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Assistive Walking Device Use and Knee Osteoarthritis: the Health, Aging, and Body Composition Study (Health ABC Study)

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Abstract

Objectives—To identify factors that predicted incident use of assistive walking devices (AWDs) and to explore whether AWD use was associated with changes in osteoarthritis of the knee.

Design—Prospective cohort study.

Setting—2,639 elderly men and women in the Health ABC (Health, Aging and Body Composition). Study followed for incident use of AWDs, including a subset of 874 with prevalent knee pain.

Participants—NA

Interventions—NA

Main Outcome Measures—Incident use of AWDs, mean Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain scores and frequency of joint space narrowing on knee radiographs over a three year time period.

Results—AWD use was initiated by 9% of the entire Health ABC cohort and 12% of the knee pain subset. Factors that predicted use in both groups were age ≥73 [entire cohort: OR 2.07 (95% CI 1.43, 3.01); knee pain subset: OR 1.87 (95% CI 1.16, 3.03)], black race [entire cohort: OR 2.95 (95% CI 2.09, 4.16); knee pain subset: OR 3.21 (95% CI 2.01, 5.11)] and lower balance ratios

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[entire cohort: OR 3.18 (95% CI 2.21, 4.59); knee pain subset: OR 3.77 (95% CI 2.34, 6.07)]. Mean WOMAC pain scores decreased slightly over time in both AWD and non-AWD users. 20% of non-AWD users and 28% of AWD users had radiographic progression in joint space narrowing of the tibiofemoral joint in at least one knee. 14% of non-AWD users and 12% of AWD users had radiographic progression in joint space narrowing in the patellofemoral joint in at least one knee.

Conclusions—Assistive walking devices are frequently used by elderly men and women. Knee pain and balance problems are significant reasons why elderly individuals initiate use of an assistive walking device. In an exploratory analysis, there was no consistent relationship between use or nonuse of an AWD and WOMAC pain scores or knee joint space narrowing progression. Further studies of the relationship of use of AWDs to changes in knee osteoarthritis are needed.

Keywords

AWDs; Balance; Knee pain

In the U.S., osteoarthritis (OA) affects 20 million people; these numbers will double over the next two decades [1]. Approximately 6% of Medicare beneficiaries obtain mobility assistive technology under durable medical equipment (DME) benefits [2]. Canes, crutches, and walkers account for approximately 53% of all purchases and 8% of all mobility-related DME costs [2]. Estimates are that 40–76% of patients with OA have an assistive walking aid [3, 4]. However, data are limited on the predictors of use of an AWD in specific populations, as many studies do not include the specific indication for use of the AWD or only include small numbers of individuals [5]. Additionally, while a recent review suggested that AWDs including canes and walkers may improve balance and mobility [5], there remains a paucity of research on the effectiveness of mobility aid devices [6]. The purpose of this study was to evaluate predictors of incident use of an AWD in the Health ABC study, and in a subset of Health ABC participants, with knee pain. Since biomechanical studies suggest that AWDs may support weight and increase stability [7], we hypothesized that use of these devices would be predicted by the presence of knee OA and balance difficulties. A secondary, exploratory purpose of this study was determine if over a three-year period AWD users and nonusers differed with respect to the progression of knee OA, as measured by WOMAC pain scores and joint space narrowing on knee radiographs.

Methods

Participants

The Health ABC Study is a community based, multicenter cohort study [including 3,075 men and women aged 70–79 recruited at The University of Pittsburgh, Pittsburgh, PA (n=1,527), and The University of Tennessee, Memphis, TN (n=1,548)] that began in 1997–1998 with the primary objective of examining the incidence of physical disability in relation to body composition and weight-based health conditions in healthy elderly individuals [8]. Participants were recruited from a random sample of white Medicare-eligible adults and all age-eligible black community residents in designated zip codes surrounding the field centers. Eligibility criteria included self-report of no difficulty in activities of daily living, walking at least one-quarter mile, and climbing 10 stairs without resting. The study was approved by the institutional review boards at the two clinical sites for this study, and written informed consent was obtained.

Use of an AWD was determined by study personnel who recorded whether a participant was using the device during their study visit or at home. AWDs included forearm crutches, canes or walkers; use among these was not differentiated. For all analyses, in order to exclude only

sporadic use of these devices, use of these devices had to be present on at least two annual visits from Year 2 to Year 5 of Health ABC.

