Research Square

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Changes in habitual physical activity after total ankle arthroplasty : A nationwide cohort study

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Abstract

Purpose

Total ankle arthroplasty (TAA) is a motion-preserving alternative to ankle arthrodesis for end-stage ankle arthritis. However, population-level evidence regarding postoperative habitual physical activity is limited. This study aimed to assess pre- to postoperative changes in habitual physical activity after TAA in a nationwide cohort.

Methods

This retrospective cohort study used data from the South Korean National Health Insurance Service database. Adults who underwent primary TAA between 2008 and 2020 and underwent health check-ups before and after surgery were included. Physical activity was assessed using the metabolic equivalent of task (MET) minutes per week. Sufficient physical activity was defined as ≥ 600 MET·min·wk^{-1}.

Results

Among the 1,916 patients, the prevalence of sufficient physical activity increased from 19.6% preoperatively to 27.1% postoperatively ($P < 0.001$). Mean MET expenditure increased from 289.0 ± 475.2 to 686.7 ± 2072.8 MET·min·wk^{-1}. Overall, 74.6% of patients had increased MET expenditure after surgery. Women were more likely to show increased MET expenditure than men (78.4% vs. 71.1%). The prevalence of sufficient physical activity did not increase significantly in patients with stroke, cancer, or depression.

Conclusion

Following TAA, MET expenditure increased in 74.6% of the patients, and the prevalence of sufficient physical activity increased from 19.6% to 27.1%. However, these improvements were not consistent across all patient subgroups. These findings suggest that patient-specific factors and the expected postoperative activity levels should be considered.

Introduction

End-stage ankle arthritis has traditionally been managed with ankle arthrodesis (AA), which relieves pain, but sacrifices joint motion. Technological advances and improved surgical techniques have made total ankle arthroplasty (TAA) a viable alternative that preserves joint motion and could support better functional recovery [1, 2]. Previous studies suggest that TAA facilitates return to sports and improves quality of life [3–5]. For example, Naal et al. reported that sports participation increased from 62.4% to 66.3% after TAA and that 79% of patients met health-enhancing physical activity postoperatively [4]. A meta-analysis of 11 studies found that sports participation increased from 49% to 61.9% after TAA [6].

However, these studies included fewer than 200 ankles, focused primarily on sports participation rather than habitual physical activity, and rarely examined factors associated with postoperative activity levels [4, 6, 7].

Therefore, this study aimed to evaluate changes in habitual physical activity after TAA and explore differences across patient subgroups using a nationwide South Korean cohort. We hypothesized that physical activity would increase following TAA.

Materials and methods

Data sources

The study used the National Health Insurance Service (NHIS) database of South Korea, which covers approximately 97% of the country's population [8]. This database combines claims data with biennial health check-up records containing self-reported surveys (smoking, alcohol intake), anthropometric measurements, blood pressure and laboratory tests.

Study design and participants

This retrospective cohort study included patients who underwent primary TAA between January 2008 and December 2020. Primary TAA procedures were identified using the insurance claim codes N2075 (uncomplicated cases) and N2079 (complicated cases). Patients were excluded if they (1) experienced TAA failure (defined as revision TAA, component removal, or arthrodesis) during follow-up; (2) lacked a health check-up within 2 years before surgery; or (3) had no available postoperative health check-up records obtained at least 6 months after surgery. Comorbid procedures (revision or removal codes N3715, N3729, N4715, N4719, N4725 and N4729; arthrodesis codes N0733, N0735, N0736, N0737) were used to identify failures. Patients with missing variables were also excluded. Follow-up extended to 31 December 2021 (Fig. 1).

Measurement of physical activity and definition of sufficient physical activity

Physical activity was assessed at two time points: the most recent health check-up within 2 years before surgery and the first available health check-up performed at least 6 months after surgery. Self-reported data on moderate- and vigorous-intensity physical activity were obtained from the health check-up questionnaire and used to calculate metabolic equivalent of task (MET)-minutes per week according to the International Physical Activity Questionnaire scoring method [9]. Vigorous activity was assigned 8 METs and moderate activity 4 METs [10]. Total weekly MET expenditure was calculated as the sum of minutes per week spent in each activity intensity multiplied by the corresponding MET value. Sufficient physical activity was defined as ≥ 600 $MET \cdot min \cdot wk^{-1}$, consistent with the minimum World Health Organization recommended aerobic activity level [11].

