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Normal Weight with Central Obesity, Physical Activity, and Functional Decline: Data from the Osteoarthritis Initiative

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Abstract

OBJECTIVES—To identify the risks of the combination of normal body mass index (BMI) and central obesity (normal weight and central obesity (NWCO)) on physical activity and function.

DESIGN—Longitudinal Osteoarthritis Initiative Study.

SETTING—Community based.

PARTICIPANTS—Adults aged 60 and older at risk of osteoarthritis (N= 2,210; mean age 68, range 67.1–69.0) were grouped according to BMI (normal 18.5–24.9 kg/m^2, overweight 25.0–29.9 kg/m^2, obese ≥30.0 kg/m^2). High waist circumference (WC) was defined as greater than 88 cm for women and greater than 102 cm for men. Subjects were subcategorized according to WC (five categories). Subjects with normal BMI and a large WC were considered to have NWCO (n=280, 12.7%).

MEASUREMENTS—Six-year changes in the Physical Component Summary of the Medical Outcomes Study 12-item Short Form Survey (PCS), Physical Activity Scale for the Elderly

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(PASE), and Late-Life Function and Disability Index (LL-FDI) were examined. The association between BMI and WC over 6 years was assessed (reference normal BMI, normal WC). Stratified analyses were performed according to age (60–69; ≥70).

RESULTS—Physical component scores, PASE, and LL-FDI declined with time. Mean PASE scores at 6 years differed between the NWCO group and the group with normal BMI and WC (117.7 vs 141.5), but rate of change from baseline to 6 years was not significantly different (p=.35). In adjusted models, those with NWCO had greater decline in PCS over time, particularly those aged 70 and older than those with normal BMI and WC (time interaction β=–0.37, 95% confidence interval=–0.68 to –0.06).

CONCLUSION—NWCO in older adults at risk of osteoarthritis may be a risk factor for declining function and physical activity, particularly in those aged 70 and older, suggesting the value of targeting those with NWCO who would otherwise be labeled as low risk.

Keywords

obesity; waist circumference; osteoarthritis; disability; physical activity; quality

The worldwide prevalence of obesity in older adults has increased over the past 4 decades[1], making it a significant public health concern. With an aging population[2], it is likely that the overall number of individuals with obesity will continue to increase. Obesity based on body mass index (BMI) has been found to lead to functional decline and disability[3, 4] in cross-sectional and longitudinal studies, accelerating disability[5] and the need for arthroplasty[6] in subjects with knee osteoarthritis (OA).

There is a subset of individuals with obesity, including older adults[7], with a normal BMI but high body fat, who otherwise may not be classified as having obesity[8] but are at high risk of cardiometabolic dysfunction and mortality[9]. Previous cross-sectional studies have identified a relationship between normal BMI and high body fat and disability[10]. It has been further suggested that inflammatory adipokines may contribute to mobility impairment[11]. To the knowledge of the authors of the current study, no longitudinal studies have explored disability in this subgroup of individuals. Identifying this subgroup requires accurate assessment of body fat, which is expensive and clinically impractical outside of research centers[12].

Using other anthropometric measures such as waist circumference (WC) may be an easier and more cost-effective method of identifying central adiposity that is also an independent marker of adverse cardiovascular outcomes[13] and disability[4]. Although obesity and large WC have been independently associated with greater risk of knee replacement,[14] the relationship between normal weight with central obesity (NWCO) in knee OA has not been explored. The addition of other anthropometric measures to BMI may lead to incremental risk assessment and provide an opportunity to identify and intervene in individuals who may be at higher risk of disability. The hypothesis, in a study cohort of OA, is that people with NWCO are at greater risk of functional decline and lack of physical activity over 6 years than those with normal BMI and normal WC.

MATERIALS AND METHODS

Data were used from the Osteoarthritis Initiative, a multicenter, longitudinal, prospective, observational study of OA in adults. Four clinical sites were involved: Baltimore, Maryland; Pawtuckett, Rhode Island; Pittsburgh, Pennsylvania; and Columbus, Ohio. Data collection began in 2004, and the National Institute of Arthritis, Musculoskeletal and Skin Diseases funded the study. Data are freely available at http://oai.epi-ucsf.edu. All centers' institutional review boards, including the Committee for the Protection of Human Subjects at Dartmouth, approved the study for secondary analysis of such data.