After exclusion of 436 participants from the original cohort of 3,075 due to death or missing data on use of AWD between Years 2–5, a total of 2,412 non-AWD users and 227 AWD users were included in the analysis of predictors of AWD use in the entire cohort.

In Health ABC, knee pain was defined as (a) pain, aching, or stiffness on most days of a month in the past month or (b) pain on most days of a month in the past year or (c) ≥ moderate activity pain in the past 30 days by WOMAC pain scores. In this knee pain subset, incident use of an AWD was defined over the time period of Years 3–5 of Health ABC with use of an AWD reported at least twice on annual visits over this time period. There were 874 participants in the knee pain substudy who were included in the predictors of AWD use in those with knee pain.

Knee x-rays were done in those reporting knee pain and in a small number of controls without knee pain. For our exploratory longitudinal analyses of the relationship of AWD use to knee pain and WOMAC scores, the small number of participants with knee pain who had initial knee x-rays done in Year 3 instead of Year 2, and the controls without knee pain were excluded. Participants with knee pain had follow-up imaging in Year 5. After exclusion due to death or missing data, there remained 493 participants (43 incident users of an AWD and 450 nonusers of an AWD) included in the exploratory longitudinal analysis of the association of AWD use with changes in knee OA parameters.

Questionnaires

Information on age, sex, race, self-report of fracture after the age of 45, education, self-report of health insurance plans other than Medicare, history of hip pain, self-reported history of eye diseases, physical activity, depressive symptoms, presence of a social support, and number of falls/year in the year prior to Health ABC was obtained from interviewer-administered questionnaires at baseline. History of eye disease was defined as history of cataracts, glaucoma, macular degeneration, or retinal disease. Depression was recorded by the Center for Epidemiological Studies-Depression (CES-D) scale and stratified into levels of ≥22 (major depressive disorder or clinically relevant depression), and <22 as has been described [9]. The level of physical activity was assessed by a questionnaire modeled from commonly used assessments including the leisure-time physical activity questionnaire. Participants were stratified into inactive (<1,000 kcal/wk. of exercise and ≤2,719 kcal/w/k of total activity), lifestyle active (<1,000 kcal/wk. of exercise and >2,719 kcal/wk. of total activity) and exerciser (≥1,000 kcal/wk. of exercise) [10].

BMI

Height was measured using a Harpenden stadiometer (Pembrokeshire, UK). Weight (without shoes) was determined using a calibrated balance scale. BMI was calculated and stratified into: obese (≥30 kg/M^2) and overweight (25–29.99 kg/M^2), and normal (18.5–24.9 kg/M^2) and underweight (<18.5 kg/M^2).

Isokinetic Quadriceps Strength Testing

Isokinetic quadriceps strength was measured in the right leg, unless contraindicated due to pain or joint replacement, using a dynamometer (Kin Com Dynamometer, Chattanooga, TN). The maximum torque (moving from 80 to 40 degrees) was recorded from averaged curves, with results expressed in Newton meters. Results were normalized for body weight (kg) and cut points stratified by the cohort median.

Balance Ratio Scores

Balance ratio scores were measured with scores ranging from 0 to 1, with the maximum score of 1 indicating that all standing balance tests (the semi-tandem, full-tandem and one-legged stand) were each held for 30 seconds. For these analyses, we stratified the population into balance ratio scores of <0.44 or ≥0.44. A score of 0.44 corresponds to holding the tandem score for approximately 10 seconds, which confers a perfect score on the standing balance of the Short Physical Performance Battery (SPPB) [11]. We thus dichotomized balance performance to distinguish those fully successful using SPPB criteria from those who had less than perfect scores.

Medication Use

At annual visits, participants brought all prescription and non-prescription medications taken during the previous two weeks. Medications were matched to a dictionary of drugs using the Iowa Drug Information System [12] to allow the identification of each individual pharmaceutical compound. Use of estrogen, nonsteroidal anti-inflammatory drugs (NSAIDs), vitamin D supplements, and acetaminophen was assessed.