Covariates

The covariates included age, sex, body mass index (BMI), smoking status, alcohol consumption, income level, and major comorbidities. Age was categorised as < 50, 50–54, 55–59, 60–64, 65–69, 70–74, and ≥ 75 years. BMI was categorised as < 18.5, 18.5–22.9, 23.0–24.9, 25.0–29.9, and ≥ 30 $kg \cdot m^{-2}$ according to Asian-Pacific BMI criteria [12]. Smoking status was classified as non-smoker, ex-smoker or current smoker, and alcohol consumption as none, 1–3 drinking sessions per week or ≥ 4 sessions per week. The income level was divided into quartiles. Comorbidities, including hypertension, diabetes mellitus, dyslipidaemia, chronic kidney disease, stroke, cancer, and depression, were identified using ICD-10-CM codes recorded at least twice in outpatient claims or once during hospitalisation following standard NHIS definitions.

Statistical analysis

Continuous variables are presented as means ± standard deviations or medians with interquartile ranges, as appropriate, and categorical variables as counts and percentages. Pre- and postoperative categorical outcomes were compared using McNemar's test. Paired continuous outcomes were compared using paired t-tests or Wilcoxon signed-rank tests, depending on distributional assumptions. Between-group differences in the proportion of patients with increased MET expenditure, defined as postoperative MET exceeding preoperative MET, were assessed using chi-squared tests. When overall between-group differences were significant, pairwise comparisons were performed using Bonferroni correction. Univariate logistic regression was used to estimate the odds ratios and 95% confidence intervals (CIs) for postoperative MET increase. Statistical significance was defined as a two-sided P value < 0.05. Analyses were performed using SAS Enterprise Guide 7.2 (SAS Institute Inc., Cary, NC, USA).

Results

Baseline characteristics

A total of 1,916 patients were included in the analysis: 998 (52.1%) were men and 918 (47.9%) were women (Table 1). The interval from surgery to the postoperative health check-up was 792.0 ± 351.6 days (Online Resource 1, Supplementary Table 1).

Table 1
Baseline characteristics of the study population

Variable	Category	n (%)
Sex	Male	998 (52.1%)
	Female	918 (47.9%)
Age group	< 50	46 (2.4%)
	50–54	105 (5.5%)
	55–59	255 (13.3%)
	60–64	269 (14.0%)
	65–69	540 (28.2%)
	70–74	353 (18.4%)
	≥ 75	348 (18.2%)
BMI category	< 18.5	15 (0.8%)
	18.5–22.9	400 (20.9%)
	23.0-24.9	429 (22.4%)
	25.0-29.9	905 (47.2%)
	≥ 30	167 (8.7%)
Smoking status	Non-smoker	1,315 (68.6%)
	Ex-smoker	336 (17.5%)
	Current smoker	265 (13.8%)
Alcohol consumption	None	1,251 (65.3%)
	1–3/week	471 (24.6%)
	≥ 4/week	194 (10.1%)
Income level	Quartile 1 (lowest)	326 (17.0%)
	Quartile 2	320 (16.7%)
	Quartile 3	502 (26.2%)
	Quartile 4 (highest)	768 (40.1%)
Comorbidities	Diabetes mellitus	554 (28.9%)
	Hypertension	1,102 (57.5%)

BMI, body mass index

Variable	Category	n (%)
	Dyslipidaemia	939 (49.0%)
	Chronic kidney disease	463 (24.2%)
	Stroke	119 (6.2%)
	Cancer	129 (6.7%)
	Depression	199 (10.4%)
BMI, body mass index		

Mean MET scores

Mean MET expenditure increased from 289.0 ± 475.2 MET·min·wk⁻¹ before surgery to 686.7 ± 2,072.8 MET·min·wk⁻¹ after surgery, with a mean change of + 397.8 MET·min·wk⁻¹ ($P < 0.001$) (Table 2). Significant increases were observed in all age groups except those aged < 50 years, all BMI categories except for underweight patients, and all income subgroups. Among the comorbidity subgroups, all groups, except patients with stroke, showed significant increases in mean MET expenditure. Mean MET expenditure increased by 454.9 MET·min·wk⁻¹ in men and 335.6 MET·min·wk⁻¹ in women. By BMI category, the largest increase was observed in patients with a BMI of 23.0–24.9 kg·m⁻² (+ 593.9 MET·min·wk⁻¹, $P < 0.001$). Patients with stroke showed no significant change in mean MET expenditure, whereas patients with cancer and depression showed significant increases of + 326.5 MET·min·wk⁻¹ ($P = 0.0371$) and + 162.0 MET·min·wk⁻¹ ($P = 0.0366$), respectively.

