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Adaptation and Psychometric Evaluation of the State Mindfulness Scale for Physical Activity (SMS-PA) Among Indonesian Runners

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Abstract

Running is a widely practised physical activity in Indonesia and has been associated with various psychological benefits. However, empirically evaluating state mindfulness during running requires context-specific measures. This study aimed to adapt the State Mindfulness Scale for Physical Activity (SMS-PA) into Indonesian and assess its internal structural validity among recreational runners. Following the analytical protocol proposed by Van Zyl and ten Klooster (2022), the adapted scale was evaluated using Confirmatory Factor Analysis (CFA) to examine baseline factor models and Exploratory Structural Equation Modelling (ESEM) to account for cross-loadings across construct dimensions. Participants were 240 adult recreational runners aged 17 to 60 years who ran at least twice a week. While bifactor CFA models exhibited high global fit but localised parameter degradation, the correlated two-factor ESEM model provided the most substantively interpretable and empirically acceptable representation of the data (CFI = .966, TLI = .942, SRMR = .032), successfully distinguishing between State Mindfulness of Mind (SMM) and State Mindfulness of Body (SMB). Overall, these findings provide initial evidence supporting the internal structural validity of the Indonesian-adapted SMS-PA, offering a context-specific tool for assessing state mindfulness during running among Indonesian recreational runners.

Keywords: confirmatory factor analysis, exploratory structural equation modelling, mindfulness theory, psychometric properties

Abstrak

Lari merupakan aktivitas fisik yang banyak dilakukan di Indonesia dan dikaitkan dengan berbagai manfaat psikologis. Namun, evaluasi empiris mengenai State Mindfulness Scale for Physical Activity (SMS-PA) saat berlari memerlukan pengukuran yang spesifik terhadap konteks tersebut. Penelitian ini bertujuan untuk mengadaptasi State Mindfulness Scale for Physical Activity (SMS-PA) ke dalam bahasa Indonesia serta mengevaluasi validitas struktur internalnya pada pelari rekreasi. Mengikuti panduan analisis yang diusulkan oleh Van Zyl dan ten Klooster (2022), skala yang telah diadaptasi tersebut dievaluasi menggunakan Confirmatory Factor Analysis (CFA) untuk menguji model faktor dasar dan Exploratory Structural Equation Modeling (ESEM) untuk mengakomodasi adanya cross-loading (muatan silang) antar-dimensi konstruk. Partisipan penelitian ini adalah 240 pelari rekreasi dewasa berusia 17 hingga 60 tahun yang berlari setidaknya dua kali seminggu. Meskipun model CFA bifactor menunjukkan kecocokan global yang tinggi namun mengalami penurunan kualitas parameter secara lokal, model ESEM dua faktor yang berkorelasi memberikan representasi data yang paling dapat diinterpretasikan secara substantif dan dapat diterima secara empiris (CFI = 0,966; TLI = 0,942; SRMR = 0,032), serta berhasil membedakan antara State Mindfulness of Mind (SMM) dan State Mindfulness of Body (SMB). Secara keseluruhan, temuan ini memberikan bukti awal yang mendukung validitas struktur internal SMS-PA versi bahasa Indonesia, sekaligus menyediakan instrumen spesifik-konteks untuk mengukur state mindfulness saat berlari di kalangan pelari rekreasi Indonesia.

***Keywords**: analisis faktor konfirmatori, pemodelan persamaan struktural eksploratori, properti psikometri, teori mindfulness.*

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Introduction

In recent decades, mindfulness has gained significant attention in psychology and mental health because of its associations with psychological and physical well-being (Dunning et al., 2018; Whitfield et al., 2021; Talebisiavashani & Mohammadi-Sartang, 2024). Mindfulness generally refers to attention and awareness of present-moment experiences accompanied by an open, accepting, curious, and non-judgmental orientation toward those experiences (Bishop et al., 2004; Brown & Ryan, 2003). In sport and physical activity, mindfulness may be particularly relevant because individuals continuously encounter changing thoughts, emotions, bodily sensations, movements, and perceptions of physical effort. Thus, mindfulness in physical activity can be understood as a context-dependent experience of attending to ongoing mental and bodily experiences while maintaining an open orientation toward them.

