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Invariance Testing of the Adult-Oriented Sport Coaching Survey Across Masters Athletes' Age, Gender, Competition Level, and Sport

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ABSTRACT

The Adult-Oriented Sport Coaching Survey (AOSCS) is a valid and reliable measure of coaches' and Masters athletes' perspectives of how often adult-oriented coaching practices are used. However, Masters athletes' heterogenous traits have been acknowledged as barriers to generalizing research findings on coaching behaviors. Therefore, this study aimed to conduct invariance testing of the AOSCS across groups of Masters athletes based on age, gender, competition level, and sport grouping variables. A sample of 616 Masters athletes (61.9% female, 37.5% male; $M_{age} = 54.47$ years, $SD = 10.82$) completed the AOSCS-A (athlete version) and demographic questions. The results indicated the AOSCS-A demonstrates configural, metric, scalar, and strict invariance across Masters athletes that differed on age, gender, competition level, and sport. This evidence advances the AOSCS-A as an assessment tool by ensuring confidence in the measurement and interpretation of adult-oriented coaching practices reported by Masters athletes, irrespective of age, gender, competition level, and sport.

KEYWORDS

Masters sport; measurement equivalence; survey development; coaching adult sport; assessment

Masters athletes (MAs) are a unique competitive cohort of adult sportspersons who regularly exceed physical activity recommendations (Larson et al., 2021) and defy socially expected aspects of aging (Geard et al., 2017). Generally, MAs are sportspersons over the age of 35 (sport-dependent) who regularly practice to ready themselves to compete at sanctioned sport events for individuals beyond the normative age of peak performance (Young et al., 2018). Whereas much of the early research on this cohort focused on the physical and physiological aspects of MAs, studies on the psychosocial aspects of Masters sport have increasingly found representation in empirical literature in the past decade (see Cannella et al., 2021; Dionigi, 2016; Young et al., 2018 for reviews).

Within the psycho-social literature, coaches have been identified as an important source of support for MAs (Callary et al., 2021; Dionigi et al., 2021), providing social, health, motivational, and performance benefits, fostering relationships inside and outside of sport (Ferrari et al., 2017; Santi et al., 2014), and enhancing a "Quality Masters Sport Experience" (Young et al., 2021, p. 1) for athletes. Following early works that interrogated the novelties of coaching middle-aged and older adults in sport (Callary et al., 2015; Morris-Eyton, 2008; Young et al., 2014), there have been significant growth in evidence-based work that has noted MAs' specific wants, needs, and preferences in terms of their coaches' behaviors (e.g., Callary et al., 2017; MacLellan et al., 2019; Rathwell et al., 2015). For example, MAs indicated that they wanted to be coached differently than youth athletes in an environment where their coaches consider their individual needs, such as knowing when and how to give constructive feedback to each athlete (Callary et al, 2015). These findings are notable because of the lack of available resources for coaches of adult athletes (Callary et al., 2018).

The adult-oriented sport coaching survey

There is a growing narrative around the proper strategies, resources, and curriculum to better prepare and educate individuals to serve as coaches with MAs (see Callary et al., 2021). One poignant example is Rathwell et al.'s, (2020) effort to develop a reliable and valid self-report measurement tool, the Adult-Oriented Sport Coaching Survey (AOSCS) that (a) allows coaches to assess key psychosocial themes in how they coach their MAs (AOSCS-C; coach version) and (b) allows athletes to reliably provide feedback on these coaching themes (AOSCS-A; athlete version). The survey measures were informed by extensive qualitative works on nuanced approaches to coaching adults in sport (Callary et al., 2015; 2017; MacLellan et al., 2019; Rathwell et al., 2015)

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with additional vetting of the initial survey item inventory by coaches (Rathwell et al., 2020).

The AOSCS measures five factors, each representing a distinct adult-oriented coaching practice: (a) *Considering the Individuality of Athletes* – coaches consider how to adapt their approach to each athlete's experiences and motives when planning, organizing, and delivering practice; (b) *Framing Learning Situations* – coaches contextualize learning situations for athletes using methods of self-discovery, problem-based scenarios, modeling, and assessments; (c) *Imparting Coaching Knowledge* – coaches share their relevant coaching knowledge, development, and athletic experience with their athletes in order to inspire, explain, and/or empathize with them; (d) *Respecting Preferences for Effort, Accountability, & Feedback* – coaches consider how each athlete wishes to be held accountable for working hard, giving effort, and how they wish to receive feedback; and (e) *Creating Personalized Programming* – coaches tailor aspects of short- and long-term scheduling (practice and competition), season-long planning, and support at competition to each athlete's needs and abilities.

Rathwell et al., (2020) established face validity of the AOSCS by testing the clarity of the items and their relevance to coaching MAs using data from 12 coaches of MAs. Further evidence has been found for the factorial validity and the internal consistency reliability of scores for both the AOSCS-A and the AOSCS-C using data from coach and athlete samples (Motz et al., 2022; 2023; Rathwell et al, 2020) – positioning both versions of the AOSCS as valuable tools for coach practitioners and researchers alike. These versions of the survey reliably assess coaches' and athletes' perceptions of adult-oriented coaching practices and are identical in their factor structure, which makes comparisons between both sources of data simple and clear. The survey has also shown criterion validity, with scores on the AOSCS-A associating with several variables "indicative of a quality sport experience" (Motz et al., 2022, p. 16) for MAs. When MAs reported greater exposure to these practices, they had greater sport commitment and enjoyment, greater investment and liking practice, better interdependent relations with their coach, and felt more satisfied in terms of their basic psychological needs (Motz. et al., 2022; 2023). Still, there has been little attempt to understand how the AOSCS versions are understood and responded to based on sub-cohorts within large samples of survey respondents. Such types of examination are important, especially considering that coaches (of Masters Sport) need to cater to heterogeneous groups, wherein a coach might have within the same group of adult athletes, a variety of motives, levels of experience, competitive orientations, ages, abilities, personalities, and other factors to consider (Callary et al., 2017; 2021).

