

Health-Related Quality of Life Among Middle-Aged Adults With Chronic Ankle Instability, Copers, and Uninjured Controls

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Context: People with chronic ankle instability (CAI) display a lower regional and global health-related quality of life (HRQoL). Examinations of HRQoL outcomes associated with CAI have addressed younger adults, restricting our understanding of the long-term consequences of CAI.

Objective: To compare ankle regional and global HRQoL in middle-aged participants with and those without CAI.

Design: Cross-sectional study.

Setting: Laboratory.

Patients or Other Participants: A total of 59 middle-aged volunteers, consisting of 18 with CAI (age = 50.2 ± 9.3 years), 17 who were ankle-sprain copers (age = 54.5 ± 8.7 years), and 24 uninjured controls (age = 56.7 ± 10.0 years).

Main Outcome Measure(s): Participants completed the Foot and Ankle Disability Index (FADI) and the Patient-Reported Outcomes Measurement Information System Adult Profile. Regional HRQoL was assessed using the FADI Activities of Daily Living and Sport subscales. Global HRQoL was measured using the 43-item Patient-Reported Outcomes Measurement Information System Adult Profile, which contains 7 short forms—Physical Function, Pain Interference, Fatigue, Depression, Sleep Disturbance, Anxiety, and Ability to Participate in Social

Roles and Activities. Separate Kruskal-Wallis tests were used to determine between-groups differences.

Results: Middle-aged participants with CAI had lower scores on both subscales of the FADI than the copers and control groups (all *P* values <.001). Participants with CAI scored lower on the Physical Function ($U=116.0$, $z=-2.78$, $P=.005$) and Ability to Participate in Social Roles and Activities ($U=96.0$, $z=-3.09$, $P=.002$) subscales but higher on the Pain Interference ($U=144.0$, $z=-2.36$, $P=.02$), Fatigue ($U=110.0$, $z=-2.72$, $P=.006$), and Depression ($U=110.5$, $z=-2.91$, $P=.004$) subscales than the control group. Participants with CAI also scored lower on the Physical Function ($U=74.5$, $z=-2.79$, $P=.005$) and Ability to Participate in Social Roles and Activities ($U=55.0$, $z=-3.29$, $P=.001$) subscales but higher on the Fatigue ($U=90.0$, $z=-2.09$, $P=.04$) and Depression ($U=96.5$, $z=-1.97$, $P=.048$) subscales than the copers group.

Conclusions: Middle-aged participants with CAI displayed worse ankle regional and global HRQoL than their age-matched healthy counterparts and copers. These results demonstrated that CAI can affect HRQoL outcomes in middle-aged adults.

Key Words: patient-centered care, patient outcomes, region-specific outcomes, generic outcomes

Key Points

- Middle-aged participants with chronic ankle instability (CAI) had worse global and regional health-related quality of life (HRQoL) than ankle-sprain copers and uninjured controls.
- Copers presented with outcomes similar to those of uninjured controls.
- Developing CAI after an ankle sprain can affect HRQoL in middle-aged adults.
- Identification and consideration of physical health and HRQoL should be incorporated into the functional evaluation and physical fitness prescription.
- Continued research is needed to better understand the potential consequences of CAI in middle-aged adults.

Assessments of health-related quality of life (HRQoL) have become a central component of health care because they can provide an understanding of how patients' experiences, expectations, beliefs, and perceptions are affected by their health conditions.¹ Given that HRQoL coalesces information from several health domains, self-report instruments are designed to survey either global or region-specific HRQoL.² Global measures of HRQoL are broad and nonspecific to a body region in order to provide a glimpse into a patient's overall

health status.¹ In contrast, region-specific instruments provide HRQoL information about a specific region of the body that may be affected by an injury.¹

Young adults with chronic ankle instability (CAI) are known to display a lower HRQoL on global and ankle-specific outcomes relative to uninjured controls.^{3,4} Chronic ankle instability is a clinical pathologic condition that develops in at least 30% of patients after an acute ankle sprain.^{5,6} It is characterized by repeated episodes of "giving way," feelings of ankle-joint instability, and recurrent ankle

Table 1. Groups' Inclusion Criteria (Mean ± SD)