Knee X-rays

Bilateral, standing, flexed views of the tibiofemoral (TF) compartment of the knee joint were obtained using the Fixed-Flexion technique [13] and axial (skyline) views were obtained of the patellofemoral (PF) joint [14]. Knee radiographs were assessed by a single experienced reader for Kellgren-Lawrence grade and for the Osteoarthritis Research Society International (OARSI) grade of joint space narrowing (JSN) in the medial and lateral TF compartments [15]. The skyline radiographs of the PF joint were read for medial and lateral osteophytes and JSN also using the OARSI atlas [15]. Knees that had a change in JSN score of ≥1 grade in either the medial or lateral PF or TF compartments were considered to have radiographic progression. Intra-reader reliability (weighted) kappa's were 0.82 (0.70–0.95) for medial patella femoral joint space narrowing and 0.90 (0.85–0.95) for lateral PF joint space narrowing and 0.91 (0.87–0.94) for medial TF joint space narrowing and 0.90 (0.85–0.95) for lateral TF joint space narrowing.

WOMAC Scores

Interviewers administered a modified WOMAC pain scale with a 5-point Likert scale [16]. WOMAC pain scores in Year 2 and Year 5 were used for assessments of knee pain.

Statistical Analyses

Descriptive analyses were stratified by incident AWD use among all Health ABC participants and among only those with knee pain. Differences in continuous variables were analyzed by *t*-tests and differences in categorical variables were analyzed with chi-square test. Cochran-Armitage trend tests were used for analyzing trend effects between AWD use and number of falls.

Predictors of incident use of an AWD were considered separately in all Health ABC participants and then in the subset with knee pain using logistic regression. In the whole cohort, demographic, anthropometric, clinical, and psychosocial predictors of use of an AWD were obtained from the baseline visit. For the subset with knee pain, demographic, anthropometric, clinical, and psychosocial predictors of incident use of an AWD were obtained from Year 2 data, where available, otherwise, baseline data were used.

Any variable with a p-value ≤0.15 in univariate logistic regression was considered to be a potential predictor in multivariable logistic regression analysis; however, some variables,

which were affected by excessive collinearity with other potential predictors were excluded as considerations in the final models. There were 2,286 and 827 participants respectively included in the multivariable analyses for the entire cohort and the knee pain subset. Descriptive statistics including the percentage of those with increases in joint space narrowing on radiographs of ≥1 by AWD use and mean WOMAC pain scores were analyzed over time using a mixed model ANOVA. All statistical analyses were performed using the SAS System for Windows (SAS Institute, Cary, NC, version 9.1). P values were two-sided and considered statistically significant if $p<0.05$.

Results

AWD use was initiated by 227 of 2,639 participants (9%) in the entire cohort. Among those with knee pain, 108 of the 874 participants (12%), initiated use of these devices.

Table 1 compares baseline characteristics of incident users of AWD with nonusers during follow-up in the entire cohort. Compared with nonusers of AWDs, users were older, more likely to be female, to be of black race, to have a higher body mass index (BMI), to have fewer years of education, to not have medical insurance other than Medicare, and to have lower quadriceps strength (normalized for weight). AWD users compared with nonusers were also more likely to have eye disease, a greater number of falls in the last 12 months, a history of a fracture, a lower balance score, lower physical activity, hip pain, higher WOMAC pain scores for both knees, to use acetaminophen and NSAIDs, and to have depression ($p \leq 0.01$ for all). There were no significant differences in use of estrogen or vitamin D supplements and social support network between the groups.

Descriptive characteristics of incident users of AWD compared with nonusers of these devices in the knee pain subset are shown in Table 2. Compared with nonusers of AWDs, users were older, more likely to be female, of black race, have a higher BMI, to have fewer years of education, to not have medical insurance other than Medicare, and to have lower quadriceps strength (normalized for weight). AWD users compared with nonusers were also more likely to have a history of eye disease, a greater number of falls in the last 12 months, a lower balance score, to be inactive, to have higher WOMAC pain scores in both knees, and to use acetaminophen ($p \leq 0.04$ for all). There was a trend for AWD users compared with nonusers to have a history of hip pain in the last 12 months ($p=0.05$). There were no significant differences in fracture history, estrogen, vitamin D, or NSAID usage, depressive symptoms or social support network between the groups.

In univariate analysis in the entire cohort, knee pain in the last 12 months was a significant predictor of use of an AWD [OR 2.33 (95% CI 1.77–3.08)]. In addition, older age (age ≥73), female gender, black race, higher BMI, lower years of education, no insurance other than Medicare, lower quadriceps strength/weight, history of eye disease, number of falls history of a fracture, lower balance ratios, lower physical activity levels hip pain, and acetaminophen and NSAID use were significantly positively associated with use of an AWD (Table 3). In multivariable analysis in the entire cohort, older age, black race, lower quadriceps strength/weight, history of a fracture, lower balance ratios, lower physical activity levels and history of hip and knee pain were significant predictors of use of an AWD (Table 3).