Study Subjects

Participants were recruited through mailings, community meetings, and advertisements, and a telephone interview was conducted to determine eligibility. Eligible subjects attended a screening clinic visit at which additional assessments were performed. Information was gathered at the enrollment clinic visit based on questionnaires, interviews, and physical assessments within a 6-week period of subject eligibility. Equal numbers of men and women aged 45 to 79 were recruited from all ethnic backgrounds. Study exclusion criteria consisted of rheumatoid arthritis, bilateral total knee arthroplasty, inability to undergo magnetic resonance imaging, inability to provide blood samples, inability to walk alone, cancer in the past 3 years, comorbidity preventing study participation, local residents, and other research project participation. All subjects completed baseline assessments and were assessed yearly. Full details of study recruitment are available online. Outcome data were assessed at 6-year follow-up.

Three groups of participants were identified: those with clinically significant knee OA at risk of disease progression (progression group), those at high risk of developing clinically significant knee OA (incident group), and a control group without any risk factors. The progression group complained of knee symptoms frequently or had tibiofemoral knee OA according to X-ray. Participants in the incident group were free of baseline OA but had risk factors for OA including age, past knee injury, family history of total knee arthroplasty, and Heberden nodes. The control group had no risk factors for or radiographic evidence of knee OA.

The overall cohort consisted on 4,976 subjects, 2,585 of whom were aged 60 and older (Figure 1). Those with missing measures of adiposity, those classified as being underweight (BMI < 18.5 kg/m^2), and those who died within the 6-year period were excluded. Individuals with incident total knee arthroplasty were also excluded because this could have affected functional outcomes in a different way than not having surgery. The final cohort consisted of 2,210 individuals with a BMI of 18.5kg/m^2 or greater.

Primary Predictors

WC was assessed at the level of umbilicus between the lower rib and iliac crest. Height was measured using a wall-mounted stadiometer, and weight was measured on a calibrated standard balance beam scale wearing light clothing. BMI was calculated as weight (kilograms) divided by height (meters) squared. Obesity was based on National Heart, Lung,

and Blood Institute classifications[15] (underweight < 18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25.0–29.9 kg/m^2, obese ≥30.0 kg/m^2). Central obesity was classified as normal or high according to metabolic syndrome criteria for WC (high values: men >102 cm; women >88 cm). Participants were classified initially into six categories based on combinations of BMI and WC. Participants with a normal BMI and large WC based on aforementioned criteria were classified as NWCO. All obese participants were collapsed into one group for analysis because there were few obese participants with a normal WC.

Dependent Variables

Four outcome variables were assessed, concentrating on physical activity, perceived health, and disability. The Physical Activity Scale for the Elderly (PASE)[16] is a 26-item instrument identifying occupational, household, and leisure activities over the past week that was administered in person. Scores range from 0 to 361, with a mean score in the general population of 103 ± 64.1—higher scores suggesting greater intensity of activity. Suggested ranges for minimally clinically important differences are not available. Subjective health status was measured using the Physical Component Summary (PCS) score of the Medical Outcomes Study 12-item Short Form Survey [17, 18], accounting for more than 90% of the statistical variance of the longer scale. The component scores range from 0 to 100, with higher scores indicating better health status in the domain. Subjects completed questionnaires at home, answering each question on a 5-point Likert scale. Disability was assessed according to self-report using the Late-Life Function And Disability Instrument (LL-FDI)[19], which was based on the Nagi disablement framework[20] in community-dwelling adults. The LL-FDI has two domains that separately evaluate a person's ability to perform daily activities (limitation) and engage in social environments and major life tasks (frequency). Better function is directly related to higher levels of function, on a score of 0 to 100. The 20-m walk test, a timed test in which 20 m at their usual walking speed in an unobstructed corridor that measures functional status in individuals with knee OA[21], was used to assess gait speed. Previous studies of individuals with knee OA show inter- and intrarater reliability correlations ranging from 0.93 to 0.98 [22]. Each instrument was measured at baseline and 1-, 2-, 3-, 4-, and 6-year follow-up except LL-FDI, for which only 4- and 6-year data were available.

