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ORIGINAL RESEARCH

Prevalence of Metabolic Syndrome According to Causes of Physical Activity Limitation

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Purpose: One cause of metabolic syndrome (MetS) is inactivity. This study analyzed the prevalence of MetS due to causes of activity limitation (AL) in adults over 40 years old.

Paticipants and Methods: Participants included 2885 people aged 40–79 (1198 men and 1687 women) who completed the Korean National Health and Nutrition Survey (KNHANES) conducted between 2013 and 2017. They were divided into two groups based on age: the middle age group (MA) included 1148 total participants, 515 men and 633 women from 40–59 years old; the older age group (OA) included 1737 total participants, 683 men and 1054 women from 60–79 years old. MetS was diagnosed according to the Third Report of the National Cholesterol Education Program and the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NCEP-ATP III). Logistic regression was conducted to calculate the odds ratio for MetS prevalence.

Results: The prevalence of MetS in people with AL increased 1.432-fold in the MA men group, 1.511-fold in the OA men group, 1.546-fold in the MA women group, and 1.565-fold in the OA women group. There were several causes of AL; people with physical activity for diabetes mellitus and hypertension increased MetS prevalence in both sexes and all age groups: MA men group (OR=3.216, 95% CI=1.852–7.354, P=0.034), MA women group (OR=2.159, 95% CI=1.854–5.346, P=0.032), OA men group (OR=3.200, 95% CI=1.235–7.841, P=0.009), and OA women group (OR=3.444, 95% CI=1.310–6.627, P=0.008). Also, mental problems in the MA men group (OR=2.284, 95% CI=1.591–4.986, P=0.012) and OA men group (OR=1.149, 95% CI=1.017–2.941, P=0.012), and musculoskeletal problems in the MA women group (OR=1.784, 95% CI=1.102–2.902, P=0.021) and OA women group (OR=1.459, 95% CI=1.054–1.993, P=0.004) increased the prevalence.

Conclusion: The prevalence of MetS due to activity limitation was increased in MA and OA groups. Activity limitation increased the MetS prevalence from 1.4- to 1.5-times, Therefore, to prevent metabolic syndrome, physical activity should be increased, and guidelines should be presented according to the activity limitation causes, age, and sex.

Keywords: metabolic syndrome, physical activity limitation, prevalence

Introduction

Metabolic syndrome (MetS) increases the risk of cardiovascular disease, but early management helps prevent more serious disease from developing.[1] In 2013, the incidence rate of MetS in Korea was 30.8% in adult men and 26.3% in adult women; it has continued to increase year over year.[2] Risk factors for MetS are similar to those for cardiovascular disease: dyslipidemia, obesity, nutritional imbalance, and low physical activity are modifiable factors, while non-modifiable factors are congenital factors and age. In particular, physical activity is considered an important component of health because it plays a positive role in lowering weight,

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insulin resistance, blood pressure, and increasing high density lipoprotein cholesterol (HDL-C).[3] However, the participant rate of physical activity is low. Guthold et al[4] found that in 2016, 27.5% of people were insufficiently physically activity, with 36.8% in high income Western countries and 35.7% in high income Asian countries.

People tend to have lower physical activity because industrialization and economic development have changed lifestyles with modernization, sedentary lifestyles, and urbanization.[5] Lack of time, facilities, and economic conditions may also limit physical activity.[6] In addition, pain or other physical symptoms from health conditions may limit people's participation in physical activity.[7] In a study by Barbour et al,[8] about 20% of arthritis patients had activity limitation (AL), and the prevalence of arthritis among people with heart disease, diabetes, and obesity was 49.3%, 47.1%, and 30.6%, respectively. This implies a strong relationship between the diseases. Arthritis obviously acts as a limiting factor, but sometimes other diseases may cause or be caused by low physical activity.