Table 2
Mean MET expenditure before and after total ankle arthroplasty by subgroup

Domain	Subgroup	Preoperative MET, mean ± SD	Postoperative MET, mean ± SD	Mean change, MET·min·wk^{-1}	P value
Overall	Overall	289.0 ± 475.2	686.7 ± 2072.8	+ 397.8	< 0.0001
Sex	Male	327.5 ± 494.7	782.4 ± 2439.9	+ 454.9	< 0.0001
	Female	247.1 ± 449.6	582.7 ± 1574.5	+ 335.6	< 0.0001
Age group	< 50	330.4 ± 450.5	598.3 ± 982.1	+ 267.8	0.0593
	50–54	329.5 ± 502.2	660.6 ± 1562.7	+ 331.0	0.0441
	55–59	263.2 ± 452.5	753.6 ± 2271.1	+ 490.4	0.0007
	60–64	335.2 ± 511.5	719.4 ± 1692.2	+ 384.2	0.0002
	65–69	330.2 ± 504.5	707.2 ± 1774.4	+ 377.0	< 0.0001
	70–74	261.1 ± 458.1	616.5 ± 1594.8	+ 355.5	< 0.0001
	≥ 75	218.7 ± 415.8	671.6 ± 3063.4	+ 452.8	0.0059
BMI category	< 18.5	184.0 ± 242.3	154.7 ± 36.1	-29.3	0.6409
	18.5–22.9	261.7 ± 428.1	607.1 ± 1814.1	+ 345.4	0.0002
	23.0–24.9	314.9 ± 504.5	908.8 ± 3053.4	+ 593.9	< 0.0001
	25.0–29.9	294.0 ± 486.3	632.4 ± 1623.4	+ 338.4	< 0.0001
	≥ 30	270.2 ± 458.5	649.3 ± 1751.0	+ 379.2	0.0065
Smoking status	Non-smoker	272.3 ± 465.6	677.2 ± 2205.0	+ 404.9	< 0.0001
	Ex-smoker	391.9 ± 539.7	807.1 ± 1609.3	+ 415.2	< 0.0001
	Current smoker	241.4 ± 414.9	581.3 ± 1910.1	+ 339.9	0.0051
Alcohol consumption	None	262.8 ± 467.8	604.2 ± 2118.4	+ 341.4	< 0.0001
	1–3/week	364.0 ± 496.2	942.7 ± 2168.2	+ 578.7	< 0.0001

Domain	Subgroup	Preoperative MET, mean ± SD	Postoperative MET, mean ± SD	Mean change, MET·min·wk^{-1}	P value
	≥ 4/week	275.7 ± 452.9	597.3 ± 1380.5	+ 321.6	0.0016
Income level	Quartile 1 (lowest)	298.6 ± 507.7	802.9 ± 3249.1	+ 504.2	0.0054
	Quartile 2	257.0 ± 440.5	676.9 ± 1701.3	+ 419.9	< 0.0001
	Quartile 3	288.5 ± 499.9	607.9 ± 1653.2	+ 319.4	< 0.0001
	Quartile 4 (highest)	298.5 ± 458.3	693.1 ± 1804.1	+ 394.6	< 0.0001
Comorbidities	Diabetes mellitus	293.6 ± 493.4	600.0 ± 1518.9	+ 306.5	< 0.0001
	Hypertension	293.0 ± 488.5	596.5 ± 1481.9	+ 303.5	< 0.0001
	Dyslipidaemia	303.1 ± 496.2	683.3 ± 1730.3	+ 380.2	< 0.0001
	Chronic kidney disease	285.6 ± 493.6	661.5 ± 1992.2	+ 375.9	< 0.0001
	Stroke	276.0 ± 458.8	279.7 ± 762.2	+ 3.7	0.9630
	Cancer	321.6 ± 503.1	648.1 ± 1725.9	+ 326.5	0.0371
	Depression	292.9 ± 544.4	454.9 ± 1139.0	+ 162.0	0.0366

MET, metabolic equivalent of task; SD, standard deviation. MET expenditure is expressed as MET·min·wk^{-1}

Among all participants, 1,430 patients (74.6%) had increased MET expenditure after surgery (Online Resource 2, Supplementary Table 2). This proportion was higher in women than in men (78.4% vs. 71.1%, P = 0.0002). The percentage of patients with increased MET expenditure differed according to alcohol consumption status (P = 0.0158), with the highest percentage observed in patients reporting no alcohol consumption. No significant differences were observed in age, BMI, smoking status, income level, or most comorbidity categories.