Baseline Covariates

Baseline demographic, medical, social, and race characteristics were assessed using self-report questionnaires. Marital status was classified as single or married, with the former encompassing widow, divorced, separated, and never married. Education was classified as high school (with or without graduation), college attendee, college graduate, or postgraduate education. Income was categorized as annual earnings less than $50,000 or $50,000 or greater. Participants who had smoked more than 100 cigarettes in their lifetime were considered smokers. Knee pain was evaluated using the self-report Western Ontario and McMaster University Osteoarthritis Index Pain Scale[23] with a 5-point Likert scale based on a total score of 0 to 20. Higher scores indicate greater pain. The Charlson Comorbidity Index[24] was used to assess comorbidity. Impairment in activities of daily living were determined according to self-report of inability to perform bathing, dressing, eating, getting out of bed, toileting, or walking.

Statistical Analysis

Univariate analyses were used to assess differences between the five groups (normal weight and normal WC, NWCO, overweight and normal WC, overweight and large WC, obese) in all baseline characteristics. Data are presented as means ± standard deviations or counts and percentages. T-tests of unequal variance were used to compare characteristics between high and normal WC within each BMI category at baseline. One-way analysis of variance was used to assess differences between all five weight and WC categories.

The primary aim of this analysis was to assess the association between weight and WC categories at baseline and physical activity and functional outcomes (PCS, PASE, LL-FDI, gait speed) over time (baseline and 1, 2, 3, 4, and 6 years). Linear mixed models were used to test these associations, including weight and WC category and time-main effects in addition to interaction terms between weight and WC and time. In this way, differences at baseline and 6 years could be tested along with differences in change over time between the weight and WC categories. Unadjusted models were used to estimate baseline and 6-year means for each outcome. Each model examined comparisons of mean outcome between normal WC and large WC within BMI category and within time point; comparisons between mean outcome at baseline and 6 years within BMI/WC category; comparisons of mean outcome across all categories within time point; mean change from baseline to 6-years across all BMI/WC categories; and mean change from baseline to 6-years, comparisons between normal and large WC within BMI category. Each of these tests was performed by creating appropriate contrasts of model parameter estimates from the unadjusted models.

Mixed models of outcome over time were adjusted for age, sex, education, race, group type (incident, progression, control), Charlson score, osteoarthritis, and smoking status. Within these models, the main effect of BMI/WC category (representing differences in mean outcome between BMI/WC categories at baseline) and the interaction between BMI/WC category and time (representing differences between BMI/WC categories in change over time of the outcome) were compared. Estimated means for the adjusted models were plotted over time. Adjusted models were fit, unstratified and stratified according to age group, based on the previous analysis suggesting differences in physical function based on age[25]. Stratification of the primary outcomes according to sex was not possible because the sample was predominantly female, the study power was low, and the model did not fulfill its assumptions. Baseline gait speed was also adjusted as a surrogate for sarcopenia in modeling the outcomes of PCS, PASE, and LL-FDI . Sensitivity analyses were used to compare baseline characteristics in those included in and excluded from the study at baseline (time 0); a separate analysis was used to compare participants enrolled in the study with baseline data but no 6-year follow-up information. Data were analyzed using Stata version 12 (Stata Corp, College Station, TX) and SAS version 9.3 (SAS Institute, Inc., Cary, NC). $P<.05$ was considered statistically significant.

RESULTS

Of the 2,210 subjects aged 60 and who fulfilled the inclusion and exclusion criteria, 280 (12.7%) had NWCO. Baseline characteristics are shown in Table 1. The mean age of participants was 68 (range 67.1–69.0), and the majority were white (71.2–93.9%). In each

BMI group, there were more women with large WC than with normal WC, with the NWCO group being 98% female. Knee OA was more prevalent in those with higher BMI and highest in those who were obese. The sensitivity analyses were older, had higher co-morbidity scores, and had higher prevalence of baseline knee OA than those included (Appendix 2).

The estimated means from the unadjusted model are denoted in Table 2. Within each BMI/WC group, there was a significant change from baseline to 6 years for each measure. The difference in change from baseline between five BMI/WC groups reached statistical significance only for gait speed (p=.006). Mean LL-FDI frequency and limitation scores differed between BMI/WC groups at 6-year follow-up.