In univariate analysis in the knee pain subset, older age, female gender, black race, higher BMI, lower education levels, having no health insurance other than Medicare, lower isokinetic quadriceps strength normalized for weight, history of eye disease, history of falls and number of falls, lower balance score ratios, inactive physical activity compared with lifestyle active, history of hip pain, and acetaminophen use were all significant predictors of

use of an AWD (Table 4). In multivariable analysis in the knee pain subset, older age, black race, history of eye disease, lower balance ratios, and acetaminophen use were significant predictors of AWD use (Table 4).

In the exploratory longitudinal analysis of the association of AWD use with changes in joint space narrowing on x-ray, for both the PF and the TF joints, there was no consistent relationship between use or nonuse of an AWD and knee JSN progression (Table 5). With respect to mean WOMAC pain scores in both AWD users and nonusers, there was no consistent relationship between use or nonuse of an AWD and WOMAC pain scores (Table 6).

Discussion

In this study of elderly, community dwelling men and women, including both the whole Health ABC cohort and the subset with prevalent knee pain, older age, black race, and lower balance scores predicted incident use of an AWD. In support of our findings, in small studies, older age [3] and black race [17] have been associated with use of an AWD. In Health ABC in those with knee pain, black participants had more than a 3-fold greater risk of initiating use of an AWD. It would be interesting to determine whether blacks with knee pain, who have far fewer total knee arthroplasties compared to whites [18], and who are more likely than whites to rely on self-care measures for osteoarthritis [19], are using AWDs in lieu of undergoing more invasive procedures, including total knee replacements. In contrast to others [20], we did not find that psychosocial factors predicted use of a walking device. Many AWDs are available without a physician's prescription, and in our cohort, the presence of supplemental medical insurance other than Medicare was not a predictor of use of these devices in multivariable analysis.

Biomechanical studies suggest that canes and walkers can improve balance [7]. Crutches increase the base of support, thereby improving lateral stability and can be used for full weight bearing [7]. Walkers improve balance by increasing the base of support, enhancing lateral stability and supporting weight [7]. Balance difficulties were significantly associated with incident use of these devices in both of our cohorts. Similarly, others have reported that general balance difficulties are the inciting factor for cane use in 30% of individuals [21]. Visual problems have been associated with balance difficulties in elderly individuals [22], and in agreement with this, a history of eye disease was associated with use of an AWD in the knee pain subset. As knee pain was also a significant predictor of use of an AWD, our data, in sum, suggest suggests that balance difficulties and knee pain are major inciting reasons for initiation of an AWD.

Study Limitations

There are several limitations to our study. We assumed that the 493 participants who had complete data are representative of the entire knee pain subset (n=874) assessed during the first annual visit. About 40% of the incident users of AWD had complete data compared with nearly 60% of the nonusers, thereby suggesting that users were more likely to be lost to follow-up or have missing data. Second, there was excessive collinearity among several of the univariate predictor variables, limiting variables that could be included in the multivariable models. A third limitation of this study is that we could not determine whether the AWDs were used correctly [23, 24]. However, in a recent study, no relationship between cane fitting and falls was noted [21]. We could not determine whether there had been professional instruction in their use, which some [25], but not all [21], studies suggest is important. We were not able to distinguish among the types of AWDs used or compliance with use of these devices. To avoid including temporary users of AWD, we only included participants who indicated that they were using these devices on at least two occasions. Only

10% of those with x-ray and WOMAC data were AWD users. We could not control for the presence of misalignment, a predictor of knee OA progression [26]. Finally, this study was based on a sample of well-functioning older adults, and the results may not be applicable to populations with more severe knee OA.

Conclusion

Our exploratory analysis of the relationship of AWD use to knee OA changes including WOMAC pain scores and radiographs is limited by the small numbers of AWD users. However, that there was no evidence of knee OA progression in the AWD users is encouraging because one would suspect that patients with worse knee OA with poorer function would be those most likely to initiate use of an AWD, and thus, more likely to progress over time.