Prevalence of sufficient physical activity

Overall, 376 patients (19.6%) had sufficient physical activity before surgery compared to 519 patients (27.1%) after surgery (P < 0.001). The percentage of sufficient physical activity increased in both men (22.2% to 28.7%, P < 0.001) and women (16.8% to 25.4%, P < 0.001) (Table 3). Patients aged 70–74 years

showed an increase from 17.0% to 28.3%. By BMI category, no change was observed in underweight patients, whereas the 23.0–24.9 $kg \cdot m^{-2}$ and 25.0–29.9 $kg \cdot m^{-2}$ groups increased by 9.8 and 7.1 percentage points, respectively. Among comorbidities, patients with hypertension, diabetes mellitus, dyslipidaemia, and chronic kidney disease showed an increased prevalence of sufficient physical activity, whereas those with stroke showed a decrease from 21.0% to 16.8%.

Table 3
Preoperative and postoperative sufficient physical activity by subgroup

Domain	Subgroup	n (%)	Preoperative sufficient PA, n (%)	Postoperative sufficient PA, n (%)	Absolute change, percentage points	P value
Overall	Overall	1,916	376 (19.6%)	519 (27.1%)	+ 7.5	< 0.0001
Sex	Male	998 (52.1%)	222 (22.2%)	286 (28.7%)	+ 6.4	0.0003
	Female	918 (47.9%)	154 (16.8%)	233 (25.4%)	+ 8.6	< 0.0001
Age group	< 50	46 (2.4%)	9 (19.6%)	16 (34.8%)	+ 15.2	0.0654
	50–54	105 (5.5%)	24 (22.9%)	30 (28.6%)	+ 5.7	0.3428
	55–59	255 (13.3%)	45 (17.6%)	66 (25.9%)	+ 8.2	0.0115
	60–64	269 (14.0%)	57 (21.2%)	76 (28.2%)	+ 7.1	0.0325
	65–69	540 (28.2%)	128 (23.7%)	153 (28.3%)	+ 4.6	0.0406
	70–74	353 (18.4%)	60 (17.0%)	100 (28.3%)	+ 11.3	0.0001
	≥ 75	348 (18.2%)	53 (15.2%)	78 (22.4%)	+ 7.2	0.0074
BMI category	< 18.5	15 (0.8%)	1 (6.7%)	1 (6.7%)	+ 0.0	1.0000
	18.5–22.9	400 (20.9%)	77 (19.2%)	102 (25.5%)	+ 6.2	0.0166
	23.0–24.9	429 (22.4%)	88 (20.5%)	130 (30.3%)	+ 9.8	0.0002
	25.0–29.9	905 (47.2%)	181 (20.0%)	245 (27.1%)	+ 7.1	< 0.0001
	≥ 30	167 (8.7%)	29 (17.4%)	41 (24.6%)	+ 7.2	0.0641
Smoking status	Non-smoker	1,315 (68.6%)	244 (18.6%)	345 (26.2%)	+ 7.7	< 0.0001
	Ex-smoker	336 (17.5%)	95 (28.3%)	115 (34.2%)	+ 6.0	0.0588

