-23.77), 4) depression; 5.59 (2.52-12.40), 5) living without spouse; 4.78 (1.68-11.94).

# IV. Discussion

In this cross-sectional study, of prevalence of any functional limitation for performing one or more of six basic and four instrumental activities of daily living among community dwelling Korean women and men aged 65-84 years, the overall rate was 9% (9.8% in women and 7.7% in men respectively).

Though differences in the definition of ADL disability and the elderly populations studied make it difficult to directly compare disability prevalence estimates, the prevalence of self reported limitation in a major activity for Koreans aged 65-84 years was less than the rate found in the elderly of the US; 11% (Kramarow E. 1999). This difference may be due, at least in part, to variations in the response patterns between the two countries. However, if older Korean women and men were found to be at a lower risk of ADL disability than US women and men, then increased understanding of the factors contributing to this difference would be valuable.

Additionally, the prevalence of self reported limitation in performing one or more of six basic ADLs in older Korean women was 3.5%, it was similar with that for older New Zealand women (4.5%) and less than that for US women (11%) (Langlois JA, 1999), and Japanese women(8.6%) (Ishizaki T, 2000). But when compared with older

Japanese men, the percentage was similar; 5.4% vs 5.8%.

The relationship between high BMI and increased prevalence of functional limitation and disability has been widely reported (Hubert HB, 1993), (Ensrud KE, 1994), (Galanos AN, 1994), (Launer LJ, 1994), (Coakley EH, 1998), (Davis JW, 1998). Our study presented similar findings of other investigations. In Korean elderly, being underweight was found to be one in ten, and being overweight or obese was found to be one in four. The overall prevalence of functional limitation in a major activity(ADLs and IADLs) of the underweight was one in ten, but those of the overweight and obese were one in two. Sarkisian and associates (Sarkisian CA, 2000) reported that BMI $\geq$29 is associated with a functional decline in general, a finding that is consistent with the results from several longitudinal studies, and was similar with the results of this study that the prevalence of any functional limitation for obese older Korean women was increased three fold or over as compared with those were underweight. Although not shown statistically significant, odds (95% CI) for functional limitation in one or more activity of ADL and IADL were 7.89 (0.77-81.00), and 4.49 (0.91-22.24) in $\geq$30 BMI group. Therefore, this implies that obese older Korean women need to be much more concerned and put forth effort in regard to weight control for preventing or postponing functional decline.

Furthermore, our findings supported a common finding that there is a significant relationship between obesity and functional limitation

especially in women, but not in men (Pinsky JL, 1985) (Keil JE, 1989) (LaCroix AZ, 1993).

On the basis of the comprehensive model that includes sociodemographical, physiological, psychosocial, and life style related factors, our study identifies significant predictors for functional limitation in major activity among older Koreans. Visual and hearing impairment, unemployed occupational status, living without a spouse, and depression were identified as significant predictors for functional limitation in ADL, and also identified as predictors for functional limitation in IADL. A history of stroke was only a significant predictor among obesity related diseases for functional limitation in ADL.

One of the most interesting findings of this study is that having sensory impairments was identified as the most significant predictors for functional limitation in major activities. This finding was not consistent with other investigations that vision impairment had important consequences on disability and functional limitation, while the role of hearing impairment appears to be less significant (Hazzard, 1999) and that self-reported hearing impairment was not associated with disability in instrumental ADL (Guralnik JM, 1999).

Though we used self-reported hearing and visual impairment, data from other studies (Elliott DB, 1990), (Clark K, 1991), this does correlate with objective information. According to another study (Rudberg MA, 1993), vision and hearing impairment is highly related to

increased functional limitation in major activities. Despite of a wide confidence interval, sensory impairments are the most significant predictors for functional limitation in major activities, and are conclusive risk factors in decreasing or postponing of subsequent ADL and IADL limitation.

The overall prevalences of visual impairment and hearing impairment were 5.8% and 3.5% respectively. When compared with other studies, these rates were relatively lower. Havlik et al.(Havlik, 1986) reported a rate of 10% of visual impairment for the age group of 65-74 years and 23% hearing impairment for the same age group. When compared with a Japanese study, these rates were lower than 11% of hearing impairment, but similar with 3.5% of visual impairment (Ishizaki T, 2000).

When we consider the fact that problems with vision and hearing are common even in those who have otherwise aged successfully, and their synergistic effect of both sensory impairments, more aggressive prevention and treatment are needed. And this is important because impairment in IADLs leads to significant needs for social services, family burden or both, and may be more affected than ADLs by sensory impairment. Consequently, these relationships need to be studied further, and better measures of hearing and visual impairment.