Criteria	Group		
	Chronic Ankle Instability (n = 18)	Coper (n = 17)	Uninjured Control (n = 24)
Ankle Instability Instrument score	6.4 ± 1.4	2.1 ± 0.9	0.0 ± 0.0
Identification of Functional Ankle Instability score	17.1 ± 4.4	5.1 ± 2.9	0.0 ± 0.0
Cumberland Ankle Instability Tool score	14.9 ± 5.6	27.3 ± 4.5	30.0 ± 0.0
No. of lateral ankle sprains	4.0 ± 4.4	2.7 ± 3.3	0.0 ± 0.0
No. of episodes of "giving way" in the 6 mo before the study	4.9 ± 6.9	0.0 ± 0.0	0.0 ± 0.0

sprains.⁷ In comparison, copers are able to return to their normal physical activity after an ankle sprain with minimal, if any, level of self-reported disability or giving way.⁸ Researchers have encouraged the inclusion of copers to better understand the mechanisms that contribute to CAI because these individuals appear to be able to manage any damage after the initial ankle sprain. As such, young adults with CAI have also been shown to display a lower HRQoL on ankle-specific outcomes than copers.³ The results of these studies underscore the influence of CAI on HRQoL outcomes among young adults.

Despite this information, examination of the consequences of CAI beyond early adulthood has been limited.⁹ Therefore, whether CAI has a similar effect on middle-aged adults or if this condition is a primary concern for college-aged individuals only is unknown. Simon and Docherty¹⁰ recently demonstrated that middle-aged adults (≥40 years of age) with CAI displayed lower global and regional HRQoL than uninjured controls. This finding suggested that the effect of CAI extends beyond early adulthood. However, whether middle-aged adults with CAI also display a lower HRQoL than middle-aged copers has not been studied. Documenting this relationship will provide a more in-depth understanding of whether previously reported HRQoL deficits in this age group are exclusive to CAI or related to any previous ankle sprain. Therefore, the purpose of our study was to compare ankle regional and global HRQoL outcomes among middle-aged adults who had CAI, who were copers, or who were uninjured controls. We hypothesized that middle-aged adults with CAI would have lower ankle regional and global HRQoL than copers and control individuals. Additionally, we hypothesized that copers and control individuals would display similar ankle regional and global HRQoL.

METHODS

Study Design

A cross-sectional study design was used to compare scores on each subscale of the Foot and Ankle Disability Index (FADI) and the Patient-Reported Outcomes Measurement Information System (PROMIS) among middle-aged adults classified as having CAI or being copers or uninjured controls.

Participants

A total of 59 middle-aged participants were enrolled. The age classification (age range, 40–70 years) was based on previously published reports in which researchers examined outcomes in middle-aged adults with CAI¹⁰ and former National Collegiate Athletic Association Division I athletes.^{11,12} Recruitment for this study occurred between

January 2016 and July 2018. All participants were recruited through advertisements posted throughout a large university and its surrounding community and announcements displayed on approved social media accounts.

Inclusion criteria for participants with CAI were adapted from the guidelines of the International Ankle Consortium (Table 1).⁷ Participants with CAI must have self-reported a previous lateral ankle sprain before 40 years of age that resulted in pain, swelling, and a temporary loss of function for at least 1 day; have experienced ≥2 episodes of giving way in the 6 months before enrollment; and have scores of ≥5 on the Ankle Instability Instrument (AII), >11 on the Identification of Functional Ankle Instability (IdFAI), and <24 on the Cumberland Ankle Instability Tool (CAIT).

The inclusion criteria for participants identified as copers were based on the minimum reporting standard recommended by Wikstrom and Brown (Table 1).⁸ Specifically, participants self-reported having ≥1 previous lateral ankle sprain before 40 years of age that resulted in pain, swelling, and a temporary loss of function for at least 1 day. Furthermore, participants could not have self-reported any previous episodes of giving way or perceived instability based on scores of <5 on the AII, ≤11 on the IdFAI, and >25 on the CAIT.

Participants classified as uninjured controls were required to report never having experienced a lateral ankle sprain or previous episode of giving way on either limb. Additionally, uninjured control participants had to have scores of 0 on the AII and IdFAI and 30 on the CAIT (Table 1).

Exclusion criteria were (1) a diagnosis of a balance, vestibular, or respiratory disorder; (2) a reported history of low back pain in the 6 months before enrollment; (3) a history of fracture or surgery in the lower extremity; or (4) a reported history of concussion. All participants provided written informed consent, and the study was approved by the University of Kentucky Institutional Review Board (#46476).