Therefore, investigating physical and psychological factors that limit activity and that increase the prevalence of MetS and suggesting appropriate healthcare alternatives may be important to addressing these associations. To date, there is a large amount of literature on AL, but these studies were focused on specific diseases and populations, mostly targeted to older age groups. In addition, few studies have simultaneously analyzed the association between AL factors and MetS.[9] Therefore, this study analyzed causes and rates of AL and the prevalence of MetS, with participants classified as middle age and older, divided by sex.

Participants and Methods

Research Design

This study aimed to analyze the causes and rates of AL and the prevalence of MetS using data from the Korea National Health and Nutrition Survey (KNHANES) conducted between 2013 and 2017. The Korea Centers for Disease Control and Prevention have been conducting KNHANES nationwide surveys since 1988, using a stratified multistage cluster-sampling design to derive a nationally representative sample. KNHANES data complied with the participants' consent and privacy laws. Moreover, this study was approved by the Institutional Review Board (IRB) of the Gangneung-Wonju National University (GWNUIRB-R2020-16) and IRB of the Korea Centers for Disease Control and Prevention (2015–01-02-6C).

Participants

Between 2013 and 2017, the KNHANES survey was conducted on 4426 families in 198 survey districts, and 2960 people aged 4079 (1228 men, 1732 women) participated. Physical activity limitation status was defined as the difficulty encountered by an individual in executing a task or action. Exclusion criteria were (1) under 40 years old and over 79 years old; (2) unclear status regarding the physical activity limitation; and (3) unreliable results from the survey. Of the total 2960, 75 (2.53%) were excluded because they had not completed at least one section of the questionnaire. Thus, a total of 2885 participants were included in the final analysis: the middle age group (MA), between –59 years old and including 515 men and 633 women; and the older age group (OA), between 6–79 years old and including 368 men and 1054 women.

Metabolic Syndrome

MetS was diagnosed using the Third Report of the National Cholesterol Education Program; criteria were based on the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NCEP-ATP III).[10] High blood pressure was based on ≥130/85 mmHg, triglyceride (TG) ≥150 mg/dL, HDL-C men <40 mg/dL, HDL-C women <50 mg/dL, and fasting blood glucose ≥100 mg/dL. Waist circumference (WC) criteria was determined according to standards from the Korean Society for the Study of Obesity, with men ≥90 cm and women ≥85 cm.[11] Participants who took hypertension, dyslipidemia, and diabetes medication were also considered to be diagnosed.

Subjects fasted 8 hours before the test; they stopped consuming caffeine and alcohol, and smoking during that time. A blood sample was collected intravenously by a nurse or medical laboratory technologist. Blood pressure was measured after resting for at least 5 minutes. The position of the arm was the height of the heart, and the cuff was sized to wrap 80% of the arm. The average was used by measuring twice.[12] The participant had their arms at their sides, feet close together, and weight evenly distributed over the feet. Measurement site was at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest.[13]

Physical Activity Limitation Questionnaire

The question studied was "Are you currently restricted in your daily activities and social activities because of health

problems or physical or mental problems?" A total of 16 items were asked regarding AL. Potential answers included musculoskeletal, joint disease, heart, hypertension, diabetes, lungs, dental discomfort, vision, hearing, dementia, anxiety, depression, mental problems, frailty, cancer, and stroke. Participants chose "Yes" or "No" and were able to make multiple choices. The nine items were classified as musculoskeletal, mental, stroke and heart, diabetes mellitus (DM) and hypertension (HTN), cancer, respiratory, vision and hearing, dental, and dementia for analysis in this study. Each item was then divided into AL and non-AL groups. The prevalence analysis considered the presence of AL and the causes of AL. The questionnaire was self-completed, and the research assistant helped the subject when requested.

Statistical Analysis

SPSS (25.0 IBM SPSS, New York, NY) was used for the analysis. General characteristics of participants with the presence or absence of MetS were described using mean and standard deviation by categorizing the sexes and age groups. After a homogeneity of variance test was completed to evaluate normal distribution, independent *t*-tests were performed for continuous variables. Chi-squared test was performed by categorizing men and women with MetS according to the cause of AL, and prevalence analysis was performed using logistic regression. Adjusted variables included age, exercise habits, alcohol consumption, smoking status, and other problems. The significance level for all tests was $P<0.05$.