The strong association between ADL limitation and the history of stroke has been reported in previous cross-sectional studies (Ensurd

KE, 1994), (Ettinger WH, 1994), (Guccione AA, 1994), and in this study, higher odds; 15.5 (95% CI 3.78-63.36) were presented. Stroke remains one of the conditions of old age most likely to result in severe disability, hospitalization and nursing home admission. Prevention strategies to reduce the incidence of stroke, and hospital based interventions aimed at reducing the severity and functional consequences of stroke, could have a large impact on reducing the risk of severe disability (Ferrucci L, 1997)

Despite a self-reported history of hypertension and diabetes, when prevalences of these was compared with data from the Framingham Heart Study, the percentage of hypertension in the 65-74 age group was lower; 17% vs 61% in men, 27% vs 69% in women, but that of diabetes was similar; 10.5% vs 10 % in men, 10% vs 6% in women (Lloyd-Jones DM, 1999). But as reported from National Health and Nutrition Examination Survey ( Korea Institute for Health and Social Affairs. Ministry of Health and Welfare, 1999), the overall prevalence of hypertension according to Jointed National Committee (JNC VI) criteria in older Korean was 53.3%. It may be means that the prevalence of hypertension in our study was underestimated because of the using of self reported history or because of including many undiagnosed persons in this study. The fact that the neglect of many Korean elderly in screening and periodic checkup for hypertension is associated with increased prevalence of stroke. It suggests that successful control of

hypertension is need for reducing prevalence of stroke, moreover, for prevention of functional limitation.

Women were more prevalent in arthritis than were men. And when prevalence of arthritis was compared with that of US data age 65 years or older, the prevalence in women was slightly lower; 53% vs 68%, and in men it was less than half; 23% vs 58% (Kotz CM, 1999). Anyway, this finding that overweight women were, more prevalent in having arthritis supported other investigations (Verbrugge LM, 1991) that obesity is a strong and important risk factor in the primary and secondary prevention of osteoarthritis (Spector TD, 1994). Also, studies of risk factors shown that obesity precedes and increases the risk of knee osteoarthritis, especially in women (Felson DT, 1990).

The finding in this study that any functional limitation in major activity and two or more comorbidity of obesity related diseases were increased as increasing BMI was consistent with other studies (Campbell AJ, 1994) (Guralnik JM, 1997) that comorbidity is associated with increased risk of adverse outcomes, as evidenced by higher short- and long-term mortality rates and significantly increased physical disability compared with those without diseases (Hazzard, 1999). Though not shown statistical significant, odds (95% CI) of three or more in six obesity related diseases for functional limitation in one or more ADL was 5.4 (0.78-36.69). This suggest that obesity, a common cause of comorbidity, in older Korean women especially, will be needed

to be controled for decreasing the risk of ADL limitation.

There is controversy about the findings that the relative risk of death associated with adiposity decreases with increasing age, and that the optimal weight for longevity may be higher in older populations. Floidin et al.(Flodin L, 2000) reported that a BMI of 23-25 were independent in all ADL functions. And Calle et al.(Calle EE, 1999) reported that the nadir of the curve for risk of death rates was within the range of body-mass index from 20.5 to 24.9 for all six groups categorized according to age and sex. On the other hand, Allison et al.(Allison DB, 1997) suggested that the relatively high BMI(27-30 for men, 30-35 for women) associated with minimum hazard for all-cause mortality in persons older than seventy years. Although these studies investigated about relationship between BMI and mortality, according to report that functional dependence among older adults is associated with increased mortality (Branch LG, 1980), these findings were applicable to relationship between high BMI and disability. Anyway, we found that optimal BMI group in Korean elderly was 22-24.9 when considering both the prevalence and the risk for any functional limitation in major activities. The finding of the normal BMI associated with minimum hazard in elderly subjects, if confirmed, has important implications for geriatric clinical guidelines. Therefore, a large scale prospective study is needed for clarifying this issue.

There are several limitations to this study. First, because it is

cross-sectional, the cause and effect relationship cannot be determined between the risk factors and limitation in ADL and IADL. Second, among 882 subjects analyzed for the logistic regression, 38 subjects were deleted from the analyses as a result of missing data. Third, these results may not be generalizable to women and men of other ages or ethnic groups. Fourth, these results did not include persons who reported 'difficult but needs no help'. Therefore, in the view of functional difficulty, the results of our study was unable to provide information for functional difficulty, but it may show a higher prevalence for functional limitation. Fifth, this study was not designed to investigate other chronic diseases such as history of hip fracture, falling, or other injury that has been known to be strongly related to functional limitation. Sixth, these results did not include information about the living area. Finally, our study was unable to report on other factors, such as cognitive impairment, strength, gait, and balance that are known to affect on the functional status in the elderly. And this study was limited by the use of self-reported disability, which is a subjective measure of physical function influenced by depressive symptoms, cognitive status, and gender and consequently substantial misclassification may occur.

Despite these limitations, we may suggest that the J-shaped association between overweight and functional limitation may be a result of health consequences of body fatness, and furthermore that,

compared with underweight group of older Korean women, the overweight and obesity groups in older Korean women are especially more strongly associated with functional disability risk. The present findings have implications for the understanding of obesity-functional disability relations, and for further public health recommendations about the weight control issue in the elderly. This study may be useful to assess and develope the method of health examinations which aim to prevent or postpone functional limitation among Korean elderly.