Procedures

Participants reported to the research laboratory for a single testing session and completed a standardized health history questionnaire consisting of questions about the number of previous ankle sprains; first and most recent ankle sprains; number of episodes of giving way in the 6 months before the study; and any previous injuries of the back, hip or thigh, knee, or leg or foot other than an ankle sprain. They also completed the AII, IdFAI, and CAIT questionnaires. Finally, participants completed each subscale of the FADI and PROMIS.

Foot and Ankle Disability Index. The FADI is an region-specific ankle instrument that is a valid and reliable outcome measure for assessing levels of perceived

Table 2. Participants' Demographic Information (Mean ± SD)

Characteristic	Group			P Value
	Chronic Ankle Instability (n = 18)	Coper (n = 17)	Uninjured Control (n = 24)	
Age, y	50.2 ± 9.3	54.5 ± 8.7	56.7 ± 10.0	.10
Height, cm	165.6 ± 10.1	169.0 ± 10.6	166.5 ± 12.7	.68
Mass, kg	78.3 ± 18.6	78.3 ± 16.4	72.2 ± 12.4	.25
Body mass index, kg/m ²	29.4 ± 8.0	27.4 ± 5.5	26.4 ± 5.5	.30

disability related to a variety of pathologic foot and ankle conditions.¹³ We selected the FADI for this investigation because of its emphasis on evaluating pain. In a recent systematic review, Al Adal et al¹⁴ demonstrated that 50% to 79% of individuals with CAI reported ankle pain. Therefore, we selected a questionnaire that is used to evaluate this important symptom.

The FADI consists of the Activities of Daily Living (FADI-ADL) and Sport (FADI-Sport) subscales. The FADI-ADL comprises 26 items; the FADI-Sport, 8 items. Each item is scored on a 4-point Likert scale, with 4 representing *no difficulty at all* and 0 signifying *unable to do*. The 2 subscales are scored separately as percentages, with 100% indicating *no self-reported disability*.¹³

Patient-Reported Outcomes Measurement Information System. We selected the PROMIS as an outcome measure because it is a National Institutes of Health Roadmap Initiative intended to design and validate a series of patient-centered measures for assessing and monitoring physical, mental, and social HRQoL in adults and children with a variety of chronic conditions. Researchers have described its development,¹⁵ the validation process undertaken across patients with different clinical pathologic conditions,^{16–18} and its psychometric properties.^{19,20} Given the rigor behind the development of the PROMIS, investigators have started to use measures derived from it to examine HRQoL in middle-aged former Division I collegiate athletes¹¹ and patients recovering from an acute ankle sprain.²¹

For our study, we implemented the PROMIS-43 Adult Profile, version 2.0.^{20,22} This is a collection of 7 separate short forms that assess 3 broad health domains of physical, mental, and social health.²⁰ Physical health is assessed using the Physical Function, Pain Interference, Fatigue, and Sleep Disturbance short forms. Mental health is examined using the Anxiety and Depression short forms. Finally, social health is measured using the Ability to Participate in Social Roles and Activities (Social Roles) short form. Each short form has 6 questions that are scored using a Likert scale. The final score for each short form is converted into a *T*-score metric, with the mean of the US general population equal to 50 and standard deviation (SD) fixed at 10. A higher score on each short form represents more of the concept being measured. For example, a higher score on the Physical Function short form indicates more physical function, and a higher score on the Pain Interference short form reflects more pain. Thus, a higher score can be either desirable (eg, physical function) or undesirable (eg, pain).

Statistical Analysis

Normality of all key demographic information and primary outcome measures was determined based on the results of the Shapiro-Wilk test. We found that all key

demographic information was normally distributed ($P > .05$). However, all primary outcome measures were non-normally distributed ($P < .05$). Separate 1-way between-groups analyses of variance were performed to identify differences in any key demographic information. A Bonferroni post hoc analysis was used when we observed a group main effect. Separate Kruskal-Wallis tests were conducted to reveal between-groups differences in any primary outcome measure. When we observed a group main effect, we performed Mann-Whitney *U* tests to discover where the differences occurred. The α level was set a priori at .05. All statistical analyses were performed using SPSS (version 24.0; IBM Corp, Armonk, NY).

RESULTS

Group means and standard deviations for participant demographic information are listed in Table 2. Median and interquartile ranges (25%–75%) for the FADI and PROMIS scores are provided in Table 3.