Figure 2 shows the adjusted estimated means over time for PCS, PASE, and gait speed. The difference between BMI/WC groups over time remained significant for gait speed only (p=.003). Adjusted model results are presented in Table 3. There was a significant decline over time in PCS, and overweight and obese participants with normal or large WC had significantly steeper declines over time than those with normal BMI and WC. Although PASE scores decreased significantly over time, and participants with NWCO had lower follow-up scores than those with normal BMI and WC, no significant differences were observed between BMI/WC groups in rate of decline. Declines in gait speed over time were significantly steeper for overweight participants with normal WC and large WC, as well as for obese participants than for those with normal BMI and WC. LL-FDI frequency score significantly declined over time but not LL-FDI limitation score.

Age-stratified (60–69, ≥70) adjusted model results suggest that the rate of change of PCS, PASE, gait speed, and LL-FDI frequency score decreased more rapidly in those aged 70 and older. PASE scores were lower in those with NWCO than in those with normal BMI and WC in both age groups. LL-FDI frequency scores were lower in all categories other than NWCO. Also, pair-wise difference in change over time appeared significant for PCS only in participants aged 70 and older, with those with NWCO having a steeper decline that those with normal BMI and WC.

DISCUSSION

These findings demonstrate that individuals with NWCO have greater declines in physical activity and physical functioning based on validated instruments than those with normal BMI and WC, particularly those aged 70 and older. These results suggest the importance of assessing WC in individuals with normal BMI to further stratify their risk of functional decline and reduced physical activity.

Previous studies found that individuals with NWCO were at higher risk of disability. A cross-sectional epidemiological study of older adults demonstrated that women, but not men, in this subgroup had a higher risk of functional limitations and activity of daily living limitations[10]. The authors speculated that biological differences between men and women partially explained this phenomenon and that lower muscle mass and quality may also be implicated. In addition, women are at greater risk of mortality in the short term[7], which it

was speculated was due in part to the protective effect of higher muscle mass in men. Although many studies have demonstrated the causal relationship between WC and disability[4], none have highlighted the additive effect of central adiposity in individuals with normal BMI and functional outcomes.

Prior studies have supported the association between adiposity and functional decline[26]. A recent metaanalysis characterized this relationship in older adults[4]. The exact mechanism as to why functional decline occurs remains unclear. It is possible that fat infiltration of muscle leads to poorer muscle quality [27]. The phenomenon of sarcopenic obesity is known to lead to greater functional impairments over time than sarcopenia or obesity alone[28], although the precise definition of sarcopenic obesity is controversial, limiting its routine use in clinical practice[12], and earlier studies did not include muscle quality in examining epidemiological relationships[28]. Gait speed has been suggested as a clinical surrogate for sarcopenia,[29] and the study results demonstrate lower gait speeds at follow-up in all categories, and adjusting for gait speed in the modeling did not alter the estimates. The rate of change in gait speed in individuals with NWCO was no different from that of those without large WC, and is not affected by age, suggesting that this process may occur earlier in this subgroup.

The role of obesity as a risk factor for incidence and progression of knee OA is well established, but the relationship between central adiposity in normal-weight adults and knee OA is not understood. The study results suggest that possible mechanisms may affect the pathogenesis and progression of knee OA and may influence functional decline in adults. These may include the metabolic contribution of central adiposity, possibly including adipokines; biomechanical influences of weight; and high C-reactive protein, interleukin (IL)-6[30], and tumor necrosis factor alpha (TNF-α) levels, which are known to be associated with poor physical function and knee radiographic scores identifying severity of OA in older obese adults[31]. The study results suggest that, although scores decline with age, after adjustment, the rate of decline is higher in those aged 70 and older than in those aged 60 to 69.9, particularly on the PCS and PASE. As expected, there were minimal changes in LL-FDI rates and scores. These differences are not surprising because disability affects older persons more than younger persons.