Domain	Subgroup	n (%)	Preoperative sufficient PA, n (%)	Postoperative sufficient PA, n (%)	Absolute change, percentage points	P value
	Current smoker	265 (13.8%)	37 (14.0%)	59 (22.3%)	+ 8.3	0.0060
Alcohol consumption	None	1,251 (65.3%)	221 (17.7%)	307 (24.5%)	+ 6.9	< 0.0001
	1–3/week	471 (24.6%)	119 (25.3%)	159 (33.8%)	+ 8.5	0.0017
	≥ 4/week	194 (10.1%)	36 (18.6%)	53 (27.3%)	+ 8.8	0.0173
Income level	Quartile 1 (lowest)	326 (17.0%)	62 (19.0%)	91 (27.9%)	+ 8.9	0.0051
	Quartile 2	320 (16.7%)	57 (17.8%)	85 (26.6%)	+ 8.8	0.0035
	Quartile 3	502 (26.2%)	95 (18.9%)	119 (23.7%)	+ 4.8	0.0285
	Quartile 4 (highest)	768 (40.1%)	162 (21.1%)	224 (29.2%)	+ 8.1	< 0.0001
Comorbidities	Diabetes mellitus	554 (28.9%)	107 (19.3%)	145 (26.2%)	+ 6.9	0.0019
	Hypertension	1,102 (57.5%)	212 (19.2%)	292 (26.5%)	+ 7.3	< 0.0001
	Dyslipidaemia	939 (49.0%)	185 (19.7%)	260 (27.7%)	+ 8.0	< 0.0001
	Chronic kidney disease	463 (24.2%)	86 (18.6%)	122 (26.4%)	+ 7.8	0.0025
	Stroke	119 (6.2%)	25 (21.0%)	20 (16.8%)	-4.2	0.4421
	Cancer	129 (6.7%)	25 (19.4%)	34 (26.4%)	+ 7.0	0.1877
	Depression	199 (10.4%)	39 (19.6%)	40 (20.1%)	+ 0.5	0.8840

BMI, body mass index; PA, physical activity. Sufficient physical activity was defined as ≥ 600 MET·min·wk^{-1}

Discussion

The principal finding was that habitual physical activity increased after TAA: the prevalence of sufficient physical activity increased from 19.6% to 27.1%, mean weekly MET expenditure increased by approximately 398 MET·min·wk⁻¹, and 74.6% of patients showed some increase in MET expenditure after surgery. However, the postoperative prevalence of sufficient physical activity remained low. Thus, the results should be interpreted as evidence that TAA is associated with improvement in habitual physical activity at the population level but not as evidence that surgery alone restores most patients to guideline-recommended activity levels [11].

End-stage ankle arthritis limits activity by causing pain, stiffness, impaired gait efficiency, and reduced walking tolerance. By replacing the arthritic ankle while preserving tibiotalar motion, TAA can reduce pain and improve gait mechanics, which may lower the physical and psychological barriers to walking and other low-impact daily activities [1, 2, 13, 14]. This mechanism may explain why nearly three-quarters of the patients increased their MET expenditure after surgery. In this respect, the present findings extend previous reports on return to sports after TAA by showing that improvement is also detectable in habitual physical activity measured in a nationwide health-screening cohort [4, 6, 7].

Nevertheless, only 27.1% of patients achieved sufficient physical activity postoperatively. This finding reflects the multifactorial nature of physical activity after TAA. Surgical pain relief may improve capacity, but actual activity behaviour is also influenced by age, preoperative deconditioning, cardiometabolic comorbidities, fear of falling, patient motivation, rehabilitation access, and advice to avoid high-impact activities to protect the implant [15–19]. In addition, many patients undergoing TAA are older adults with chronic ankle disease of long duration; therefore, reduced activity may have become habitual before surgery [15, 17–19]. These factors may explain why a statistically significant increase in activity did not translate into sufficient physical activity in most patients.

The difference between the mean MET increase and the threshold-based sufficient physical activity results is also important. The mean postoperative MET value was much higher than the preoperative value; however, the large postoperative standard deviation suggested a right-skewed distribution, in which a subset of highly active patients contributed substantially to the mean. In contrast, the sufficient physical activity threshold of 600 MET·min·wk⁻¹ reflects whether patients reached a minimum guideline-recommended level [9–11, 20]. Therefore, the two outcomes are complementary: mean MET expenditure captures the overall magnitude of change, whereas sufficient physical activity better reflects the proportion of patients who achieved a clinically meaningful activity target [11]. This explains why the average MET expenditure increased substantially, while most patients still remained below the sufficient physical activity threshold.

Sex-related findings showed different patterns depending on the activity outcome. Men had higher preoperative MET expenditures and postoperative prevalence of sufficient physical activity, whereas women had a higher proportion of patients with increased MET expenditures. One possible explanation is baseline or ceiling effects. Since men had higher activity levels before surgery, a larger proportion may already have been closer to the sufficient physical activity threshold, whereas women had lower baseline activity and therefore had more room for detectable improvement after pain relief and functional recovery

[19]. In contrast, the greater absolute mean MET increase in men may reflect a smaller subgroup returning to higher intensity or longer duration activities, which would have a stronger influence on the mean MET value.