Foot and Ankle Disability Index

We observed a group main effect for both the FADI-ADL and FADI-Sport scores (Table 3). Post hoc comparisons using the Mann-Whitney *U* test indicated that participants with CAI had lower scores on both subscales than the coper (FADI-ADL: $U = 20.0$, $z = -4.53$, $P < .001$; FADI-Sport: $U = 25.5$, $z = -4.27$, $P < .001$) and uninjured control (FADI-ADL: $U < 0.001$, $z = -6.08$, $P < .001$; FADI-Sport: $U < 0.001$, $z = -6.09$, $P < .001$) groups. The coper group also had lower scores on the FADI-ADL ($U = 168.0$, $z = -2.11$, $P = .04$) and FADI-Sport ($U = 120.0$, $z = -3.39$, $P = .001$) than the uninjured control group.

Patient-Reported Outcomes Measurement Information System

A main effect of group was present for the Physical Function, Pain Interference, Fatigue, Depression, and Social Roles subscales (Table 3). Post hoc comparisons using the Mann-Whitney *U* test showed that participants with CAI scored worse on the Physical Function ($U = 116.0$, $z = -2.78$, $P = .005$), Pain Interference ($U = 144.0$, $z = -2.36$, $P = .02$), Fatigue ($U = 110.0$, $z = -2.72$, $P = .006$), Depression ($U = 110.5$, $z = -2.91$, $P = .004$), and Social Roles ($U = 96.0$, $z = -3.09$, $P = .002$) subscales than the uninjured control group (Figure). Participants with CAI also scored worse on the Physical Function ($U = 74.5$, $z = -2.79$, $P = .005$), Fatigue ($U = 90.0$, $z = -2.09$, $P = .04$), Depression ($U = 96.5$, $z = -1.97$, $P = .048$), and Social Roles ($U = 55.0$, $z = -3.29$, $P = .001$) subscales than the coper group. No differences were observed between the coper and uninjured control groups (P values $> .05$).

Table 3. Primary Outcome Measure Results

Score	Group (Median [25%–75% Interquartile Range])			χ^2 Value	P Value
	Chronic Ankle Instability (n = 18)	Coper (n = 17)	Uninjured Control (n = 24)		
Foot and Ankle Disability Index, %					
Activities of Daily Living subscale	90.8 (86.0–95.4)	100 (100–100)	100.0 (100–100)	46.10	<.001
Sport subscale	78.1 (64.0–87.5)	100 (93.7–100)	100.0 (100–100)	43.72	<.001
Patient-Reported Outcomes Measurement Information System					
Physical Function	49.6 (45.4–58.7)	58.7 (53.9–58.7)	58.7 (52.4–58.7)	10.77	.005
Pain Interference	41.1 (41.1–52.3)	41.1 (41.1–41.3)	41.1 (41.1–41.1)	6.20	.045
Fatigue	47.0 (43.6–51.0)	44.2 (33.4–47.0)	39.1 (33.4–46.1)	8.23	.02
Sleep Disturbance	45.2 (43.8–50.5)	45.9 (42.0–49.5)	43.0 (37.3–51.5)	3.16	.21
Anxiety	42.5 (42.5–49.7)	39.1 (39.1–47.4)	39.1 (39.1–48.4)	5.69	.06
Depression	44.9 (38.4–48.3)	38.4 (38.4–45.9)	38.4 (38.4–44.9)	8.85	.01
Ability to Participate in Social Roles and Activities	57.1 (51.6–64.7)	65.0 (59.2–65.0)	65.0 (56.2–65.0)	13.85	.001

DISCUSSION

The purpose of our study was to compare HRQoL outcomes between middle-aged adults with and those without CAI. We surveyed regional HRQoL using the FADI. This instrument was designed to measure the level of difficulty a person experienced in performing activities of daily living or during sport and recreational activities in the previous 7 days because of his or her ankle condition.¹³ Our hypothesis was supported because participants with CAI had worse scores on both subscales than did copers and uninjured controls. We used the 43-item PROMIS Adult Profile to examine global HRQoL. Global instruments are broad and not specific to a body region in order to provide an understanding of how people perceive their overall physical, mental, and social health. As expected, we found that participants with CAI scored worse on constructs related to their physical, mental, and social health than did copers and uninjured controls.