Running is one of the most accessible forms of physical activity and has been consistently linked to physical and psychological well-being (Oswald et al., 2020). Running involves continuous interaction between attentional processes and bodily experiences, including movement, breathing rhythm, physical sensations, and perceptions of effort, while runners may also experience changing thoughts and emotions throughout the activity. These characteristics make running a relevant context for examining mindfulness as a state that occurs within a specific activity rather than solely as a general individual tendency. Previous research has indicated that mindfulness is associated with psychological experiences during physical activity, including affective and motivational processes (Cox et al., 2016; Yang & Conroy, 2020). However, the extent to which an established measure of state mindfulness in physical activity adequately represents mindfulness experiences within the specific context of running remains to be empirically examined.

Mindfulness can be conceptualised as both a relatively stable individual tendency (trait mindfulness) and a temporary, context-dependent experience (state mindfulness) (Brown & Ryan, 2003; Tanay & Bernstein, 2013). State mindfulness is particularly relevant when mindfulness is examined within a specific activity because it reflects how individuals attend to and experience events occurring at a particular moment. Tanay and Bernstein (2013) developed the State Mindfulness Scale (SMS) to assess state mindfulness in relation to present-moment mental and bodily experiences. Their conceptualisation drew on the broader view of mindfulness as regulating attention to present-moment experience, along with an orientation characterised by openness, acceptance, and curiosity (Bishop et al., 2004).

Building on this framework, Cox et al. (2016) developed the State Mindfulness Scale for Physical Activity (SMS-PA) by revising the SMS to better represent mindfulness within physical activity contexts. The SMS-PA was designed to capture state mindfulness during physical activity, including experiences related to movement, bodily sensations, and physical effort, while retaining attention to mental experiences such as thoughts and emotions. The measure represents state mindfulness through two related experiential domains: mindfulness of the mind and mindfulness of the body. Mindfulness of the mind refers to awareness and observation of mental experiences, including thoughts and emotions, whereas mindfulness of the body refers to awareness and observation of bodily experiences, including sensations, movement, and muscular activity (Cox et al., 2016).

The distinction between mindfulness of the mind and mindfulness of the body should not be interpreted as suggesting that mindfulness consists of two independent or exhaustive components. Rather, these domains represent different objects of present-moment awareness through which the broader construct of state mindfulness is expressed. The qualities of openness, acceptance, curiosity, and non-judgment describe how individuals relate to ongoing experiences, whereas the mind and body domains describe the types of experiences being attended to. Accordingly, awareness of a thought, emotion, bodily sensation, movement, or physical effort becomes relevant to mindfulness when these experiences are attended to with the qualities that characterise a mindful orientation (Bishop et al., 2004; Tanay & Bernstein, 2013; Cox et al., 2016). This distinction provides the theoretical basis for examining whether mental and bodily experiences remain empirically distinguishable while representing a broader state mindfulness construct.

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Although the SMS-PA provides an established measure of state mindfulness in physical activity, it was originally developed for physical activity contexts broadly rather than for a specific activity such as running. Therefore, its applicability to a particular activity and cultural context cannot be assumed solely from evidence obtained in the original context. Running involves a distinctive combination of repetitive movement, bodily sensations, physical effort, and continuously changing mental experiences. Contextualising the items to running may improve their correspondence with experiences encountered during the activity; however, this assumption requires empirical psychometric evaluation rather than being taken for granted. Accordingly, the present study addresses a contextualization and measurement question rather than developing a new mindfulness construct or instrument.

This issue is particularly important when examining the factorial structure of mindfulness during running. Because running simultaneously involves mental and bodily experiences, the adapted items may reflect related but distinguishable domains of state mindfulness. At the same time, these domains are expected to be correlated because mental and bodily experiences occur together during physical activity. Therefore, rather than assuming the original structure will be reproduced unchanged, the present study examines alternative factorial representations to determine which structure best represents state mindfulness during running.