To further test the AOSCS-A as a tool for reliable and valid self-report, the current study pursues invariance testing. Invariance (or equivalence) testing is important in the field of assessment because it informs the confidence with which one can use an instrument, and specifically, the accuracy of using the same tool to measure a construct (e.g., adult-oriented coaching practices) across different groups within a population (e.g., male/female adult athletes) (Byrne, 2012). In contrast, non-invariance (or non-equivalence) would indicate that a construct differs in meaning for subgroups within a population (Putnick & Bornstein, 2016), rendering future attempts at testing the effectiveness of the construct (i.e., adult-oriented coaching practices) problematic. That is, in the case of noninvariance, MAs (e.g., male/female MAs) would understand and interpret adult-oriented coaching practices differently during assessment. Thus, noninvariance would make the application of adult-oriented coaching practices arduous for MAs, their coaches, and Masters sport personnel. Indeed, a series of invariance tests would help to determine if the AOSCS-A factors are similarly and accurately interpreted, and measured, across pertinent subgroups within a sample of MAs. Invariance testing is a prerequisite for comparing groups on constructs (Wang & Wang, 2020), such as the five coaching themes of the AOSCS-A. There is precedent for the value of invariance testing in heightening empirical confidence for other coaching behavior instruments. For example, invariance testing, focused on gender, heightened confidence in the Sportsmanship Coaching Behavior Scale (Bolter & Weiss, 2013), the Coaching Behaviors in Comprehensive Community Sport Clubs questionnaire (Takamatsu & Yamaguchi, 2018), and the Fitness Coaching Behaviour Scale (Pimenta et al., 2020). No research has yet examined measurement invariance of surveys for adult-oriented coaching practices, and none specifically regarding Rathwell et al.'s, (2020) AOSCS-A.

Prospective variables that could influence athletes' responses on the AOSCS-A

On the question of reliable assessment, one cannot simply assume the AOSCS-A performs the same way in various subgroups, which is especially important to consider given the heterogeneity of Masters groups. Any information drawn from the AOSCS-A that may be useful to coaches, or to understanding how coaches can apply adult-oriented coaching practices in Masters sport, depends on understanding whether its utility as an assessment tool is invariant across key grouping variables within a sample. Indeed, MAs' heterogenous characteristics have been well documented in the literature. Particularly, MAs' psychosocial outcomes, including achievement and participatory motives, have been shown to vary as a function of age, gender, competition level, and sport types (see Young, 2011 for a review). These four factors appear to be legitimate, testable grouping variables important to measurement and are the focus of this study for invariance testing.

Age is a key consideration as it influences both the physiology and the competitive performance expectations of MAs. Age is a key marker related to performance that may indicate differences across groups of MAs. Specifically, the world record Masters performers aged 35–49 have the smallest age-related percentage differences in performance. After age 55 years, record holders' performances see a noticeable decrease, and after age 85, such decline is typically exponential (Ransdell et al., 2009). Further, age-related considerations – managing age-related injury and negotiating self-appraisals in the face of decline – are a key area of concern for MAs who seek applied sport psychology consultation (Makepeace et al., 2021). Age status is a significant moderator of performance-oriented motives and participatory motives across the lifespan (Young, 2011). Finally, aging expectancies are proposed to influence how coaches utilize adult learning principles in sport (MacLellan et al., 2019). Altogether, it is possible that the reliability of AOSCS-A items could vary as a function of young or older age status.

A review of survey reports on MAs' sport commitment, achievement, and participatory motives noted that gender and competition levels are significant moderators (Young, 2011). In terms of gender, a review of motivational research among MAs (Young, 2011) showed that men and women have been portrayed differently. Though there are exceptions, men generally have been portrayed as being higher in competitiveness, ego-orientation, and obligatory commitment, than women, who have typically been described as having participatory orientations focused on social and health reasons, with higher task-orientation and lower obligatory commitment. Callary and Young (2016) suggested that coaching women MAs may be quite different than coaching men, though no research attests to whether self-report of adult-oriented coaching practices are equivalent across men and women. Further, competitive level ranges across samples of MAs, from recreational to serious-minded. The andragogy in sport model of coaching (MacLellan et al., 2019), which parallels the AOSCS-A, indicates that competition level in the coaching context has a significant influence on how adult-oriented coaching approaches are delivered and received. Further, in Callary' et al., (2022) qualitative study, coaches perceived that the items in the AOSCS-C are competitively oriented. Thus, it is possible that the competition level of MAs may cause variability in how items are understood and reported, resulting in non-invariance in the AOSCS-A. One can look outside of Masters Sport literature to note that coaches use different forms of knowledge and behaviors when coaching athletes of different competition levels (González-Rivera et al., 2017). The current study will test whether gender status and competition-level influence AOSCS-A measurement equivalency.

Coach education broadly purports that coaching practices may differ based on the sport typology (e.g., basketball, baseball, athletics, tennis, etc.; see Coaching Association of Canada, n.d.). That said, psychosocial scholars in Masters Sport have focused on individual sports, especially the most popular sports like swimming. We suspect swimming is overrepresented in part because much of the Masters Sport coaching literature has been built upon convenience sampling of swim coaches/coaching (e.g., see Callary et al., 2015; 2017; Ferrari et al., 2017; Rathwell et al., 2015; Young, 2011). Moreover, psychosocial scholars in Masters Sport have focused on individual sports, of which swimming is usually highly popular, and it also has some of the highest registration numbers at Masters sporting events (e.g., see Torino 2019European Masters Games Organising Committee, 2020). The fact that much Masters Sport coaching literature has been built upon convenience sampling of swim coaches/coaching may be problematic considering the many various Masters sports available for adult athletes that are coached (e.g., Motz et al., 2022) and the possibility that self-report may vary across these sports. Thus, the current study aimed to test the invariance of AOSCS-A self-report between swimming and various other sport types.

Given the recency of the development of the AOSCS-A, and keeping in mind MAs' heterogeneity, no studies have determined if coaches need to alter their adult-oriented approaches based on athletes' variable traits. There is currently no indication to suggest Rathwell' et al., (2020) AOSCS-A is protected from volatility due to MAs' heterogeneity. One strategy for improving confidence with which the AOSCS-A instrument is resilient (or susceptible) to such variability is invariance testing. Therefore, the aim of this study was to conduct invariance testing of the AOSCS-A to determine if the five distinct factors of adult-oriented coaching practices are interpreted and measured similarly across groups of MAs based on age, gender, competition level, and sport type.