Results

General Characteristics

Table 1 shows the general characteristics of participants. MetS was 28.3% in the MA men group, 15.2% in the MA women group, 38.9% in the OA women group, and 47.2% in the OA women group. Most factors were significant differences ($P<0.05$) excluding height in the MA group, age, height, and systolic blood pressure (SBP) in the OA men group, and age in the OA women group.

Activity Limitation Rate and Metabolic Syndrome Rate According to Cause

Tables 2 and 3 show chi-squared test results of the cause of AL and the rate of MetS. MetS rates increased in the OA group compared to the MA group. The percentage of MetS was 28.3% in the MA men group, 15.2% in the MA women group, 38.9% in the OA men group, and 47.2% in the OA women group. All causes of AL were significantly different among men of both age groups and the OA women group. The MA men group showed significant differences in musculoskeletal ($P=0.035$), mental problems ($P<0.001$), and DM and HTN ($P=0.009$). The MA women group showed significant results only in DM and HTN; MetS showed 14.5% in non-AL and 46.2% in AL ($P=0.002$). In the OA men group, only DM and HTN were significant; MetS was 37.8% in non-AL and 66.7% in AL ($P=0.003$). In the OA women group, there were significant differences in musculoskeletal ($P=0.003$), stroke and heart ($P=0.002$), and DM and HTN ($P<0.001$).

Metabolic Syndrome Prevalence According to Activity Limitation

Table 4 shows the prevalence of MetS according to cause of AL. The prevalence analysis (Table 4) analyzed AL that were significant in the results of the chi-square test (Tables 2 and 3). The prevalence of MetS in people with AL increased 1.432-fold in the MA men group (95% CI=1.023–2.142, $P=0.041$), 1.511-fold in the OA men group (95% CI=1.109–1.845, $P=0.003$) and 1.565-fold in the OA women group (95% CI=1.201–2.455, $P=0.006$). Musculoskeletal problems showed a significant increase in MetS in the MA men group (OR=1.207, 95% CI=1.102–2.184, $P=0.042$), the MA women group (OR=1.784, 95% CI=1.102–2.902, $P=0.021$), and the OA women group (OR=1.459, 95% CI=1.054–1.993, $P=0.004$). Mental problem resulted in significant prevalence of MetS in the MA and OA men groups; MetS increased 2.284 times in the MA men group (95% CI=1.591–4.986, $P=0.012$) and 1.149 times in the OA men group (95% CI=1.017–2.941, $P=0.012$). Stroke and heart showed significant results only in the OA women group (OR=2.545, 95% CI=1.110–4.859, $P=0.007$). Diabetes mellitus and hypertension showed significant increased prevalence values in all groups, the MA men group (OR=.216, 95% CI=1.852–7.354, $P=0.034$), the MA women group (OR=2.159, 95% CI=1.854–5.346, $P=0.032$), the OA men group (OR=3.200, 95% CI=1.235–7.841, $P=0.009$), and the OA women group (OR=3.444, 95% CI=1.310–6.627, $P=0.008$).

Discussion

MetS is a group of risk factors for cardiovascular diseases such as abdominal obesity, dyslipidemia, high blood pressure, and high glucose.[3,14,15] Experts emphasize that people with MetS should be treated early because they are