The average scores of CAI participants on the Physical Function, Fatigue, Depression, and Social Roles short forms were >0.5 SD away from those of copers and uninjured controls. Amtmann et al²³ suggested that a between-groups difference >0.5 SD on HRQoL instruments was clinically meaningful. Subsequently, it appears that the statistical differences observed in our study were also clinically meaningful. Unlike other HRQoL instruments that have age-based norm values, the average T-score metric for the US general population is 50, with a fixed SD of 10. The average scores of the CAI group were within 0.5

SD of the US general population. Therefore, the reported symptoms were within the normal expected range.

In contrast, the average scores for the copers and uninjured controls were >0.5 SD away from the US general population. Such a difference would indicate that our copers and uninjured controls displayed HRQoL scores that were better than those of most of the US general population. A potential explanation for this might be the result of an exchange between our exclusion criteria and the original construction of the PROMIS. The item selection and scoring procedures for the PROMIS were based on data collected from a large number (>21 000) of survey respondents (age > 18 years) with a median age of 50 years.¹⁵ This sample consisted of otherwise healthy individuals from the US general population and patients with a diagnosis of a chronic condition, such as heart disease or osteoarthritis.¹⁵ In this study, we excluded participants with a past or current chronic condition or a history of fracture or surgery to eliminate possible confounding factors. Therefore, our copers and uninjured controls likely resembled individuals from the general population who scored higher than average on measures of HRQoL. This should be considered when interpreting and applying our data.

Most of the current literature examining the association between HRQoL outcomes and CAI has focused on college-aged adults. In a systematic review with meta-analysis, Houston et al²⁴ concluded that individuals with CAI reported a lower regional HRQoL than copers and uninjured controls. Moderate evidence suggested that CAI was associated with deficits on global instruments used to assess physical health.²⁴ However, the conclusions as to whether CAI influenced mental or emotional health outcomes were mixed.^{4,24,25} Our results reflected the current evidence and demonstrated the potential for lingering symptoms after an acute ankle sprain to affect how people perceive their global and ankle HRQoL. This emphasizes the need for clinicians and researchers to evaluate global HRQoL and ankle function during rehabilitation.

Our findings agree with the limited research on the consequences of CAI beyond early adulthood. Specifically, using the American Academy of Orthopaedic Surgeons Lower Limb questionnaire and the Short Form-36 (SF-36, version 2), Simon and Docherty¹⁰ studied a similar-aged population and documented decreases in ankle function and poorer physical health among middle-aged adults with CAI

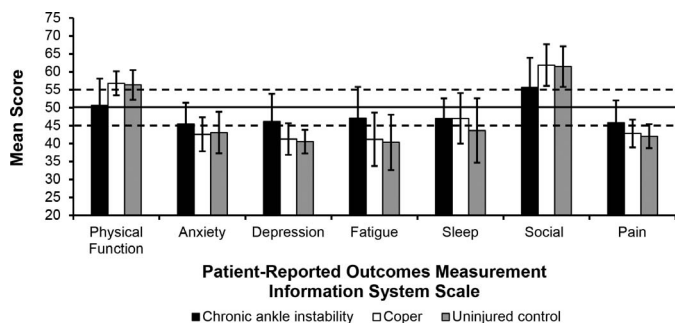


Figure. Patient-Reported Outcomes Measurement Information System score group means and standard deviations. The solid line represents the US population mean; the dotted lines represent 0.5 SDs.

than among uninjured controls. In another study,²⁶ a combination of mechanical and sensorimotor impairments associated with CAI contributed to how young adults perceived their ankle function and physical health. We did not report on any mechanical or sensorimotor impairments in our participants. Nevertheless, it is plausible that a combination of unresolved impairments after an ankle sprain can persist into middle adulthood and contribute to the HRQoL reported by our participants with CAI.