Age-related differences are less consistent. Patients aged 70–74 years showed an increase in sufficient physical activity; however, the proportion of patients with increased MET expenditure did not differ significantly across age groups. This suggests that chronological age alone is not the main determinant of postoperative activity improvement after TAA. Patients selected for TAA, even at older ages, may represent a relatively healthy and motivated subgroup that can increase low-impact daily activity once ankle pain improves [18]. Conversely, younger patients may have higher functional expectations or may be more cautious about implant longevity and high-impact sports, resulting in less uniform changes in questionnaire-based habitual activity [6, 7].

Therefore, the BMI-related results should be interpreted cautiously. Most BMI groups showed increased activity, whereas the underweight group showed little change in activity. Because the underweight subgroup was very small, this result may have been unstable. Overweight or obese patients may experience meaningful improvements because ankle pain is a modifiable barrier to walking; however, residual obesity-related limitations may prevent many patients from achieving sufficient physical activity [19].

Alcohol consumption showed an outcome-dependent pattern. Patients who reported no alcohol consumption had the highest proportion of any MET increase, whereas those who consumed alcohol 1–3 times per week had the largest mean MET increase. This discrepancy may reflect differences in baseline lifestyle, general health, social activity, and the influence of a small number of highly active individuals on the mean MET expenditure. As alcohol consumption was self-reported and not the primary exposure of interest, this finding should be interpreted as descriptive rather than causal.

The comorbidity-related patterns provide clinically relevant information. Patients with diabetes mellitus, hypertension, dyslipidaemia, and chronic kidney disease generally showed increased activity after TAA, suggesting that common metabolic comorbidities do not necessarily prevent postoperative activity improvement when ankle pain and mechanical limitations are addressed. In contrast, patients with stroke showed a decrease in the prevalence of sufficient physical activity and almost no change in mean MET expenditure. This finding is plausible because neurological impairment, weakness, spasticity, impaired balance, fear of falling, and reduced walking confidence may limit activity even if ankle pain improves [21–24]. In such patients, the limiting factor may be neurological function rather than ankle joint mechanics alone.

Patients with cancer or depression also showed less consistent improvements in physical activity. In cancer survivors, fatigue, deconditioning, treatment-related symptoms, and concern about general health can act as barriers to activity [25–27]. In patients with depression, reduced motivation, fatigue, sleep disturbance, pain amplification, and lower adherence to rehabilitation may limit the behavioural changes required to increase habitual physical activity [28, 29]. These findings suggest that postoperative activity

after TAA is not determined solely by implant function or local ankle symptoms but by the interaction between musculoskeletal recovery and systemic, neurological, and psychological factors.

These findings have practical implications for postoperative care after TAA. First, improvements in ankle pain and function should not be assumed to automatically result in sufficient habitual physical activity [15, 17]. Second, postoperative counselling should include explicit activity goals, such as progressive walking and low-impact aerobic exercise, rather than focusing only on implant survival and range of motion [11, 16]. Third, patients with stroke, cancer, depression, underweight status, or other markers of frailty may require multidisciplinary rehabilitation, balance training, fall prevention strategies, and motivational support [16, 21, 28]. Finally, future studies should incorporate objective activity monitoring, patient-reported outcome measures, implant-related outcomes, and multivariable modelling to clarify which patients are most likely to achieve sufficient physical activity after TAA and which modifiable factors can be targeted.

Strengths include the nationwide database linked to health check-up records, a cohort of 1,916 patients larger than those in previous studies of activity after TAA, and use of the same questionnaire before and after surgery to assess paired changes in MET expenditure and sufficient physical activity.

This study had several limitations. First, this was an observational study without a nonoperative or arthrodesis control group; therefore, the observed improvements could not be attributed solely to TAA. Second, physical activity was self-reported and may have been affected by recall or social desirability bias; objective measures, such as accelerometry, would provide more precise estimates of activity [9, 10, 15, 17]. Third, the interval between surgery and postoperative health check-ups varied among patients, and postoperative activity may not have stabilised in all cases. Fourth, patients who experienced TAA failure or lacked complete health check-up data were excluded, which may have introduced a selection bias and limited generalisability. Fifth, because only univariate analyses were performed, the subgroup results should not be interpreted as independent predictors of postoperative activity improvement.

Conclusion

In this nationwide cohort, TAA was associated with a significant increase in habitual physical activity, with higher postoperative MET expenditure and MET improvement in nearly three-quarters of patients. However, only 27.1% of patients achieved sufficient physical activity after surgery, suggesting that surgery alone may not be sufficient to restore guideline-level activity in many patients. Patients with stroke, cancer, depression, or frailty-related features showed less consistent improvement and may require targeted postoperative rehabilitation and activity counselling.