In conclusion, those who are older, of black race, who have balance problems and who have knee pain are most likely initiate use of an AWD. In exploratory analysis, there was no consistent relationship between use or nonuse of an AWD and WOMAC pain scores or knee joint space narrowing progression. Further studies, of the relationship of AWD use to changes in WOMAC scores and knee radiographs in those with knee OA, are needed.

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Abbreviations

AWD	Assistive walking device
BMI	Body mass index
CES-D	Center for Epidemiological Studies Depression
DME	Durable medical equipment
JSN	Joint Space Narrowing
NSAID	Nonsteroidal, anti-inflammatory drugs
OA	Osteoarthritis
OARSI	Osteoarthritis Research Society International
PF	Patellofemoral
SPPB	Short Physical Performance Battery
TF	Tibiofemoral
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

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TABLE 1

Baseline Characteristics of Health ABC Participants by use of an AWD (Entire Cohort) (Mean ± SEM or %)

	No AWD (N=2412)	AWD (N=227)	P-value
Demographics			
Age	73.46 (2.84)	74.68 (2.93)	<0.01
Gender			
Female	1258 (47.84)	144 (63.44)	0.00
Male	1154 (52.16)	83 (36.56)	
Race			
White	1523 (63.14)	83 (36.56)	<0.01
Black	889 (36.86)	144 (63.44)	
Anthropometric			
BMI	27.19 (4.58)	29.91 (5.94)	<0.01
Clinical Factors			
Education (yrs.)			
≥12	1810 (77.92)	132 (60.27)	<0.01
<12	513 (22.08)	87 (39.73)	
Medicare plus other Insurance			
Yes	1979 (82.56)	167 (74.22)	
No	418 (17.44)	58 (25.78)	0.01
Missing	15	2	
Isokinetic quadriceps strength (weight normalized)	1.43 (0.43)	1.13 (0.39)	<0.01
History of Eye Disease			
Yes	1224 (50.75)	149 (65.64)	<0.01
No	1188 (49.25)	78 (34.36)	
Number of Falls during previous 12 months *			
0	1904 (79.43)	160 (70.48)	
1	367 (15.31)	36 (15.86)	<0.01
2+	126 (5.26)	31 (13.66)	
Missing	15	0	
History of Fracture			
Yes	523 (21.77)	67 (29.78)	
No	1879 (78.23)	158 (70.22)	0.01
Missing	10	2	
Balance Score Ratio	0.78 (0.25)	0.55 (0.31)	<0.01
Physical Activity Scores			
Inactive	532 (22.06)	85 (37.44)	
Lifestyle	1,495 (61.98)	120 (52.86)	<0.01
Exercise	385 (15.96)	22 (9.69)	
Hip Pain in past 12 months			
Yes	360 (14.94)	53 (23.35)	0.01
No	2049 (85.06)	174 (76.65)	

	No AWD (N=2412)	AWD (N=227)	P-value
Missing	3	0	
WOMAC Score			
Right Knee	6.76 (4.77)	8.78 (5.35)	0.01
Left Knee	6.73 (4.71)	9.59 (5.21)	<0.01
Medications			
Acetaminophen			
Yes	451 (19.91)	63 (28.51)	
No	1814 (80.09)	158 (71.49)	0.01
Missing	147	6	
Estrogen			
Yes	321 (14.17)	25 (11.31)	
No	1944 (85.83)	196 (88.69)	0.24
Missing	147	6	
Vitamin D Supplements			
Yes	224 (9.89)	17 (7.69)	0.29
No	2041 (90.11)	204 (92.31)	
Missing	147	6	
NSAIDS			
Yes	504 (22.25)	77 (34.84)	<0.01
No	1761 (77.75)	144 (65.16)	
Missing	147	6	
Psychosocial Factors			
Depressive Symptoms	4.50(5.17)	5.53 (5.32)	0.01
Social Support Network			
Yes	1454 (73.07)	124 (69.66)	0.33
No	536 (26.93)	54 (30.34)	
Missing	422	49	

*Cochran-Armitage test for trends

TABLE 2

Baseline Characteristics of Health ABC Participants by Use of an AWD (Subset with Knee Pain) (Mean ± SEM or %)