Accordingly, the present study aimed to adapt the State Mindfulness Scale for Physical Activity (SMS-PA) for Indonesian recreational runners and evaluate its psychometric properties and structural validity. Specifically, the study examined alternative representations of the adapted scale, including a unidimensional structure, a correlated two-factor structure representing mindfulness of the mind and mindfulness of the body, a higher-order structure, and a bifactor structure, while also considering potential cross-loadings using exploratory structural equation modelling (ESEM). Thus, the present study does not propose a new mindfulness construct or a new instrument; rather, it provides empirical evidence regarding the applicability and factorial representation of an established physical-activity mindfulness measure when contextualised for running among Indonesian runners.

Mindfulness theory

Mindfulness has been conceptualised as attention and awareness of present-moment experiences accompanied by an open, accepting, curious, and non-judgmental orientation toward those experiences (Bishop et al., 2004; Tanay & Bernstein, 2013). According to Bishop et al. (2004), mindfulness involves two interrelated processes. First, it involves the self-regulation of attention toward present-moment experiences, allowing individuals to recognise events occurring in their immediate experience. Second, it involves adopting an orientation toward experience characterised by curiosity, openness, and acceptance. Thus, mindfulness is not simply the ability to attend to a particular stimulus; it also concerns how the individual relates to that experience. Mindful experience therefore involves not only attending to a bodily sensation, thought, or emotion, but also relating to that experience with an open and accepting orientation.

Mindfulness may be conceptualised as both a relatively stable individual tendency (trait mindfulness) and a temporary, context-dependent experience (state mindfulness) (Brown & Ryan, 2003; Tanay & Bernstein, 2013). State mindfulness refers to the extent to which an individual attends to and becomes aware of present-moment experiences within a particular situation. Because state mindfulness is sensitive to situational contexts, it is particularly relevant for examining mindfulness during specific activities such as physical exercise and running.

Tanay and Bernstein (2013) developed the State Mindfulness Scale (SMS) to assess state mindfulness in relation to ongoing mental and bodily experiences. The SMS is based on the conceptualisation that state mindfulness involves present-moment attention and awareness, along with an open and accepting orientation toward experience. The measure includes items addressing mental events and bodily sensations, providing a basis for examining different domains of present-moment experience within state mindfulness.

Building on this framework, Cox et al. (2016) developed the State Mindfulness Scale for Physical Activity (SMS-PA) by adapting the SMS for physical activity contexts. The SMS-PA retains the broader conceptualisation of state mindfulness while emphasising experiences that occur during physical activity.

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Its items represent two related domains: mindfulness of the mind and mindfulness of the body. Mindfulness of the mind refers to awareness of mental experiences, particularly thoughts and emotions, whereas mindfulness of the body refers to awareness of bodily experiences, including bodily sensations, movement, and muscular activity (Cox et al., 2016).

The distinction between mindfulness of the mind and mindfulness of the body does not imply that mindfulness itself consists of two independent or exhaustive components. Rather, SMM and SMB represent two domains or objects of present-moment experience through which state mindfulness is expressed. The qualities of openness, acceptance, curiosity, and non-judgment describe how individuals attend to and relate to their experiences, whereas the mind and body domains describe what is being attended to. Therefore, awareness of thoughts, emotions, bodily sensations, movement, or physical effort can represent state mindfulness when these experiences are approached with the qualities that characterise a mindful orientation.

This distinction matters in running because mental and bodily experiences occur simultaneously throughout the activity. Runners may experience changing thoughts and emotions while also attending to movement, bodily sensations, and muscular effort. Consequently, SMM and SMB are theoretically expected to be distinguishable while remaining related. This theoretical relationship provides the basis for examining whether the adapted SMS-PA is best represented by a single factor, correlated SMM and SMB factors, a higher-order structure, or a bifactor structure. The present study therefore treats SMM and SMB as related experiential domains within state mindfulness rather than as separate constructs or as a complete definition of mindfulness itself.

Methods

Participants

Participants were 240 adults aged 17 to 60 years who consistently ran at least twice a week for the past three months. The age range was selected to capture a broad spectrum of adult runners, from late adolescents to older adults, while excluding populations (e.g., children or the elderly above 60) that may have significantly different physical, psychological, or health profiles. This range allows for an exploration of running habits and associated psychological variables within a developmentally and physically active adult population. Including only those who have run at least twice a week for the past three months ensures participants have a consistent running routine, which is necessary to meaningfully assess the psychological or behavioural constructs under study.