Table 1 Participant Characteristics

	Men (n=1198)		Women (n=1687)	
	Non-MetS	**MetS**	**Non-MetS**	**MetS**
Middle age, n (%)	369 (71.7%)	146 (28.3%)	537 (84.8%)	96 (15.2%)
Age, years	51.5±5.9	51.6±5.5*	51.1±5.7	51.7±5.0*
Height, cm	168.9±6.4	169.6±8.1	157.7±5.6	156.8±5.6
Weight, kg	67.8±10.5	75.4±11.3*	58.6±8.9	66.1±10.5*
BMI, kg/m^2	23.7±3.0	26.2±3.3*	23.5±3.2	26.9±3.9*
MetS factors				
SBP, mmHg	118.2±15.1	135.2±15.8*	114.2±15.9	133.5±15.8*
DBP, mmHg	77.9±8.7	88.0±11.2*	74.5±10.0	84.1±9.2*
WC, cm	83.5±8.2	90.5±8.4*	78.5±8.2	88.5±9.4*
Glucose, mg/dL	104.6±34.4	120.3±36.0*	97.1±20.8	116.1±41.1*
TG, mL/dL	158.9±142.4	239.2±162.2*	113.3±73.9	195.9±110.6*
HDL-C, mL/dL	48.5±11.3	43.8±12.2*	54.7±12.3	46.7±7.9*
Older age, n (%)	417 (61.1%)	266 (38.9%)	556 (52.8%)	498 (47.2%)
Age, years	70.6±6.3	70.9±6.2	70.2±6.6	70.8±6.1
Height, cm	164.9±5.9	165.3±5.6	151.3±6.2	151.6±5.8*
Weight, kg	61.8±9.5	68.6±9.5*	54.0±8.2	60.1±9.1*
BMI, kg/m^2	22.7±3.0	25.1±3.1*	23.5±3.1	26.1±3.4*
MetS factors				
SBP, mmHg	124.7±17.1	133.1±16.2	125.6±17.0	135.1±17.1*
DBP, mmHg	72.2±10.0	73.8±11.5*	72.4±10.6	75.0±10.2*
WC, cm	83.0±8.7	91.2±8.0*	81.0±8.6	89.1±8.8*
Glucose, mg/dL	106.8±32.6	119.6±30.9*	100.1±22	116.5±31.9*
TG, mL/dL	123.3±82.3	170.7±97.9*	114.7±61.0	177.5±94.0*
HDL-C, mL/dL	47.8±12.5	41.8±10.8*	52.3±12.0	44.7±9.8*

Notes: Data are presented as mean±standard deviation; * $P<0.05$; test by analysis of independent *t*-tests was performed.
Abbreviations: MetS, metabolic syndrome; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; WC, waist circumference; TG, triglyceride; HDL-C, high density lipoprotein cholesterol.

more likely to develop cardiovascular disease in the future.[16] Mottillo et al[17] found that MetS increased the relative risk for myocardial infarction to 1.99 and to 2.27 for strokes when compared to people without MetS. Physical activity has the role of resolving cardiovascular risk factors such as obesity, improving HDL-C, and managing blood pressure and glucose levels.[18,19]

The American College of Sports Medicine (ACSM) proposed exercise guidelines as a way to prevent cardiovascular disease: at least 150 minutes per week of moderate-intensity aerobic activity or 75 minutes per week of vigorous aerobic activity.[19] However, the physical activity participation rate is relatively low. In the US, about 50–80% of adults fail to do enough physical activity;[20] aerobic exercise participation in Korea decreased from 62.0% for men and 54.7% for women in 2014 to 50.6% for men and 46.6% for women.[21] A study examining the reasons for not participating in physical activity indicated lack of time (70.0%), lack of interest (41.1%), and lack of budget (23.1%).[22] Health problems can also be a reason for limiting participation in physical activity, which is especially noticeable in older people. Previous studies have shown that people with hemiplegia after stroke, 20% of people with arthritis, and 49.6% of COPD have AL.[8,23,24]

The most representative finding of this study was that the prevalence of MetS increased in people with AL at all ages and genders, except for MA women. DM and HTN was the only significant factor that increased MetS in all groups. Previous studies have reported AL from DM and HTN. Our researchers expected that HTN and DM would not limit physical activity, but found that some people did experience limited activities due to the conditions.[25,26] Wu et al[27] found that DM is associated with significantly increased risks in activities of daily living (ADL) and instrumental activities of daily living. This may be due to fear of hypoglycemia and complications. In a previous study, 50% of patients with type 2 DM who had