	No AWD (N=766)	AWD (N=108)	P-value
Demographics			
Age	73.46 (2.9)	74.76 (3.0)	<0.01
Gender			
Female	451 (58.88)	75 (69.44)	0.04
Male	315 (41.12)	33 (30.56)	
Race			
White	455 (59.40)	33 (30.56)	<0.01
Black	311 (40.60)	75 (69.44)	
Anthropometric			
BMI	28.35 (4.93)	30.96 (5.81)	<0.01
Clinical Factors			
Education (yrs.)			
≥12	560 (73.11)	65 (60.19)	0.01
<12	190 (24.80)	40 (37.04)	
Medicare plus other Insurance			
Yes	644 (84.07)	76 (70.37)	0.01
No	117 (15.27)	31 (28.70)	
Isokinetic quadriceps strength (weight normalized)	1.27 (0.42)	1.08 (0.38)	0.02
History of Eye Disease			
Yes	409 (53.39)	76 (70.37)	0.00
No	357 (46.61)	32 (29.63)	
Number of Falls/Year *			
0	542 (70.76)	58 (53.70)	<0.01 *
1	125 (16.32)	17 (15.74)	
2+	64 (8.36)	19 (17.59)	
unknown	35	14	
History of Fracture			
Yes	175 (22.85)	31 (28.70)	0.15
No	587 (76.63)	75 (69.44)	
Balance Score Ratio	0.76 (0.25)	0.54 (0.29)	<0.01
Year 2 Physical Activity			
Inactive	161 (21.02)	36 (33.33)	0.012
Lifestyle	500 (65.27)	60 (55.56)	
Exercise	105 (13.71)	12 (11.11)	
Hip Pain			
Yes	189 (24.67)	33 (30.56)	0.05
No	545 (70.50)	61 (56.48)	
History of Knee Pain			

	No AWD (N=766)	AWD (N=108)	P-value
WOMAC Score R Knee	5.48 (4.85)	8.03 (5.77)	<0.01
WOMAC Score L Knee	5.05 (4.48)	6.35 (5.84)	0.04
Medications			
Acetaminophen			
Yes	157 (20.50)	33 (30.56)	0.02
No	570 (74.41)	69 (63.89)	
Estrogen			
Yes	89 (11.62)	11 (10.19)	0.67
No	638 (83.29)	91 (84.26)	
Vitamin D Supplements			
Yes	83 (10.84)	9 (8.33)	0.43
No	644 (84.07)	93 (86.11)	
NSAIDS			
Yes	211 (27.55)	31 (28.70)	0.78
No	516 (67.36)	71 (65.74)	
Psychosocial Factors			
Depressive Symptoms	5.24 (5.53)	5.74 (5.65)	0.39
Social Support Network			
Yes	456 (59.53)	61 (56.48)	0.95
No	199 (25.98)	27 (25.00)	

*Cochran-Armitage test for trends

TABLE 3

Predictors of Incident Use of an AWD in Health ABC Participants (Entire Cohort)

	Univariate		Multivariate	
Predictors	**OR**	**95% CI**	**OR**	**95% CI**
Demographics				
Age (yrs.).(≥73 vs. <73)	1.98	1.45, 2.68	2.08	1.43, 3.01
Gender (female vs. male)	1.59	1.20, 2.11		
Race (black vs. white)	2.97	2.24, 3.94	2.95	2.09,4.16
Anthropometric				
BMI (overweight & obese vs. others)	1.61	1.16, 2.21		
Clinical Factors				
Education (≥12 vs. <12 yrs.)	0.43	0.32, 0.57		
Insurance (Yes vs. No)	0.78	0.67, 0.92		
Isokinetic Quadriceps Strength (Weight Normalized) (≤1.39 vs. >1.39)	3.46	2.41, 4.96	2.50	1.70, 3.66
History of Eye Disease (Yes vs. No)	1.85	1.39, 2.47		
Number of Falls/Year				
0 vs. 1	0.86	0.59, 1.25		
0 vs. 2	0.34	0.22, 0.52		
1 vs. 2	0.40	0.24, 0.67		
0 vs. (1, 2+)	0.54	0.40, 0.74		
(0,1) vs. 2+	0.37	0.24, 0.57		
History of Fracture (Yes vs. No)	1.52	1.13, 2.06	1.58	1.10,2.28
Balance ratio (<0.44 vs. ≥0.44)	4.88	3.63, 6.57	3.18	2.21, 4.59
Inactive vs. Lifestyle Active	1.99	1.48, 2.67		
Inactive vs. Exerciser	2.80	1.72, 4.55		
Exerciser vs. Lifestyle Active	0.71	0.45, 1.14		
Inactive vs. Others (Lifestyle active/Exerciser)			1.53	1.08,2.21
Hip Pain in past 12 months (Yes vs. No)	1.73	1.25, 2.41	1.53	1.02, 2.31
Knee pain past 12 months (Yes vs. No)	2.33	1.77, 3.08	1.98	1.39,2.82
Medications				
Acetaminophen (Yes vs. No)	1.60	1.18, 2.19		
Estrogen (Yes vs. No)	0.77	0.50, 1.19		
Vitamin D Supplements (Yes vs. No)	0.76	0.45, 1.27		
NSAIDS (Yes vs. No)	1.37	1.18, 1.58		
Psychosocial Factors				
Depressive Symptoms (≥22 vs. <22)	0.92	0.33, 2.59		
Social Support Network (Yes vs. No)	0.85	0.61, 1.18		