This study has a number of limitations. First, dropouts from clinical studies have higher degrees of comorbidities and lower socioeconomic status, which may bias the results. Comparison analyses of missing and included subjects were used to explore this effect. The longitudinal models used do not require a participant to contribute data at all time-points to be included in the analysis. Therefore, all available data were included in the analysis and covariates that may be related to likelihood of missing data were included in the adjusted analyses. Such linear mixed-effects models are robust to data that is missing at random. Second, the primary goal of the study from which the data were obtained was to study the natural course of OA. Although the results of this investigation could add to the clinical understanding of the process, the aims could be misaligned with those of the parent study. Third, 6 years of follow-up in an overall healthy population with minimal comorbidity, as evidenced by Charlson Comorbidity Index, may not be long enough to demonstrate appreciable clinical differences. These results may underestimate the stated effect of NWCO on overall function and quality of life, because the cohort was healthier and of higher

socioeconomic status than excluded individuals. Fourth, identification of potential biological markers of inflammation such as IL-1, IL-6 and TNF-α that could mediate the relationship in this overall trajectory[11] could not be assessed. Fifth, because of study power problems, subcategorization of obese subjects according to WC was not possible. Lack of central adiposity in obese subjects could be considered metabolically healthy obesity, a condition that is thought to put people at high risk for adverse outcomes[32]. It unlikely that this would affect the study results. Future longitudinal studies should have adequate study power to assess sex-specific differences in function. It is likely that there are biological differences, further mediated by muscle metabolism, that explain some of these findings. Lastly, ascertainment of body composition was not possible, which would have allowed whether changes in visceral and subcutaneous fat and muscle were associated with such changes in overall function in later life to be discerned.

Older adults with NWCO are at higher risk of decline in physical function and activity. Basing treatment recommendations solely on BMI may represent a missed opportunity to identify individuals at risk of obesity-related complications[33]. WC can be measured in clinical practice; similar to BMI, does not require sophisticated equipment; and can provide additional risk stratification in people with a BMI less than 30.0 kg/m^2. These results highlight the importance of identifying and intervening in this subgroup in clinical practice and counseling them accordingly. Although clinical studies demonstrate the effect of weight loss on physical function in OA, future studies should place additional focus on this poorly recognized subgroup.

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Batsis: UB4HP19206–01–00—Medical Educator (0.15 FTE): Health Resources and Services Administration; grand rounds speaker at Rutland Regional Medical Center, Rutland, Vermont; speaker at the University of Scranton Aging Conference; Clinical Case Review for legal firm Dinse, Knapp, McAndrew LLC. Scherer: NIH, National Cancer institute (NCI) P30 CA 23108, 1UL1TR001086–01, 1P60AR062799; NIH, National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), NIH, National Institute on Drug Abuse (NIDA) R01RA015186, NIH, National Institute of Mental Health (NIMH) R01MH102325, NIH/NIMH R01MH089811, NIH/NIDA R01DA032243–03. Bartels: NIMH; Centers for Disease Control and Prevention, Substance Abuse and Mental Health Services Administration. Dr. Batsis received an honorarium for travel expenses in presenting an educational activity at Rutland Regional Medical Center.