Methods

Procedures

Ethics approval for this study was attained at the lead researcher's institutional ethics board. Participants' consent was acquired prior to data collection. MAs were recruited from 2018 to 2021 to participate in studies for a broader research project. They were recruited from various online sources including, but not limited to, social media and team/club websites. Additionally, MAs were recruited in-person at local Masters sport events in Canada and Australia. For our purpose of invariance testing, the current MAs' data were collated from independent samples in Motz et al. (2022) and Motz et al. (2023).[1] MAs in both studies completed the same demographic and sport involvement questions, read the same survey prefaces, and responded to the same AOSCS survey, prior to completing any questions regarding outcome or other criterion variables. Thus, the outcome/criterion variables that were treated in analyses in the abovementioned studies (Motz et al., 2022; 2023) should not systematically bias responses to AOSCS items because of their placement at the end of the respective survey protocol.

Participants

All participants were considered MAs according to Young' et al., (2018) criteria: they met the age requirements for their respective Masters sport,[2] were formally registered with a team/club or for a competitive event, and indicated they practiced/trained to prepare for competition (i.e., indicated above zero practice/training times/hours per week to prepare for competition). After applying a further inclusion criterion – that a participant had to acknowledge the use of a personal coach, the collated sample included 616 MAs, whose ages ranged from 20 to 85 years old ($M = 54.47$, $SD = 10.82$) with 61.9% ($n = 381$) identifying as female, 37.5% ($n = 231$) identifying as male, and four electing to not to respond regarding gender. Additionally, 95.07% identified as being white/Caucasian, 1.81% as Asian, 1.15% as Hispanic, 1.15% as African American/black, 0.33% as being Aboriginal, and 0.49% as "other" or unspecified. Participants resided in Canada (73.1%), USA (13.5%), Australia (8.3%), and the UK (2.3%), with the remaining 2.8% residing in 12 additional countries. Highest level of education constituted a graduate degree or equivalent professional degree (45.0%), undergraduate degree (35.9%), college diploma (13.6%), or high-school education (5.2%), with 0.2% comprising lesser levels or missing responses.

Participants indicated their primary sport as swimming (43.8%), athletics (15.4%), rowing (10.9%), skiing (7.6%), triathlon (6.3%), dragon boat (3.4%), speed skating (3.1%), artistic swimming (2.9%), weightlifting (1.6%), artistic skating (1.3%), or one of the 11 additional sports (3.7%; biathlon, CrossFit, cycling, diving, golf, gymnastics, judo, racewalking, ringette, ultrarunning, water polo). On average, participants engaged in their sport (including training) 10.55 months per year ($SD = 2.38$) and practiced 4.29 times per week ($SD = 2.11$). They competed in a mean of 4.96 events ($SD = 5.42$) in the last year, ranging from recreationally to internationally competitive. Finally, they reported practicing with a coach who was present, on average, 2.74 times per week ($SD = 1.47$).

Self-reported measurements

Data were collected using online questionnaires to gather demographic and sport involvement information and responses for the AOSCS-A.

AOSCS – athlete version

The athlete version of the Adult-Oriented Sport Coaching Survey (AOSCS-A; Rathwell et al, 2020) consisted of 22 items assessing athletes' perceptions of how often their coaches use five factors of adult-oriented coaching practices: *Considering the Individuality of Athletes, Framing Learning Situations, Imparting Coaching Knowledge, Respecting Preferences for Effort, Accountability, and Feedback*, and *Creating Personalized Programming*. See Appendix I for the respective items for each factor. All the items were prefaced with the stem "My coach/instructor ... " while the response format was a 7-point Likert scale ranging from *never* (1) to *always* (7), with the middle anchor (4) labeled as *sometimes*. In the present collated sample, the internal consistency of each factor was interpreted based on McDonald's Omega (recommended $\Omega > .80$; Feißt et al., 2019), with all factors surpassing .82.

[1]Motz et al. (2022) used a full factorial structural equation model to examine the cross-sectional associations between MAs' perceptions of adult-oriented coaching practices and various qualities of their relationship with their coach. Motz et al. (2023) examined changes over time, using latent variable path analyses and difference scores (absolute difference in athletes' scores over time), in MAs' perceptions of adult-oriented coaching practices in relation to basic psychological needs satisfaction and thwarting, and in relation to changes in the coach-athlete relationship. Neither study examined invariance – the explicit aim of the present study.

[2]The respective age to qualify as a MA was vetted in Motz et al. (2023) on a case-by-case basis, based on the primary sport for which the participant reported engagement and cross-referencing this with the minimal age for Masters competition in that sport. Thus, though 14 athletes in the present sample were under 35 years of age, they were legitimately MAs in their respective sports.

Grouping variables

Our grouping variables were determined based on inspection of cell sizes according to logical and intuitively relevant categories for our four targeted sub-cohort grouping variables (i.e., age, gender, competition level, and sport type).

Age. Given Ransdell' et al., (2009) key markers of age-related physiological decline, and given the availability and distribution of data in our sample, we created two groups: a group aged 35–55 representing "Peak Performance Years of MAs" ($n = 301$), and those aged 56–85 representing "Resolute Years of MAs" ($n = 301$; i.e., resolute in their commitment to sport, yet declining in performance). As most studies involving MAs use a cutoff of 35 years as the inclusion criteria (e.g., Hoffmann et al., 2019), we excluded 14 athletes (<35 years) from these groups for the purpose of the age invariance analysis.

Gender. We used the self-disclosure of gender ($n = 4$ preferred not to report and needed to be excluded for analytic reasons) to constitute female ($n = 381$) and male ($n = 231$) groups. Only male and female MAs were compared in our analyses.

Competition level. In the sport involvement questions, participants reported their present levels of competition from a range of categorical responses: recreational; regional; provincial/state; national; and international level. We inspected the responses, noting the highest category each participant reported. Given the distribution of athletes' responses, two distinct groups were formed: a "higher" group ($n = 297$) comprising those competing at national or international events (at least one event), and a "lower" group ($n = 315$) including those competing at provincial/state, regional, or recreational events, creating two groups for invariance analyses.

Sport type. In terms of one's primary sport, many indicated swimming ($n = 270$; 43.8% of the sample), while the remaining respondents indicated 21 other sports as their primary sports. Thus, we elected to contrast "non-swimming" ($n = 346$) and "swimming" groups. These groups allowed for invariance testing between Masters swimmers, a popular research sample, and MAs from all other underrepresented/understudied Masters sports (in relation to coaching).