TABLE 4

Predictors of Incident Use of an AWD in Health ABC Participants (Knee Pain Subset)

	Univariate		Multivariate	
Predictors	**OR**	**95% CI**	**OR**	**95% CI**
Age (≥73 vs. <73 yrs.)	**1.44**	**1.15, 1.80**	**1.87**	**1.16, 3.03**
Gender (female vs. male)	1.26	1.01, 1.57		
Race (black vs. white)	1.82	1.47, 2.27	3.21	2.01, 5.11
Anthropometric				
BMI (overweight & obese vs. others)	1.34	1.01, 1.78		
Clinical Factors				
Education (≥12 vs. <12 yrs.)	0.74	0.06, 0.92		
Insurance (Yes vs. No)	0.67	0.53, 0.84		
Isokinetic Quadriceps Strength/Weight Normalized (≤1.39 vs. >1.39)	1.48	1.07, 2.07		
History of Eye Disease (Yes vs. No)	1.44	1.16, 1.79	1.76	1.09, 2.83
Number of Falls/Year				
0 vs. 1	0.79	0.44, 1.40		
0 vs. 2	0.66	0.49, 0.89		
1 vs. 2	0.84	0.57, 1.23		
0 vs. (1,2+)	0.72	0.48, 1.09		
(0,1) vs. 2+	0.74	0.61, 0.90		
History of Fracture (Yes vs. No)	1.18	0.94, 1.48		
Balance Score Ratio (<0.44 vs. ≥0.44)	2.12	1.70, 2.65	3.77	2.34, 6.07
Year 2 Physical Activity				
Inactive vs. Lifestyle	1.86	1.19, 2.92		
Inactive vs. Exerciser	1.96	0.97, 3.93		
Exerciser vs. Lifestyle Active	0.95	0.50, 1.83		
Hip Pain in past 12 months (Yes vs. No)	1.25	1.00, 1.57		
Medications				
Acetaminophen (Yes vs. No)	1.32	1.05, 1.65	1.66	1.02, 2.70
Estrogen (Yes vs. No)	0.93	0.67, 1.30		
Vitamin D Supplements (Yes vs. No)	0.87	0.60, 1.24		
NSAIDS (Yes vs. No)	1.03	0.82, 1.29		
Psychosocial Factors				
Depressive Symptoms (≥22 vs. <22)	0.84	0.45, 1.57		
Social Support Network (Yes vs. No)	1.00	0.78, 1.26		

TABLE 5

Progression in Joint Space Narrowing by Assistive Walking Device Use (AWD)

		Patellofemoral Progression		Tibiofemoral Progression	
	Knee	**N**	**%**	**N**	**%**
No AWD (N=450)	Left	61	14	57	13
	Right	52	12	90	20
AWD (N=43)	Left	5	12	8	19
	Right	3	7	12	28

TF or PF progression: ≥1 JSN at Year 5 compared with Year 2

TABLE 6

WOMAC Pain Scores by Assistive Walking Device Use (AWD) (Mean ± SD)

	Left - Year 2 WOMAC			Left - Year 5 WOMAC			Right - Year 2 WOMAC			Right - Year 5 WOMAC		
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
No AWD	450	5.14	4.36	450	3.62	4.38	450	5.62	4.74	450	4.24	4.96
AWD	43	6.74	6.13	43	5.70	6.20	43	8.23	5.93	43	6.07	5.95