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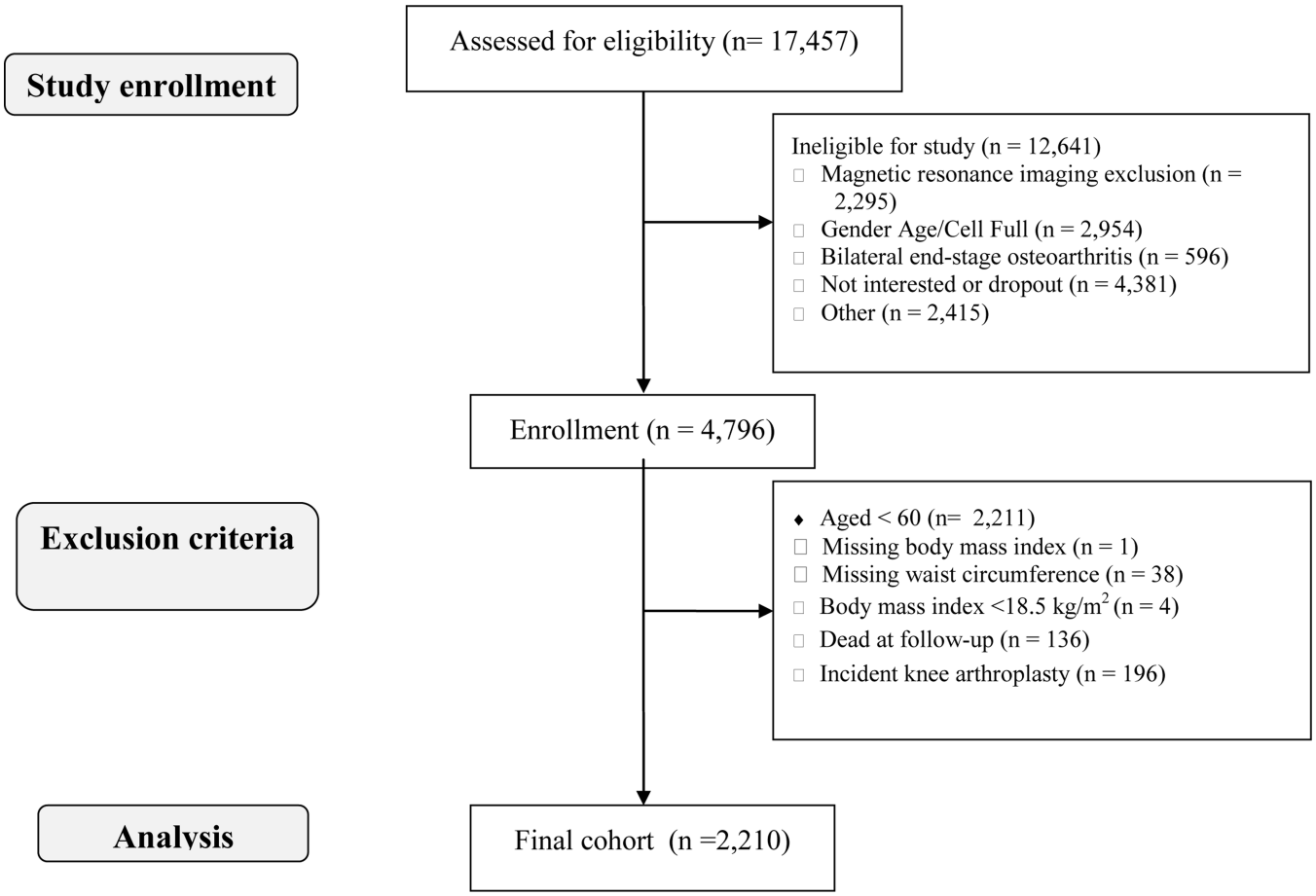

Figure 1.

Flow of 17,457 participants screened in the Osteoarthritis Initiative Protocol from initial telephone screen to cohort included in this study.