Planned data analyses

Descriptive statistics were conducted using SPSS Statistics 25 (IBM, 2017). The AOSCS-A variables were analyzed for univariate and multivariate outliers using standardized *z*-scores and Mahalanobis distance, respectively. Univariate and multivariate skewness and kurtosis were calculated using WebPower (Zhang & Yuan, 2018). Invariance tests were conducted using Mplus 8.6 (Muthén & Muthén, 2021). A maximum likelihood estimator with a correction for non-normality (MLR; Kelloway, 2014) was used to examine CFA measurement models. The hypothesized CFA measurement models consisted of five latent factors (i.e., the five subscales of the AOSCS-A) and 22 observed variables (i.e., the 22 items from the AOSCS-A). For each model, we used multiple indicators to examine model fit. First, we determined and evaluated the chi-square exact fit (χ^2) and its degrees of freedom (*df*). A non-significant ($p > .05$) chi-square test is indicative of an acceptable fit. Conversely, a significant chi-square test suggests that the observed discrepancy between the hypothesized measurement model and the observed model is greater than would be expected due to chance. Notably, a significant chi-square exact fit *p*-value is expected with large samples sizes (Brannick, 1995) such as the sample in this study ($N = 616$ and 22 observed variables). For this reason, we further examined and reported five additional fit indices (Hair et al, 2018; Kelloway, 2014; Schermelleh-Engel et al., 2003; Tabachnick & Fidell, 2019) with acceptable criteria indicated in parentheses: normed chi-square ($\chi^2/\text{df} \leq 3$), comparative fit index (CFI > .90), Tucker, and Lewis index (TLI > .90), root mean square error of approximation (RMSEA < .07), and the standardized root mean residual (SRMR < .08). Of note, due to the chi-square significance model being criticized for its sensitivity (Kline, 2011), we relied more heavily on normed chi-square statistics when interpreting measurement model fit.

The invariance tests were conducted in accordance with guidelines published by Byrne (2012), Muthén and Muthén (2021), and Wang and Wang (2020). Invariance tests examine equality between groups over a hierarchically ordered set of models that increase in restrictiveness with each successive step (Byrne, 2012; Pacewicz et al., 2022). Testing measurement invariance ensures that the observed AOSCS-A items measure the same theoretical constructs (i.e., five factors of adult-oriented coaching) in all comparison groups. In total, we conducted four invariance analyses (one for each grouping variable) which examined the configural, metric, scalar, and strict invariance across comparison groups within each grouping variable. Invariance tests examined different aspects of assessment, each with unique test criteria, as articulated below.

Configural invariance

Establishing configural measurement invariance was the first step in determining whether the AOSCS-A is interpreted equivalently across different groups (Byrne, 2012; Muthén & Muthén, 2021). Configural measurement invariance tests whether the data from the comparison groups are represented by the same basic factor structure (i.e., the same number of items load on the same number of intended factors, but the items do not have to have equivalent loadings; Wang & Wang, 2020). The *configural model* acted as a baseline model for comparisons because no equality restrictions were stipulated for model parameters (i.e., factor loadings or item intercepts). In our analyses, configural invariance was inferred if: the chi-square test was non-significant ($p > .05$), $\chi^2/df \leq 3$, CFI >.90, TLI >.90, RMSEA <.07, SRMR <.08.

Metric invariance

Metric invariance tests whether the strengths of the factor loadings (i.e., the strength of the linear relationships between items and their intended factors) are equivalent. If the comparison groups are equivalent in factor structures and factor loading strengths, then it is possible to infer that items are interpreted on the same scale between comparison groups (i.e., metric invariance; Wang & Wang, 2020). Thus, for the *metric model* (or the weak invariance model; Wang & Wang, 2020), we imposed equality constraints on factor loadings. To test for metric invariance, the metric model is compared to the configural model and metric invariance is assumed if there are minimal changes to fit criteria after imposing the equality constraint. More specifically, chi-square difference testing ($\Delta\chi^2$) was performed to compare metric and configural models. Metric invariance is assumed if the metric and configural models *do not* significantly differ ($p > .05$; Pacewicz et al., 2022). However, chi-square difference tests often yield significant results ($p < .05$) due to sensitivity to sample size, group size, and other assumptions (Pacewicz et al., 2022). Therefore, Chen (2007) suggests examining changes in additional fit indices when chi-square results are significant. Specifically, we determined that metric invariance was present if the absolute change values for CFI and TLI (ΔCFI and ΔTLI, respectively) were less than .01 and the absolute change in RMSEA (ΔRMSEA) was less than .015, or the change in SRMR (ΔSRMR) was less than .01.

Scalar invariance

Scalar invariance tests whether item intercepts are equivalent across groups. Scalar invariance allows one to infer that items interpreted on the same scale are also systematically equivalent in terms of scale (i.e., one group is not systematically responding higher or lower to any items), which sets the precedence for group-based comparisons to be made at the factor level (Wang & Wang, 2020). Thus, we examined the *scalar model* (or strong invariance model; Wang & Wang, 2020) by imposing equality constraints on both factor loadings and item intercepts when testing our comparison groups within each of our grouping variable analyses. The scalar model was compared to the metric model, and scalar invariance was inferred if there were minimal changes to fit criteria (same as described above for metric invariance) after imposing the equality constraints: $\Delta\chi^2$ ($p > .05$); or ΔCFI and ΔTLI < .01 with ΔRMSEA < .015 or ΔSRMR < .01.

Strict Invariance

Strict invariance tests whether the residual covariance matrix is equivalent across groups (Gregorich, 2006; Meredith, 1993; Pacewicz et al., 2022; Vandenberg & Lance, 2000; van de Schoot et al., 2012). Thus, we imposed constraints on item residual variances. Although differences in the latent factor means can still be assessed and interpreted if noninvariance exists at this step (Pacewicz et al., 2022), the establishment of strict invariance adds additional confidence that differences between groups are due solely to group membership (Sousa et al., 2012; Vandenberg & Lance, 2000). The *strict variance model* was compared to results from the scalar model. Strict factor-level invariance was inferred if there were minimal changes to fit criteria after imposing the equality constraints: $\Delta\chi^2$ ($p > .05$); or ΔCFI and ΔTLI < .01 with ΔRMSEA < .015 or ΔSRMR < .01.

Results

Descriptive statistics by age, gender, competition level, and sport

Table 1 displays AOSCS-A descriptive statistics for each comparison grouping. Participants' ages, as well as how often they were practicing and were coached per week, are also presented. No univariate or multivariate outliers were observed. Maridia's multivariate skewness and kurtosis values were 3.20 and 43.18, respectively ($p < .05$), which suggested non-normality and justified the use of the MLR estimator.