Table 2 Metabolic Syndrome Rate (%) According to Cause of Activity Limitation in Middle Age

Middle Age	AL	Men (n=515)			Women (n=633)		
		Non-MetS 369 (71.7%)	MetS 146 (28.3%)	*P*	Non-MetS 537 (84.8%)	MetS 96 (15.2%)	*P*
All Causes	Non-AL AL	247 (75.3%) 122 (65.2%)	81 (24.7%) 65 (34.8%)	0.015*	311 (85.9%) 226 (83.4%)	51 (14.1%) 45 (16.6%)	0.382
Musculoskeletal	Non-AL AL	310 (73.6%) 59 (62.8%)	111 (26.4%) 35 (37.2%)	0.035*	411 (85.4%) 126 (82.9%)	70 (14.6%) 26 (17.1%)	0.444
Mental	Non-AL AL	354 (73.4%) 15 (45.5%)	128 (26.6%) 18 (54.5%)	<0.001*	487 (85.6%) 50 (78.1%)	82 (14.4%) 14 (21.9%)	0.115
Stroke and Heart	Non-AL AL	351 (71.8%) 18 (69.2%)	138 (28.2%) 8 (30.8%)	0.779	526 (85.3%) 11 (68.8%)	91 (14.7%) 5 (31.3%)	0.069
Diabetes mellitus and Hypertension	Non-AL AL	365 (72.4%) 4 (36.4%)	139 (27.6%) 7 (63.6%)	0.009*	530 (85.5%) 7 (53.8%)	90 (14.5%) 6 (46.2%)	0.002*
Cancer	Non-AL AL	359 (71.1%) 10 (100.0%)	146 (28.9%) 0 (0.0%)	0.055	523 (84.6%) 14 (93.3%)	95 (15.4%) 1 (6.7%)	0.353
Respiratory	Non-AL AL	360 (71.4%) 9 (81.8%)	144 (28.6%) 2 (18.2%)	0.449	526 (84.7%) 11 (91.7%)	95 (15.3%) 1 (8.3%)	0.505
Dental	Non-AL AL	365 (71.9%) 4 (57.1%)	143 (28.1%) 3 (42.9%)	0.678	532 (85.0%) 5 (71.4%)	94 (15.0%) 2 (28.6%)	0.710
Vision and hearing	Non-AL AL	352 (71.8%) 17 (68.0%)	138 (28.2%) 8 (32.0%)	0.391	516 (84.7%) 21 (87.5%)	93 (15.3%) 3 (12.5%)	0.320
Dementia	Non-AL AL	369 (71.8%) 0 (0.0%)	145 (28.2%) 1 (100.0%)	0.112	537 (84.8%) 0 (0.0%)	96 (15.2%) 0 (0.0%)	1.000

Notes: Data are presented as mean±standard deviation; * *P*<0.05; test by analysis of chi-squared test was performed.

hypoglycemia showed significantly higher fears and lower quality-of-life according to a Hypoglycemia Fear Survey Worry subscale.[28] Furthermore, after 3 years of follow-up in older age, the likelihood of developing ADL disability was reported to be 1.91-times higher in hypertensive patients.[29] Therefore, patients need to attend to risk factor management methods, physical activity consulting, psychological interventions, and emergency management training from experts by participating in educational programs such as cardiac rehabilitation.[30] Recently, healthcare management by smartphone has shown positive results; this may be a good option for people who have difficulty visiting a healthcare center due to distance and time constraints.[31]