The sample size (N = 240) was determined based on commonly used heuristic guidelines in structural equation modelling and factor analysis rather than an a priori statistical power analysis. Several methodological references suggest that sample sizes between 200 and 300 are generally considered adequate for confirmatory factor analysis when model complexity is moderate, and communalities are acceptable (Kline, 2016; Wolf et al., 2013).

However, some methodological studies recommend larger samples, typically 300-400, when conducting CFA with ordinal data using robust estimators such as WLSMV to ensure greater parameter stability and more accurate model fit indices (Moshagen & Musch, 2014). Therefore, although the sample size in the present study meets several commonly cited minimum recommendations for CFA, it remains somewhat below the more conservative thresholds suggested for robust ordinal estimation. This limitation should be considered when interpreting the stability and generalizability of the model parameters, and future research should replicate the findings with larger samples.

The sample was taken using a purposive sampling method of 240 people, with specific criteria, namely: (1) participating in running activities for at least 30 minutes per session. (2) not having a diagnosed severe mental disorder, (3) participants who use other mindfulness methods outside of running.

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Instrument

The instrument used in the present study was adapted from the State Mindfulness Scale for Physical Activity (SMS-PA) developed by Cox et al. (2016). The SMS-PA was developed by revising the State Mindfulness Scale (SMS) originally developed by Tanay and Bernstein (2013) for use in physical activity contexts. The original SMS conceptualised state mindfulness in relation to mental and bodily experiences, whereas Cox et al. (2016) revised the measure to better represent experiences occurring during physical activity, particularly bodily movement, physical sensations, and muscular engagement. The SMS-PA represents state mindfulness through two related experiential domains, namely mindfulness of the mind and mindfulness of the body.

In the present study, the SMS-PA was contextualised to running and adapted for Indonesian recreational runners. The adapted version consists of 10 items: four representing State Mindfulness of the Mind (SMM) and six representing State Mindfulness of the Body (SMB). SMM refers to awareness and observation of ongoing mental experiences, including thoughts and emotions during running, whereas SMB refers to awareness and observation of bodily experiences, including bodily sensations, movement, and muscular activity during running.

Referring to ITC guidelines for translating and adapting tests (2nd ed.) in 2017 (International Test Commission, 2017), the adaptation process began with the translation of the instrument into Indonesian by two independent translators with different backgrounds: The first translator (P1) has a background in English literature and has experience in academic translation, while the second translator (P2) is an expert in statistics and psychology. After that, the two translations were synthesised by the research team, taking into account conceptual meaning and cultural appropriateness. If the translations differed, the team selected the items most appropriate to the original scale in the context of mindfulness while running. Next, back translation was carried out by two other translators to ensure accuracy and consistency of meaning with the original version. After this stage, a panel of statistics and psychology experts reviewed the instrument to ensure each item reflects mindfulness appropriate to the context of running. This adapted instrument measures two main aspects of mindfulness in running activities, namely mindfulness in the mind (State Mindfulness of the Mind, SMM) and mindfulness in the body (State Mindfulness of the Body, SMB). The scale consists of 10 items: four measuring mental awareness and six measuring physical awareness. Respondents are asked to rate each item using a 4-point Likert scale, from 1 (Never), 2 (Rarely), 3 (Often), and 4 (Very Often), with higher scores indicating higher levels of mindfulness. Mindfulness Running Scale Instrument. The full version of the instrument can be obtained by contacting the first author. The operational definition of the adapted instrument can be seen in Table 1 below:

Table 1. Operational definition of aspects

No	Aspect	Definition of aspect
1.	*State Mindfulness of the Mind*	The individual's ability to be aware of, observe, and recognize thoughts and emotions that arise during running activities. This aspect includes awareness of emotional changes, the ability to observe and recognize positive and negative thoughts, and an understanding of the transition of thought patterns that occur during running.
2.	*State Mindfulness of the Body*	The individual's ability to fully feel the presence of his body during running activities. This aspect includes awareness of body signals or cues, the ability to recognize physical conditions, body sensations, and the experience of feeling muscles working harmoniously while running.