Measurement model for the AOSCS-A

Table 2 displays the results for the hypothesized measurement models for the AOSCS-A for each comparison

Table 1. Descriptive statistics for key demographic variables and adult-oriented coaching practices as a function of age, gender, competition level, and sport.

	Age		Gender		Competition Level		Sport	
Variable	35–55 years ($n = 301$)	56–85 years ($n = 301$)	Women ($n = 381$)	Men ($n = 231$)	Int./Nat. ($n = 297$)	Pro./Reg./Rec. ($n = 315$)	Swimming ($n = 270$)	Other Sports ($n = 346$)
Age, years	46.99 (*5.58*)	63.25 (*6.46*)	52.95 (*10.57*)	56.78 (*10.77*)	56.67 (*10.58*)	52.42 (*10.65*)	54.77 (*11.34*)	54.24 (*1.49*)
Practice times per week	4.30 (*2.36*)	4.35 (*1.83*)	4.13 (*2.10*)	4.54 (*2.07*)	4.74 (*2.17*)	3.88 (*1.98*)	3.90 (*1.85*)	4.60 (*2.25*)
Coached times per week	2.78 (*1.53*)	2.73 (*1.43*)	2.80 (*1.45*)	2.62 (*1.44*)	3.03 (*1.51*)	2.48 (*1.39*)	3.08 (*1.37*)	2.48 (*1.50*)
AOSCS-A:								
CIA	5.10 (*1.53*)	5.01 (*1.47*)	4.99 (*1.55*)	5.14 (*1.39*)	5.18 (*1.45*)	4.94 (*1.53*)	4.75 (*1.47*)	5.29 (*1.47*)
FLS	4.72 (*1.21*)	4.63 (*1.16*)	4.62 (*1.20*)	4.73 (*1.13*)	4.75 (*1.20*)	4.59 (*1.16*)	4.55 (*1.10*)	4.76 (*1.23*)
ICK	5.38 (*1.35*)	5.20 (*1.46*)	5.29 (*1.44*)	5.30 (*1.36*)	5.37 (*1.42*)	5.23 (*1.39*)	5.08 (*1.47*)	5.46 (*1.33*)
RPE	5.35 (*1.32*)	5.29 (*1.31*)	5.31 (*1.32*)	5.33 (*1.28*)	5.44 (*1.22*)	5.21 (*1.37*)	5.27 (*1.23*)	5.37 (*1.36*)
CPP	4.88 (*1.45*)	4.72 (*1.55*)	4.73 (*1.50*)	4.92 (*1.49*)	5.06 (*1.42*)	4.58 (*1.54*)	4.50 (*1.46*)	5.05 (*1.49*)

Note: *SD* = Standard deviation; Int./Nat. = Internationally or nationally competitive; Pro./Reg./Rec. = Provincially (or State), regionally, or recreationally competitive; Other Sports = Artistic swimming, artistic skating, athletics (various events), biathlon, CrossFit, cycling, diving, dragon boat, golf, gymnastics, judo, race walking, ringette, rowing (various events), skiing (various events), speed skating, triathlon, ultra-running, water polo, and weightlifting; AOSCS-A = Adult-Oriented Sport Coaching Survey (athlete version); CIA = Considering the Individuality of Athletes, FLS = Framing Learning Situations, ICK = Imparting Coaching Knowledge, RPE = Respecting Preferences for Effort, Accountability, and Feedback, CPP = Creating Personalized Programming.

group. All CFA measurement models had significant χ^2 values (p values <.001), providing evidence against an exact fit. However, as noted above, χ^2 can be overly sensitive to the sample size. All incremental fit indices indicated good model fit (all CFI >.900, TLI >.900, RMSEA <.070, SRMR <.080, and $\chi^2/\text{df} \leq 3.00$). Table 3 displays the factor loadings for each model. Finally, Table 4 displays factor standardized covariance matrices from the hypothesized measurement models (covariance range .59–.87; all p values <.001).

Measurement invariance

Table 2 displays all invariance results. Configural invariance models for the AOSCS-A all had significant χ^2 values (p values <.001), suggesting noninvariance. All incremental fit indices that are less sensitive to sample size suggested good model fit (CFI > .900, TLI >.900, RMSEA <.070, SRMR <.080, and $\chi^2/\text{df} \leq 3.00$), providing evidence for configural equivalence across groups sorted by age, gender, competition level, and sport.

When comparing metric (weak) models to their respective configural invariance models, age, gender, and competition-level groupings had non-significant $\Delta\chi^2$ ($p = .404$, $p = .837$, and $p = .081$, respectively), suggesting evidence of metric invariance. Changes to incremental fit indices for age, gender, and competition-level groupings suggested metric invariance (ΔCFI and ΔTLI < .01 with ΔRMSEA < .015 or ΔSRMR < .01). For the sport type, the comparison between the configural and metric models was significant ($\Delta\chi^2$ p value =.001) suggesting metric noninvariance. However, as mentioned prior, $\Delta\chi^2$ is sensitive to sample size, group size, and other model assumptions (Pacewicz et al., 2022). Comparisons using additional fit indices for sport type suggested metric invariance (ΔCFI = .005, ΔTLI = .002, ΔRMSEA = .001 or ΔSRMR = .010). Taken together, these findings provided strong evidence for metric (weak) invariance for age, gender, and competition level, which suggested that these comparison groups were equivalent on AOSCS-A factor loadings (i.e., measured on the same scale). Mixed evidence was found for metric (weak) invariance for sport type depending on the interpretation of exact fit (i.e., χ^2 based analyses) or incremental fit (i.e., CFI, TLI, RMSEA, and SRMR) based analyses.

When comparing all scalar models to their respective metric invariance models for all comparison groups, all $\Delta\chi^2$ values were significant (all p values <.05) suggesting noninvariance.[3] Conversely, changes in incremental fit indices (ΔCFI and ΔTLI < .01 with ΔRMSEA < .015 or ΔSRMR < .01) supported scalar invariance for all comparison groups, suggesting mixed evidence for scalar (strong) invariance for age, gender, competition level, and sport type.