As expected, musculoskeletal disease is a cause of AL. Musculoskeletal discomfort is a major cause of pain in all age groups. In particular, lower back pain has an incidence rate of 1.5% to 36.0%, and gradually increases in adulthood through the 60s.[32] Slater et al[33] found that patients with arthritis and back pain had increased cardiovascular disease 1.60- and 146-times, diabetes 1.51- and 1.36-times, and respiratory disease 1.38- and 1.44-times, respectively. This was due to how muscle and joint pain caused AL. AL causes weight gain and muscle weakness and begins a vicious cycle that causes other diseases. Therefore, musculoskeletal patients need to learn exercises such as stretching and yoga through exercise specialists to help resolve muscle joint pain and maintain physical activity.[34]

MA people had the second highest rate of AL due to mental problems. Mental problems, despite the absence of physical problems, gradually constrain external activities because they are accompanied by a lack of self-confidence, weak motivation, low goal consciousness, and interpersonal difficulties.[35,36] Studies have reported that physical activity has a positive effect on mental problems[37,38] and that beta endorphins secreted by the body during exercise have a positive effect on mental health.[39] Therefore, encouraging physical participation through family and social support and physical activity with music will be positive.[40]

Table 3 Metabolic Syndrome Rate (%) According to Cause of Activity Limitation in Older Age

Variables	AL	Men (n=683)			Women (n= 1054)		
Older Age		**Non-MetS 417 (61.1%)**	**MetS 266 (38.9%)**	***P***	**Non-MetS 556 (52.8%)**	**MetS 498 (47.2%)**	***P***
All causes	Non-AL AL	166 (65.6%) 251 (58.4%)	87 (34.4%) 179 (41.6%)	0.042*	213 (61.0%) 343 (48.7%)	136 (39%) 362 (51.3%)	<0.001*
Musculoskeletal	Non-AL AL	291 (63.3%) 126 (56.5%)	169 (36.7%) 97 (43.5%)	0.089	294 (57.5%) 262 (48.3%)	217 (42.5%) 281 (51.7%)	0.003*
Mental	Non-AL AL	401 (60.8%) 16 (66.7%)	258 (39.2%) 8 (33.3%)	0.566	522 (52.2%) 34 (63.0%)	478 (47.8%) 20 (37.0%)	0.123
Stroke and Heart	Non-AL AL	384 (61.8%) 33 (53.2%)	237 (38.2%) 29 (46.8%)	0.185	543 (53.8%) 13 (29.5%)	467 (46.2%) 31 (70.5%)	0.002*
Diabetes mellitus and hypertension	Non-AL AL	408 (62.2%) 9 (33.3%)	248 (37.8%) 18 (66.7%)	0.003*	548 (53.7%) 8 (24.2%)	473 (46.3%) 25 (75.8%)	<0.001*
Cancer	Non-AL AL	397 (60.5%) 20 (74.1%)	259 (39.5%) 7 (25.9%)	0.157	551 (52.7%) 5 (62.5%)	495 (47.3%) 3 (37.5%)	0.579
Respiratory	Non-AL AL	389 (60.3%) 28 (73.7%)	256 (39.7%) 10 (26.3%)	0.100	543 (53.1%) 13 (41.9%)	480 (46.9%) 18 (58.1%)	0.221
Dental	Non-AL AL	412 (61.2%) 5 (50.0%)	261 (38.8%) 5 (50.0%)	0.371	542 (52.6%) 14 (58.3%)	488 (47.4%) 10 (41.7%)	0.621
Vision and hearing	Non-AL AL	373 (61.7%) 44 (56.4%)	232 (38.3%) 34 (43.6%)	0.470	516 (52.5%) 40 (55.6%)	466 (47.5%) 32 (44.4%)	0.580
Dementia	Non-AL AL	412 (61.1%) 5 (55.6%)	262 (38.9%) 4 (44.4%)	0.733	550 (52.8%) 6 (50.0%)	492 (47.2%) 6 (50.0%)	0.848

Notes: Data are presented as mean±standard deviation; * *P*<0.05; test by analysis of chi-square test was performed.