Sources: Personal data.

Data analysis procedure

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In this study, the data analysis procedure follows the ESEM Estimation guidelines from van Zyl LE & ten Klooster PM (2022). These general guidelines divide the procedure into three phases: (a) the Planning Phase, (b) the Data Preparation Phase, and (c) the Data Analysis and Reporting Phase.

(a) The Planning Phase

In the planning stage, researchers first establish the theoretical basis of the instrument being analysed, including the expected factorial structure and possible alternative factorial models that can be tested. In this study, the State Mindfulness Scale for Physical Activity (SMS-PA) instrument is contextualised in running activities to measure the experience of mindfulness running. Therefore, the initial factor structure follows the original instrument's theoretical model and is then tested using Confirmatory Factor Analysis (CFA).

As mindfulness dimensions are often conceptually interrelated, the CFA and ESEM approaches are tested simultaneously for different purposes. CFA was used to examine whether the data fits the original theoretical structures. Specifically, it evaluates multiple competing models: a unidimensional model (where all items load onto a single factor), a correlated two-factor model (representing mind and body dimensions), a higher-order model and a bifactor model. assumed to correlate moderately (Tanay & Bernstein, 2013). Moreover, in a higher-order model, both dimensions are deemed to measure a general factor, namely state mindfulness (Tanay & Bernstein, 2013; Andrade et al., 2019). Finally, the bifactor model was analysed because all items measure state mindfulness directly while also measuring each dimension (Navarette et al., 2023).

On the other hand, ESEM was used because psychological traits are complex, allowing items to relate to more than one factor of the construct represented by the SMS-PA instrument. This comparison was conducted to determine which model provided a more flexible structure, better fit, and the most interpretable empirical results.

(b) The Data Preparation Phase

In the data preparation stage, the dataset is first filtered and cleaned before analysis. This process includes checking for missing values, outliers, and overall data quality. The presence of outliers or extreme values requires careful evaluation as they can impact model fit and measurement quality in factor analysis. Therefore, a data quality check was conducted to ensure that the dataset used in the SMS-PA instrument factor structure analysis in the context of running activities met the necessary assumptions and was suitable for further analysis.

In the next step, researchers need to determine and report the software, estimation method, rotation technique, and analysis procedure to be used. In this study, the analysis was conducted using Mplus 8.5 software. Once the software is selected, the next step is to determine the appropriate estimation method. Generally, Mplus uses the Maximum Likelihood (ML) estimation method as the default setting. However, some literature recommends using robust Maximum Likelihood (MLR) because it better accommodates possible violations of the multivariate normality assumption. Using this robust estimator requires additional procedures when comparing models, because chi-square values from models estimated with different methods cannot be directly compared. Therefore, procedures such as the scaled chi-square difference test can be used to evaluate differences between models.

In addition to selecting an estimator, researchers also need to determine the most appropriate rotation method for Exploratory Structural Equation Modelling (ESEM) analysis. In van Zyl LE & ten Klooster PM (2022), the choice of rotation method is usually adjusted to the analysis's purpose. Geomin rotation is generally used in more exploratory approaches to minimise correlation between factors, while target rotation is used in more confirmatory approaches when the expected factor structure has been predetermined based on theory. In some cases, particularly in bifactor ESEM modelling, orthogonal rotation can also be used to evaluate whether a common factor underlies the measured indicators. Finally, the measurement modelling strategy used, including a total of 7 models

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to be compared, also needs to be clearly explained before the analysis is conducted (see results in Table 4).

(c) The Data Analysis and Reporting Phase

To determine the measurement model that best fits the data, this study used several goodness-of-fit indices and measurement quality indicators simultaneously. The measurement model will only be retained if it demonstrates good model fit and adequate measurement quality. The model fit indices used include the Comparative Fit Index (CFI) and the Tucker–Lewis Index (TLI), with values ≥ 0.90 indicating acceptable model fit and ≥ 0.95 indicating excellent fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) was used with criteria of ≤ 0.08 for adequate fit and ≤ 0.06 for good fit. The Standardized Root Mean Square Residual (SRMR) index was also reported, with values ≤ 0.08 indicating good model fit (McNeish, D., & Wolf, M. G., 2023). Using several indices simultaneously is necessary because each indicator has limitations, making the model evaluation more comprehensive (see results in Table 4).