When comparing strict (residual) level models to their respective scalar models, the $\Delta\chi^2$ value was non-significant for age ($p = .106$). Changes in incremental fit indices for age (ΔCFI = .002 and ΔTLI = .003 with ΔRMSEA = .001 or ΔSRMR = .014) suggested strict invariance. When comparing strict level models to their respective scalar models, the $\Delta\chi^2$ value was significant for gender, ($p < .001$), competition level ($p = .008$), and sport type ($p < .001$), suggesting strict

[3]Notably, for age, gender, and competition level, the $\Delta\chi^2$ value was significant when comparing the scalar to metric models but was non-significant in the previous step (i.e., comparing metric to configural models). As an optional step, we attempted to examine partial metric invariance for these groups using the forward method suggested by Jung and Yoon (2016). All partial scalar invariance tests indicated model misspecification for the partial invariance models, thus we could not make inferences about partial invariance based on our age, gender, and competition level comparison groups.

Table 2. Results for all CFA and invariance models.

Grouping Variable	Model	MLR χ^2 (df)	χ^2/df	CFI	TLI	RMSEA	SRMR	MC	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Δ χ^2 (df)
n/a (*N* = 616)	Model 1 (CFA; full sample: hypothesized)	472.78***(199)	2.38	.950	.942	.047	.037	-	-	-	-	-	-
Age	Model 2 (CFA; 35–55 years: hypothesized)	370.21***(199)	1.86	.937	.926	.053	.045	-	-	-	-	-	-
(*n* = 602)	Model 3 (CFA; 56–85 years: hypothesized)	319.57***(199)	1.61	.957	.951	.045	.041	-	-	-	-	-	-
	Model 4 (configural)	695.06***(398)	1.75	.946	.938	.050	.043	-	-	-	-	-	-
	Model 5 (metric/weak)	714.35***(415)	1.72	.946	.940	.049	.048	5 vs 4	.000	.002	−.001	.005	17.76(17)
	Model 6 (scalar/strong)	746.35***(432)	1.73	.943	.939	.049	.050	6 vs 5	−.003	−.001	.000	.002	32.72**(17)
	Model 7 (strict)	788.44***(464)	1.70	.941	.942	.048	.064	7 vs 6	−.002	.003	−.001	.014	42.24(32)
Gender	Model 8 (CFA; Women; hypothesized)	390.97***(199)	1.96	.941	.932	.050	.042	-	-	-	-	-	-
(*n* = 612)	Model 9 (CFA; Men: hypothesized)	348.54***(199)	1.75	.939	.929	.057	.049	-	-	-	-	-	-
	Model 10 (configural)	732.80***(398)	1.84	.942	.933	.052	.044	-	-	-	-	-	-
	Model 11 (metric/weak)	746.16***(415)	1.80	.943	.936	.051	.047	11 vs 10	.001	.003	−.001	.003	11.36(17)
	Model 12 (scalar/strong)	775.17***(432)	1.79	.940	.936	.051	.049	12 vs 11	−.003	.000	.000	.002	28.65*(17)
	Model 13 (strict)	872.03***(464)	1.88	.928	.929	.054	.072	13 vs 12	−.011	−.007	.003	.023	97.76***(32)
Competition Level	Model 14 (CFA; Int./Nat.: hypothesized)	299.40***(199)	1.50	.959	.953	.041	.042	-	-	-	-	-	-
(*n* = 616)	Model 15 (CFA; PRR: hypothesized)	382.96***(199)	1.92	.940	.930	.054	.043	-	-	-	-	-	-
	Model 16 (configural)	680.14***(398)	1.71	.949	.941	.048	.043	-	-	-	-	-	-
	Model 17 (metric/weak)	706.28***(415)	1.70	.947	.941	.048	.050	17 vs 16	−.002	.000	.000	.007	25.67(17)
	Model 18 (scalar/strong)	757.32***(432)	1.75	.941	.937	.050	.052	18 vs 17	−.006	−.004	.002	.007	62.63***(17)
	Model 19 (strict)	811.60***(464)	1.75	.937	.937	.049	.077	19 vs 18	−.004	.000	−.001	.025	54.44**(32)
Sport	Model 20 (CFA; Swimming: hypothesized)	342.88***(199)	1.72	.941	.931	.052	.045	-	-	-	-	-	-
(*n* = 616)	Model 21 (CFA; Other sports: hypothesized)	383.42***(199)	1.93	.941	.932	.052	.043	-	-	-	-	-	-
	Model 22 (configural)	728.22***(398)	1.83	.941	.931	.052	.044	-	-	-	-	-	-
	Model 23 (metric/weak)	768.29***(415)	1.85	.936	.929	.053	.054	23 vs 22	−.005	−.002	.001	.010	41.51**(17)
	Model 24 (scalar/strong)	819.95***(432)	1.90	.930	.925	.054	.058	24 vs 23	−.006	−.004	.001	.004	56.70***(17)
	Model 25 (strict)	912.06***(464)	1.97	.919	.920	.056	.083	25 vs 24	−.011	−.005	.002	.025	91.87***(32)

Note: ***$p = < .001$, **$p = < .010$, *$p = < .050$; χ^2 = MLR chi-square statistic; df = degrees of freedom; χ^2/df = normed (relative) chi-square; CFI = comparative fit index; TLI = Tucker and Lewis index; RMSEA = root means square error of approximation; SRMR = standardized root mean residual; MC = Model comparison; Δ = change in value; Int./Nat. = International/national competition; PRR = Provincial (state), regional, and recreational competition; Other sports = Artistic swimming, artistic skating, athletics (various events), biathlon, CrossFit, cycling, diving, dragon boat, golf, gymnastics, judo, race walking, ringette, rowing (various events), skiing (various events), speed skating, triathlon, ultra-running, water polo, and weightlifting.

Table 3. CFA standardized factor loadings (for their intended factors only) for the final measurement models.