Although this study did not show that vision and hearing problems would further increase MetS, the risk of falls and anxiety may increase, resulting in a reduction in physical activity.[41,42] Vision and hearing are the most basic methods of orienting oneself, and as a person ages, vision and hearing problems can become more serious.[43] Therefore, wearing eyeglasses and proper hearing aids may increase physical activity among older people. The insignificant results in this study were likely due to a low prevalence of MetS due to the small population for prevalence analysis.

One unexpected finding was that AL due to dental problems were found in elderly men. This problem may cause low nutrient intake due to tooth pain and low chewing ability, and will adversely affect health, such as weakness, weight loss, and muscle loss.[44,45] In this regard, dental health of older people is important.

AL can be classified into two categories. First, as a relatively high physical activity, it includes sports, exercise, and labor in the form of labor. The second is relatively low activities and includes important movements such as eating and bathing for basic daily living.[46,47] These limitations can be expressed in terms of activity limitation, restriction, and disability, and active management by experts will contribute to improving the physical and mental health of these individuals. This study has some limitations. There were some limitations in applying statistics because of the relatively low incidence rate of AL subjects. Next, since this was a cross-sectional study, definitively demonstrating the causality of AL and MetS is not possible. Future studies will need to make up for these limitations and clarify the causality of AL and MetS through longitudinal studies.

Conclusion

The prevalence of MetS due to activity limitation was increased in the MA and OA groups. Activity limitation increased the MetS prevalence from 1.4- to 1.5-times, and diabetes mellitus and hypertension induced activity limitation increased MetS prevalence in both sexes and all age groups.

Table 4 MetS Odds Ratio According to Activity Limitation

Variables	AL	Men		Women	
		MetS OR (95% CI)	*P*	MetS OR (95% CI)	*P*
Middle age					
All causes	Non-AL AL	Reference 1.432 (1.023–2.142)	– 0.041*	Reference 1.546 (0.413–1.985)	– 0.142
Musculoskeletal	Non-AL AL	Reference 1.207 (1.102–2.184)	– 0.042*	Reference 1.784 (1.102–2.902)	– 0.021*
Mental	Non-AL AL	Reference 2.284 (1.591–4.986)	– 0.012*	Reference 0.456 (0.012–2.852)	– 0.418
Stroke and heart	Non-AL AL	Reference 1.123 (0.210–2.623)	– 0.841	Reference 1.198 (0.257–2.743)	– 0.441
Diabetes mellitus and hypertension	Non-AL AL	Reference 3.216 (1.852–7.354)	– 0.034*	Reference 2.159 (1.854–5.346)	– 0.032*
Older age					
All causes	Non-AL AL	Reference 1.511 (1.109–1.845)	– 0.003*	Reference 1.565 (1.201–2.455)	– 0.006*
Musculoskeletal	Non-AL AL	Reference 0.781 (0.511–1.986)	– 0.521	Reference 1.459 (1.054–1.993)	– 0.004*
Mental	Non-AL AL	Reference 1.149 (1.017–2.941)	– 0.012*	Reference 0.841 (0.354–1.981)	– 0.521
Stroke and heart	Non-AL AL	Reference 2.001 (0.952–6.419)	– 0.521	Reference 2.545 (1.110–4.859)	– 0.007*
Diabetes mellitus and hypertension	Non-AL AL	Reference 3.200 (1.235–7.841)	– 0.009*	Reference 3.444 (1.310–6.627)	– 0.008*

Notes: Data are presented as odds ratio (95% CI); * $P<0.05$; test by analysis of logistic regression, adjusted for age, exercise habits, alcohol consumption, and smoking status and other problems, was performed.
Abbreviation: OR, odds ratio.

Among the causes of activity limitation, mental problems in MA and OA men groups and musculoskeletal problems in MA and OA women groups increased the prevalence of MetS. Therefore, to prevent metabolic syndrome, physical activity should be increased, and guidelines should be presented according to the activity limitation causes, age, and sex.

Author Contributions

All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflict of interests.

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