Our findings differed from those reported by Simon and Docherty¹⁰ because they did not identify a difference on the mental component of the SF-36 between middle-aged adults with CAI and uninjured controls. Instead, we demonstrated that participants with CAI scored worse on the Depression short form, which contributes to the overall mental domain of the PROMIS. This suggested that factors related to CAI might contribute to an increased feeling of sadness or negativity. We also observed that middle-aged adults with CAI were less content with respect to their social interactions with family, friends, or colleagues. Differences in the SF-36 and PROMIS might explain the inconsistent results. The PROMIS Adult Profile used in our study contains 2 individual short forms to assess different domains related to mental health (Anxiety and Depression). In comparison, the mental component score of the SF-36 aggregates the scales.²⁷ Another reason for the inconsistency could be related to our inclusion criteria. Specially, we required that our participants self-report having their initial ankle sprain before the age of 40 years. We decided to make this a part of our inclusion criteria to identify participants who might have developed CAI as young adults. Simon and Docherty¹⁰ did not specify when their participants with CAI had to have sustained their initial ankle sprains. Therefore, the residual effects of an ankle sprain as a young adult may yield more measurable deficits.

A unique aspect of our study was that middle-aged participants identified as copers were included. Copers are individuals who can return to their regular activities after an ankle sprain with minimal, if any, level of disability.⁸ Thus, it is not surprising that middle-aged copers self-reported a better global HRQoL than did participants with CAI. In contrast, we noted a difference on the FADI, suggesting that copers had more regional disability than the uninjured control group but less than the participants with CAI. The average between-groups differences on the FADI-ADL and FADI-Sport for the coper and the uninjured control groups were 1.4% and 3.5%, respectively. The *minimal detectable change* (MDC) provides an estimate of the amount of change beyond measurement error that should be considered relevant. The MDCs have been reported as 4.4% on the FADI-ADL and 6.3% on the FADI-Sport.^{13,28} Hence, the average between-groups difference for the coper and uninjured control groups was within the MDC for the FADI. Conversely, the mean differences on the FADI-ADL and FADI-Sport between the CAI and coper groups were 9.7% and 22.7%, respectively. These differences were greater than the previously reported MDC. These large between-groups differences build on the current research among this age cohort by demonstrating the concern for developing CAI after an acute ankle sprain.¹⁰ Furthermore, these results emphasize the need for physical rehabilitation after an acute ankle sprain to minimize the risk of developing CAI and its effect on HRQoL.

Authors of studies^{11,12} surveying the current HRQoL of former Division I athletes (age range = 40–65 years) detected trends of diminished physical, mental, and social health similar to those of nonathletes. This observation led the researchers to hypothesize that injuries sustained while participating in athletics as a young adult may negatively affect HRQoL outcomes with advancing age. Whereas we did not enroll former Division I athletes, most ankle injuries occurred during sport or recreational activities. Furthermore, we required participants to self-report having their first ankle sprain before 40 years of age. Therefore, our data lend support to the idea that musculoskeletal injuries leading to chronic conditions may negatively affect HRQoL outcomes with advancing age. However, similar to previous investigators,^{11,12} we did not prospectively follow our middle-aged participants. The retrospective cross-sectional design of our study prohibits the drawing of any clear connection. Outside factors (eg, education level, income, or other health conditions not recorded) may have also contributed to the lower HRQoL. Future researchers should document and control these factors to gain a better understanding of the relationship between musculoskeletal injury and HRQoL outcomes in middle-aged adults.

The inclusion criteria for this study were centered on guidelines of the International Ankle Consortium for selecting participants with CAI. The guidelines were based on common self-reported characteristics (eg, giving way) and scores on questionnaires originally designed to discriminate between college-aged adults with and those without CAI. We are among the first to apply these guidelines to a middle-aged population. Some concern exists that middle-aged individuals with CAI might present with different symptoms than younger adults. Therefore, the need to identify and develop valid and reliable inclusion criteria for middle-aged adults with CAI is clear. Another limitation of this study was that it was difficult to confirm when our middle-aged participants developed CAI. We asked them to estimate how long they had experienced symptoms related to CAI, and the average was 18 years. As such, we have reason to speculate that some of our participants may not have started to experience symptoms of CAI until they were older. Thus, the duration of symptoms of CAI might also influence how individuals perceive their HRQoL. Moreover, based on the design of our study, it was also feasible that participants classified as copers had CAI earlier in life and learned to manage their symptoms over time.

CONCLUSIONS

Our results demonstrated that middle-aged participants with CAI had worse regional and global HRQoL than copers and uninjured controls. We also determined that copers presented with outcomes similar to those of uninjured controls. Together, these findings suggest that developing CAI after an ankle sprain can affect HRQoL in middle-aged adults. Both physical health and HRQoL should be incorporated into the functional evaluation and physical fitness prescription. Continued research is needed to further understand the potential consequences of CAI in middle-aged adults.

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