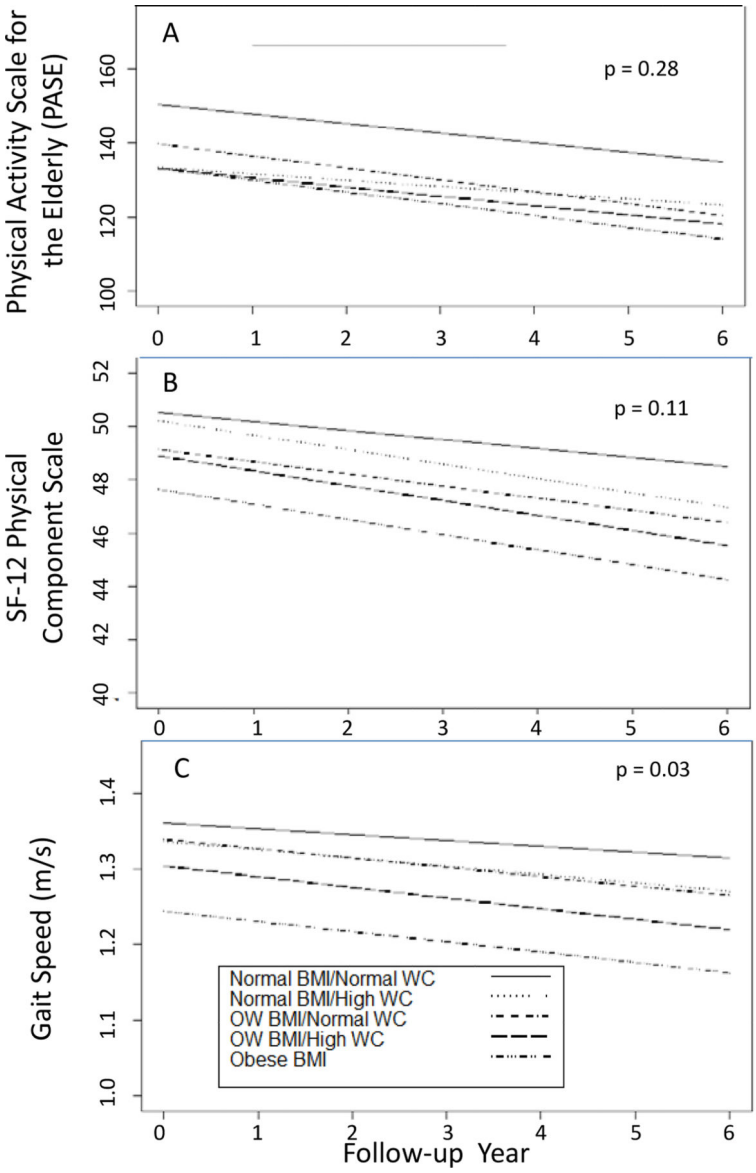

Figure 2.

Estimated means from adjusted longitudinal models of outcome: (A) Physical Activity Scale for the Elderly (PASE), (B) Physical Component Subscale score of the Medical Outcomes Study 12-item Short-Form Survey (SF-12), and (C) Gait Speed; p-values shown are for differences in slope between categories of body mass index (BMI) and waist circumference (WC). BMI was categorized using standard categories (18.5–24.9, 25.0–29.9, ≥30 kg/m^2). WC was categorized according to sex (men ≥102 cm; women ≥88 cm). Combinations are indicated in the legend. Because of study power, obese subjects (BMI ≥30.0 kg/m^2) were not stratified according to waist circumference (large vs normal). OW=overweight.

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Table 1

Baseline Characteristics of Subjects Aged 60 and Older (n= 2,210)

Characteristic	Normal Weight (BMI 18.5–24.9 kg/m^2)			Overweight (BMI 25.0–29.9 kg/m^2)			Obese (BMI ≥30 kg/m^2)	Overall P-Value[d]
	Normal WC	Large WC[a]	P-Value[b]	Normal WC	Large WC[a]	P-Value[b]	High and Normal WC[c]	
	N=255	N=280		N=254	N=677		N=744	
Age, mean±SD	68.4±5.5	69.0±5.6	.21	68.7±5.4	68.8±5.2	.91	67.1±5.2	<.001
Female, n (%)	126 (49.4)	275 (98.2)	<.001	40 (15.8)	476 (70.2)	<.001	467 (62.8)	<.001
Education, n (%)			<.001			.001		<.001
< High school	23 (9.1)	64 (22.9)		35 (13.8)	146 (21.7)		166 (22.4)	
Some college	44 (17.4)	61 (21.8)		47 (18.5)	163 (24.2)		216 (29.2)	
College	51 (20.2)	63 (22.5)		46 (18.1)	125 (18.6)		134 (18.1)	
>College	135 (53.4)	92 (32.9)		126 (49.6)	239 (35.8)		224 (30.3)	
Yearly income >$50,000, n (%)	158 (65.3)	147 (55.9)	.03	158 (64.5)	333 (51.7)	.01	328 (46.7)	<.001
Married, n (%)	182 (71.9)	191 (68.2)	.30	188 (74.0)	451 (66.9)	.05	441 (59.7)	<.001
Race, n (%)			.02			.18		<.001
White	225 (88.2)	262 (93.9)		211 (83.1)	584 (86.3)		530 (71.2)	
Black	19 (7.5)	15 (5.4)		33 (13.0)	79 (11.7)		196 (26.3)	
Charlson Comorbidity Index, mean±SD	0.36±0.78	0.27±0.63	.18	0.49±1.03	0.38±0.8	.11	0.61±1.04	<.001
Baseline Western Ontario and McMaster Universities Osteoarthritis Index, mean±SD								
Right	6.5±8.9	8.5±10.8	.02	8.7±11.7	11.2±13.0	.008	15.2±16.5	<.001
Left	5.9±10.7	8.0±11.3	.02	8.8±13.5	11.0±14.1	.03	14.8±17.1	<.001
Ever smoker, n (%)	117 (46.3)	131 (52.0)	.97	131 (52.0)	351 (52.4)	.96	370 (50.5)	.24
Number of medications, mean±SD	3.24±2.1	3.42±2.31	.40	3.38±2.23	3.81±2.4	.03	4.32±2.60	<.001
Knee osteoarthritis, n (%)	115 (8.6)	143 (10.7)	.19	150 (11.3)	398 (29.9)	.94	527 (39.5)	<.001
Cohort, n (%)			.33			.95		<.001
Incident	219 (85.9)	232 (82.9)		185 (72.8)	507 (74.9)		1,614 (73.0)	
Progression	34 (13.3)	46 (16.3)		66 (26.0)	168 (24.8)		586 (26.5)	