Declarations

Author Contribution

YJ drafted the main manuscript. JHP and YJB critically reviewed and revised the manuscript. GWC supervised the study. All authors read and approved the final manuscript.

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Figures

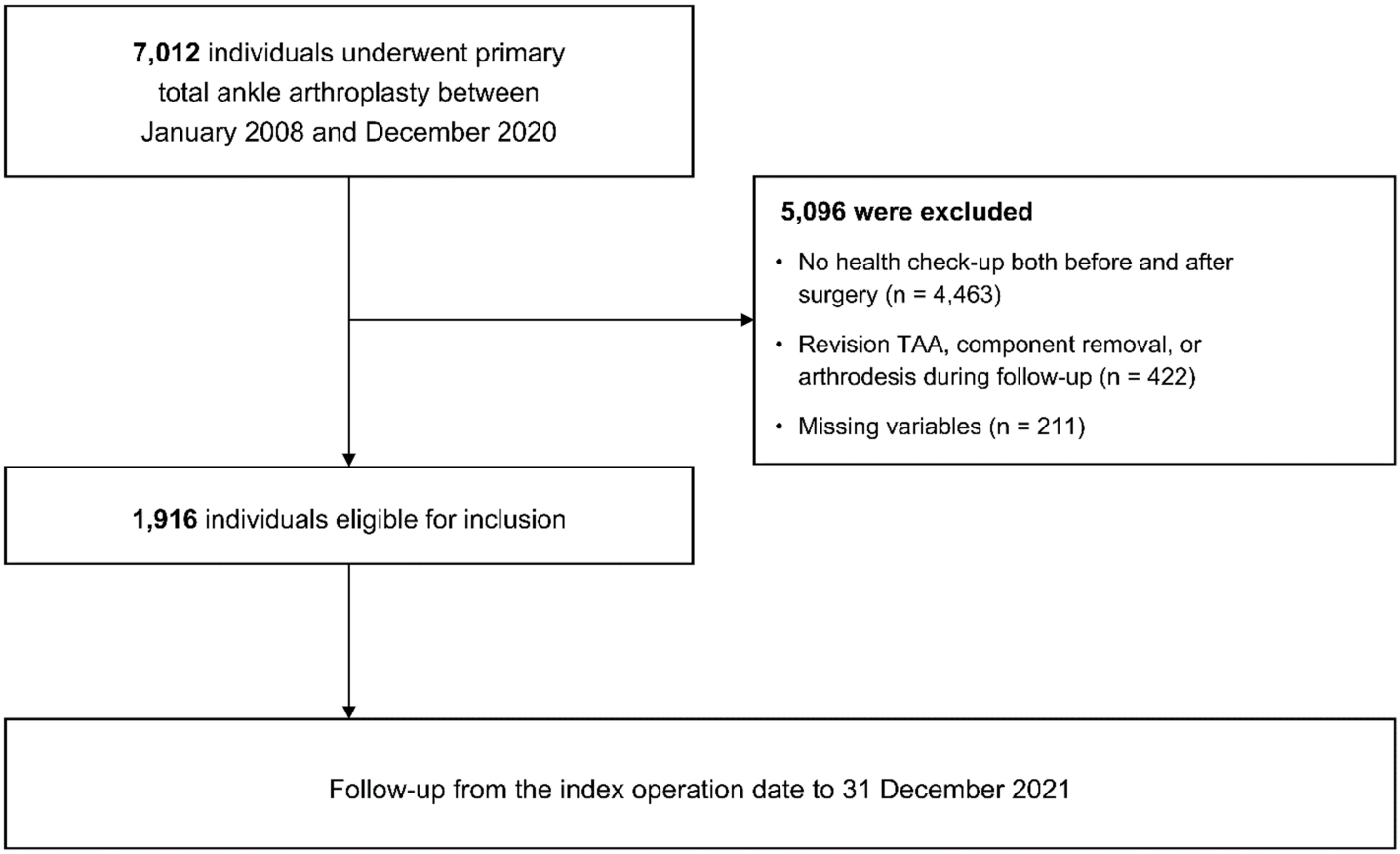


Figure 1

Flow diagram of the study population. TAA, total ankle arthroplasty

Supplementary Files

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