		β								
			Age		Gender		Competition Level		Sport	
AOSCS-A Factor	Item	All samples	35–55 years	56–85 years	Women	Men	Int./Nat.	Pro./Reg./Rec.	Swimming	Other Sports
Considering the Individuality of Athletes	CIA1	.79	.82	.76	.79	.77	.73	.83	.72	.72
	CIA2	.81	.83	.79	.81	.82	.82	.80	.78	.78
	CIA3	.81	.81	.82	.82	.78	.83	.79	.77	.77
	CIA4	.80	.82	.80	.79	.82	.78	.80	.84	.84
Framing Learning Situations	FLS1	.70	.74	.67	.70	.70	.67	.72	.65	.65
	FLS2	.66	.69	.62	.62	.72	.64	.67	.63	.63
	FLS3	.59	.57	.61	.56	.64	.62	.56	.52	.52
	FLS4	.58	.56	.62	.56	.62	.60	.56	.62	.62
	FLS5	.65	.66	.65	.64	.89	.64	.67	.65	.65
	FLS6	.66	.67	.65	.67	.63	.68	.65	.66	.66
	FLS7	.48	.48	.49	.48	.46	.56	.41	.48	.48
Imparting Coaching Knowledge	ICK1	.75	.75	.75	.75	.76	.74	.76	.80	.80
	ICK2	.85	.86	.84	.84	.87	.84	.87	.86	.86
	ICK3	.74	.69	.78	.70	.80	.71	.75	.73	.73
Respecting Preferences for Effort, Accountability, and Feedback	RPE1	.77	.76	.78	.76	.77	.70	.82	.72	.72
	RPE2	.72	.73	.72	.72	.72	.65	.77	.64	.64
	RPE3	.85	.84	.87	.83	.88	.83	.87	.85	.85
Creating Personalized Programming	CPP1	.80	.79	.82	.79	.81	.80	.80	.77	.77
	CPP2	.80	.76	.84	.77	.86	.78	.83	.78	.78
	CPP3	.81	.78	.85	.79	.85	.82	.81	.82	.82
	CPP4	.80	.76	.84	.76	.83	.74	.83	.75	.75
	CPP5	.65	.65	.65	.65	.64	.67	.62	.60	.60

Note: All *p* values <.001; β = standardized factor loading (coefficient); AOSCS-A = Adult-Oriented Sport Coaching Survey (athlete version); Int./Nat. = Internationally or nationally competitive; Pro./Reg./Rec. = Provincially (or State), regionally, or recreationally competitive.

Table 4. CFA standardized factor covariance estimates for the full sample, as well as a function of age, gender, competition level, and sport.

Grouping Variable	AOSCS Factors	1	2	3	4	5
Full sample	1. CIA	-	-	-	-	-
($n = 616$)	2. FLS	.81	-	-	-	-
	3. ICK	.64	.75	-	-	-
	4. RPE	.79	.82	.69	-	-
	5. CPP	.80	.78	.67	.84	-
Age	1. CIA	-	.80	.68	.82	.78
($n = 602$)	2. FLS	.83	-	.77	.83	.75
	3. ICK	.60	.73	-	.74	.67
	4. RPE	.76	.82	.64	-	.82
	5. CPP	.82	.82	.64	.84	-
Gender	1. CIA	-	.83	.69	.87	.79
($n = 612$)	2. FLS	.80	-	.73	.80	.73
	3. ICK	.61	.74	-	.75	.71
	4. RPE	.75	.83	.65	-	.82
	5. CPP	.80	.80	.64	.84	-
Competition	1. CIA	-	.80	.59	.79	.83
Level	2. FLS	.82	-	.72	.85	.80
($n = 616$)	3. ICK	.68	.76	-	.63	.62
	4. RPE	.79	.79	.75	-	.84
	5. CPP	.77	.76	.72	.83	-
Sport	1. CIA	-	.83	.69	.81	.76
($n = 616$)	2. FLS	.83	-	.78	.83	.80
	3. ICK	.69	.78	-	.72	.69
	4. RPE	.81	.83	.72	-	.85
	5. CPP	.76	.80	.69	.85	-

Note: all p values <.001; Top diagonal = Age (56–85 age group), Gender (Male), Competition level (Provincial/Regional/Recreational), Sport (Other sports); Bottom diagonal = Age (35–55 age group), Gender (Female), Competition level (International/National), Sport (Swimming); AOSCS = Adult-Oriented Sport Coaching Survey; CIA = Considering the Individuality of Athletes, FLS = Framing Learning Situations, ICK = Imparting Coaching Knowledge, RPE = Respecting Preferences for Effort, Accountability, and Feedback, CPP = Creating Personalized Programming.

noninvariance. However, changes in incremental fit indices for competition level (ΔCFI = .004 and ΔTLI = .000 with ΔRMSEA = .001 or ΔSRMR = .025) suggested strict invariance, while changes in incremental fit indices supported strict noninvariance for gender (ΔCFI = .011 and ΔTLI = .007 with ΔRMSEA = .003 or ΔSRMR = .023) and sport type (ΔCFI = .011 and ΔTLI = .005 with ΔRMSEA = .002 or ΔSRMR = .025). Taken together, our findings showed full support for invariance for age, and mixed support for competition level, suggesting with different degrees of confidence that these comparison groups were equivalent in residual variances on AOSCS-A items. Gender and sport-type comparison groups were not found to be equivalent in residual variances.

Discussion

The aim of this study was to determine if the athlete version of the Adult-Oriented Sport Coaching Survey (AOSCS-A; Rathwell et al., 2020) was invariant across groups of MAs that categorically differed on age, gender, competition level, and sport. Our results suggest that the AOSCS-A performed equally across all groups of interest, whereby MAs had a similar understanding of the AOSCS-A factor structure and its constituent 22 items (i.e., configural invariance) when using the incremental fit indices approach. Notably, the exact fit approach (i.e., interpreting χ^2 results) did suggest configural noninvariance, but the interpretation of χ^2 values has been criticized for being overly sensitive to large sample sizes (Brannick, 1995) such as the one in the current study (616 MAs). Support for metric invariance was found for age, gender, and competition level (using incremental and exact fit results), while mixed support was found for sport type (using incremental fit results only). This demonstrated that the AOSCS-A items and their respective factors were measured in the same way across groups of MAs. Evidence of scalar invariance was found using an incremental fit approach for all groups, which suggests that groups of MAs used the response scale of AOSCS-A items in the same way (i.e., item intercepts were equal across groups). Finally, full support for strict invariance was established based on age and mixed support was found for competition level, highlighting that the residual variance for each AOSCS-A item was equivalent across these comparison groups.

Our results suggested that MAs' gender and sport-type groupings were not equivalent in AOSCS-A residual variance. Notably, strict invariance has "limited practical value" (Gregorich, 2006, p. 7; Wang & Wang, 2020) because strict noninvariance still allows for viable assessments and interpretations of latent factor means (Pacewicz et al., 2022; Vandenberg & Lance, 2000). Taken together, our findings suggest that the AOSCS-A was perceived similarly by MAs, and for the most part, measured coaching practices equally across groups. Our results add support to the growing evidence for the validity of the AOSCS-A, the first adult-based coaching survey used to measure coaching practices in ways that respect the individuality and uniqueness of adult athletes.