[a] Large waist circumference (WC) was classified as ≥88 cm in women and ≥102 cm in men.

[b]P-values within body mass index (BMI) categories represent t-tests of unequal variance between high and normal WC.

[c]Because of study power, all subjects with BMI ≥30.0 kg/m^2 were collapsed into one group and no p-values were calculated for BMI.

[d]P-values represent analysis of variance values across all categories.

Table 2

Mean Baseline and Follow-Up Outcome Measures from Unadjusted Model (n=2,210)

Outcome Measure	Normal Weight (BMI 18.5–24.9 kg/m^2)			Overweight (BMI 25.0–29.9 kg/m^2)			Obese (BMI ≥30 kg/m^2)	Overall P-Value[d]
	Normal WC	Large WC[a]	P-Value[b]	Normal WC	Large WC[a]	P-Value[b]	High and Normal WC[c]	
	Mean±SD			Mean±SD			Mean±SD	
Medical Outcomes Study 12-item Short Form Health Survey, Physical Component Subscale								
Baseline	52.3±0.5	51.2±0.5	.11	50.3±0.5	48.7±0.3	.05	46.2±0.3	<.001
Follow-up	50.4±0.6	48.0±0.5	.002	47.4±0.6	45.6±0.3	.005	42.9±0.3	<.001
P-value[e]	<.001	<.001	.05[f]	<.001	<.001	.24[f]	<.001	.09[g]
Physical Activity Scale for the Elderly								
Baseline	156.8±3.6	128.0±3.5	<.001	149.5±3.6	130.8±2.2	<.001	131.9±2.1	<.001
Follow-up	141.5±4.0	117.7±3.9	<.001	129.3±4.0	115.9±2.5	.005	112.5±2.4	<.001
P-value[e]	<.001	.006	.35[f]	<.001	<.001	.24[f]	<.001	.21[g]
Late-Life Function and Disability Index								
Frequency	55.7±0.4	56.7±0.4	.11	53.9±0.4	55.3±0.3	.005	54.4±0.3	<.001
Limitation	85.0±1.0	81.9±1.0	.03	82.6±1.0	80.4±0.6	.06	78.0±0.6	<.001
Gait Speed								
Baseline	1.39±0.01	1.33±0.01	<.001	1.37±0.01	1.30±0.01	<.001	1.23±0.01	<.001
Follow-up	1.35±0.01	1.26±0.01	<.001	1.30±0.01	1.22±0.01	<.001	1.15±0.01	<.001
P-value[e]	<.001	<.001	.11[f]	<.001	<.001	.39[f]	<.001	.006[g]

SD=standard deviation.

[a] Large waist circumference (WC) was classified as ≥88 cm in women and ≥102 cm in men.

[b] P-values within body mass index (BMI) categories represent significance of change between WC categories at baseline and follow-up.

[c] Because of study power, all subjects with BMI ≥30.0 kg/m^2 were collapsed into one group, and no p-values were calculated for BMI.

[d] P-values represent overall test of difference in means between BMI/WC categories at baseline and follow-up.

[e] P-values represent significance within each BMI/WC category in change from baseline to follow-up.

[f] P-value represents significance between normal and high WC within each BMI category in change from baseline to follow-up

[g] p-values represent significance between change from baseline to follow-up across all categories.