# V. Conclusions

This study showed that women were more prevalent in arthritis, hypertension, hyperlipidemia than men were, more were depressed, had lower educational levels, and more lived alone. In this cross-sectional study, the prevalence of community dwelling Korean women and men aged 65-84 years, for any functional limitation for performing one or more of six basic and four instrumental activities of daily living, was 9% in overall (9.8% in women and 7.7% in men respectively), and it was less than 11% for the older US population

Our study presented the findings that the underweight was one in ten, the overweight was one in four. And the overall prevalence of functional limitation in major activities(ADLs and IADLs) of the underweight was one in ten, but those who were overweight and obese were one in two.

This study shows that the prevalence of any functional limitation for obese older Korean women was increased to three fold or more as compared with that of the underweight. Though not shown statistically significant, the odds for functional limitation in one or more activity of ADL and IADL were 7.89 (0.77-81.00), and 4.49 (0.91-22.24) in $\geq$30 BMI group. Therefore, this implies that obese older Korean women need

to be much concerned and additional efforts for controlling their weight be used for preventing or postponing functional decline. Additionally, our finding supported a common finding that there is a significant relationship between obesity and functional limitation especially in women, but not in men.

Our study identified significant predictors for functional limitation in major activities among older Koreans. Visual and hearing impairment, unemployed occupational status, living without a spouse, and depression were identified as significant predictors for functional limitation in ADL, and also identified as predictors for functional limitation in IADL. A history of stroke was only a significant predictor among obesity related disease for functional limitation in ADL.

This study presents that having sensory impairments were identified as most significant predictors for functional limitation in major activities. Despite a wide confidence interval, sensory impairments were the most significant predictors for functional limitation in major activities and are conclusive risk factors in decreasing or postponing of subsequent ADL and IADL limitation. Consequently, these relationships need to be studied further, and better measurements of hearing and visual impairment.

In this study, higher odds; 15.5 (95% CI 3.78-63.36) were presented in the history of stroke.

We found that any functional limitation in a major activity and two

or more comorbidity of obesity related diseases were increased as the increased BMI. Not shown statistically significant, odds (95% CI) of three or more in six obesity related diseases for functional limitation in one or more ADL was 5.4 (0.78-36.69). This suggested that obesity, a common cause of comorbidity in older Korean women especially, will be needed to be controled for decreasing the risk of ADL limitation.

We found that the optimal BMI group in Korean elderly was 22-24.9 when considering both the prevalence and the risk for any functional limitation in major activities.

Despite several limitations, we may suggest the J-shaped association between overweight and functional limitation. The overweight and obesity groups in older Korean women were especially more strongly associated with functional limitation risk. The present findings have implications for the understanding of obesity-functional disability relations, and for further public health recommendations about weight control issue in the elderly. Conclusively, despite no statistical significance, obesity in old Korean women had high odds. Further research is needed to clarify the excess of disability among obese women. And sensory impairments are conclusive factors for decreasing or postponing of subsequent ADLs and IADLs limitation.

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# ABSTRACT

## The Relationship Between Obesity and Functional Status in Korean Elderly: An Analysis of Korean National Health And Nutrition Examination Survey, 1998

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**OBJECTIVES**: To examine the relationship between obesity and functional status among older(65-84 years) Koreans in community dwelling population and to examine the relationship between comorbidity and the different levels of BMI in older Korean men and women, using the classifications of body mass index(BMI) proposed by the National Heart, Lung and Blood Institute (NHLBI).

**DESIGN**: A cross-sectional, nation-wide population-based study in Korea.

**PARTICIPANTS**: A total of 920 community dwelling women and men, age 65 to 84, who completed both the home questionnaire and medical examination that conducted from November 1 through December 31,

1998.

**MEASUREMENTS**: Type II diabetes mellitus, hypertension, hyperlipidemia, ischemic heart disease, stroke, and arthritis were measured as obesity-related diseases. The proportion of subjects with prevalence of comorbidity of obesity-related diseases and functional limitation by NHLBI classifications was determined. Risks for functional limitation associated with comorbidity of obesity-related diseases and fat distribution were examined using multivariate adjusted logistic regression methods.

**RESULTS**: Among 920 studied subject, 91% were functionally independent, the underweight were one in ten, the overweight were one in four. And the overall prevalence of functional limitation in a major activity(ADLs and IADLs) among underweight was one in ten, but that of overweight or over was one in two. After multivariate adjustment, significant predictors for functional limitation in ADLs and IADLs were vision and hearing impairment, unemployed occupational status, depression, living with spouse, a history of stroke. Though not significantly shown in statistics, comorbidity($\geq$3) of six obesity related diseases had odds of 5.4 times and in obese elderly women the odds were 7.9 times.

**CONLUSIONS**: Despite no statistical significance, obesity in older Korean women had higher odds for functional limitation in ADLs and IADLs. Further research is needed to clarify the excess of disability among obese women. And sensory impairments are conclusive factors for decreasing or postponing of subsequent ADLs and IADLs limitation.

Key words: obesity; functional status; cross-sectional study; comorbidity; the elderly