The results have applications for those involved with coaching Masters Sport. For instance, the findings suggest that coaches, coach educators, and/or research practitioners can use the AOSCS-A as an assessment instrument that performs well across a variety of different groups of competitive adult athletes with moderate confidence. Previous research has shown promising results regarding reliability and factorial validity (Rathwell et al., 2020). Prior work also supported the criterion validity of the AOSCS-A, in that when athletes perceived their coaches to use the five adult-oriented coaching themes more often, it resulted in enhanced relationship quality between athlete and coach, increased adult athletes' willingness to invest and commit to sport, increased their liking of practice because of their coach, and satisfied their basic psychological needs (Motz et al., 2022; 2023).

The present findings also answer an outstanding question that very few quantitatively oriented coaching science scholars clarify – whether different groups of athletic respondents interpret self-report surveys similarly (cf., Bolter & Weiss, 2013). This is particularly poignant for assessment in Masters Sport, wherein scholars have frequently described how MAs can vary significantly on demographic and involvement characteristics. In our case, based on bimodal categories for age, gender, competition level, and sport type from a large sample of MAs, we can state that the AOSCS-A shows evidence of assessment equivalence. Our results showed that certain factors related to MAs' heterogeneity (i.e., age, gender, competition level, and sport type) likely did not change how they understood adult-oriented coaching practices. These findings are important because they suggest that the AOSCS-A, if used broadly across age, gender, competition level, and sport types, seems to provide reliable and valid survey questions for all respondents. That is, the items and factors seem to be understood by adult athlete respondents similarly and inherent categorical differences (at least the ones in this study) appear to not be biasing/skewing the data.

The underlying conceptual frameworks that informed the development of the AOSCS-A may help explain why adult-oriented coaching practices are interpreted similarly across different groups of adults. For instance, several of the adult-oriented coaching practices were derived from qualitative research in Masters Sport that used the adult education concept of andragogy (i.e., the art and science of teaching adults; Knowles et al., 2012) as a theoretical framework. Knowles' et al., (2012) andragogic principles have found support in studies of MAs and were modified to accommodate sport-contextual nuances (see Callary et al, 2017; MacLellan et al., 2019). These works from which the AOSCS (both versions) were derived have continually emphasized the importance of accommodating the individual (e.g., their self-concept, attributes, needs, motives, etc.) in the coaching of adults. Thus, a possible explanation for the equivalent assessment characteristics of the AOSCS-A is that the survey items reflect inherently individualized and personally accommodating phrasing in the assessment of coach practices. For example, items pertaining to *Considering the Individuality of Athletes*, and *Creating Personalized Programming* ask whether the coach has considered one's motives, experiences, needs, and abilities in terms of planning/organizing/delivering practice and programming. Items pertaining to *Respecting Preferences for Effort, Accountability, and Feedback* ask whether the coach has considered one's preferences in terms of how they wish to receive feedback and to be held to account for giving effort. In other words, AOSCS-A general invariance may, in part, be due to MAs' common interpretation of such individualization, seeing the items as related to "me," in the reporting of one's experiences. It may be that narratives on respecting the coaching needs and preferences of individual MAs (e.g., see Callary et al., 2015; 2017) that informed the origin of the AOSCS (both versions) have helped to contribute to the invariance found in quantitative assessment. This invariance held across different factors (related to different adult-oriented coaching practices) in the survey.

Limitations and future directions

Although this study provides promising results to support the use of the AOSCS-A, it is not without limitations. First, this study was limited to four grouping variables for invariance analyses. Thus, we have set the precedent for mean-based comparisons based on age, gender, competition level, and sport groupings. With this said, these are not the only grouping variables that influence outcomes in Masters sport. Invariance tests for new grouping variables (i.e., those not tested in this study) should be explored before making alternative group-based comparisons in the future. We were also limited to the number of groups we could explore based on our sample size. Thus, future studies with more adult athletes may want to expand the number of comparison groups for each grouping variable. For instance, for age, future research may look at MAs under 35, smaller age cohorts within the peak performance years, and athletes older than 85. For competition level, they may want to consider five groups representing all levels of competition: recreational, regional, provincial, national, and international, respectively. For sport, a need exists to extend beyond the swimming domain where a disproportionate amount of research on coaching MAs has been located.

A notable limitation of our study was that some standardized covariances were high (>.70; Hair et al., 2018). Multicollinearity has not been an issue for measurement models in past studies using the AOSCS-A (c. f. Motz et al., 2022 and Rathwell et al, 2020). With this said, future researchers exploring the grouping variables used in this study should pay close attention to possible problems regarding multicollinearity. To address this limitation in future studies, we suggest researchers use exploratory structural equation modeling, which accounts for naturally correlated constructs in social science research.

Future researchers may also wish to explore other key variables that were not measured in this study that may be important for coaching MAs. For example, researchers may wish to consider the nature of MAs' participatory trajectories, such as how long adults have been participating in their sport, and whether they are Continuers, Rekindlers, or Late Bloomers (Dionigi, 2015) with respect to Masters Sport participation. Other factors, including nationalities/cultures, socioeconomic status, race, education level, or how long MAs have been with their coach, are also worth pursuing. A strength in the development of the AOSCS is that it can measure the five themes of adult-oriented coaching from both the athletes' and coaches' perspectives. That said, with respect to measurement invariance, our data were athletes' perceptions of how often their coaches use adult-oriented coaching practices. Thus, it may also be enlightening to assess invariance for intuitive grouping variables in relation to the AOSCS-C (coach version), which affords coach-reported data on adult-oriented practices.

Conclusion

From a measurement perspective, the present study provides insight on measurement invariance for the AOSCS-A across age, gender, competition level, and sport type. Specifically, we tested configural, metric, scalar, and strict invariance, with each of these successive models looking deeper into the underlying statistics of factor analyses. Our evidence for invariance strengthens the applicability and useability of the AOSCS-A. The results increase confidence that the AOSCS-A constructs are measured on the same metric and scale. Further, these initial findings of measurement equivalence suggest that reasonably variable samples of MAs can now be compared across AOSCS-A constructs (and with associated outcomes) based on grouping variables used in this study (e.g., future researchers could compare how female and male MAs reception of specific AOSCS-based practices affects the athletes' quality sport experience outcomes). Overall, our study advocates that researchers and practitioners can use the AOSCS-A with confidence knowing that MAs' age, gender, competition level, and sport have little effect on MAs' interpretations of the survey items.

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