Once model fit is obtained, the next step is to evaluate the measurement quality at the item level. This evaluation is conducted by examining several indicators, such as standardised factor loadings, item uniqueness, cross-loadings, and the R^2 value for each item. In general, a factor loading value of ≥ 0.35 is considered adequate to indicate that the item represents the construct being measured (see results in Table 5.)

Results and Discussion

Descriptive Statistics

Based on Table 1, the descriptive statistics from 240 participants show who is currently running regularly in Indonesia and their demographic characteristics. (1) The majority of runners in this study were male (53.1%), but the proportion of women was also significant (47.7%). This shows that running is not only a man's domain but also an increasingly popular activity among adult women. (2) The 20–29 age group is the largest group (42.4%), followed by the 30–39 age group (30.5%). Only a few are under 20 (4.9%) and over 50 (8.2%). This reflects that mindfulness while running is most practised by the younger generation and early adults at a time when self-awareness, physical performance, and the need for healthy coping are high. (3) Almost half of the participants (49.6%) were undergraduate graduates, followed by high school/equivalent graduates (27.1%) and postgraduates (14.6%). This suggests that the runners in this study tended to have higher levels of education, which may correlate with awareness of the importance of mental health and mindfulness practices. (4) More than half of the respondents (50.6%) were private employees, while civil servants were only 11.1%. Freelancers (7.4%) and the self-employed (7.8%) were fairly balanced. Interestingly, students also reached 13.6%. This means that running as a means to increase mindfulness is not limited to certain professions, but is widely practised by those who work full-time in the private sector.

Table 1. Distribution of the participants and demographic data

Variable		Frequency (N = 240)	Percentages (%)
Sex	Male	129	53.1%
	Female	111	47.7%
Age	< 20 years	12	4.9%
	20– 29 years	103	42.4%
	30– 39 years	74	30.5%
	40– 49 years	33	13.6%
	>50 years	20	8.2%

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Educational Level	High school/equivalent	65	27.1%
	Diploma	20	8.3%
	Bachelor	119	49.6%
	Postgraduate	35	14.6%
Employment Status	Not working currently	8	3.3%
	Students	33	13.6%
	Civil servants	27	11.1%
	Private employees	123	50.6%
	Self-employed	19	7.8%
	Freelancer	18	7.4%
	Others (housewives, teachers, police, TNI, and retirees)	12	6.2%

Sources: Personal data.

Descriptive results show [see Table 2] that most participants are regular recreational runners and strongly oriented toward the physical and psychological benefits of running. Most respondents (93.4%) said running helps them improve focus and self-awareness, indicating an intrinsic awareness of the mindfulness aspect of running.

As many as 88.1% of participants ran to maintain physical health, but not a few (63%) admitted to running to calm their minds. This finding indicates that running is not only a means of fitness but also a way to regulate emotions and maintain mental balance. Interestingly, almost half of respondents (45.3%) consider running as part of their lifestyle, reflecting the integration of this activity into their identity and routine.

Table 2. Descriptive statistics of participants' running habits and psychological perceptions

Statements	**Category**	**Frequency (%)**
How often do you run in a week?	Never	4 (1.6%)
	1-2 times	119 (49%)
	3-5 times	107 (44%)
	>5 times	13 (5.3%)
What is your average running duration per session?	<30 minutes	30 (12.3%)
	30 – 60 minutes	174 (71.6%)
	>60 minutes	39 (16%)
Do you regularly run races (e.g., 5K, 10K, half-marathon, marathon)?	Yes	199 (81.9%)
	No	44 (18.1%)
How long have you been running regularly?	<1 years	61 (25.1%)
	1-3 years	115 (47.3%)
	4-6 years	24 (9.9%)
	>6 years	43 (17.7%)

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What is your main goal of running?	Maintaining physical health	214 (88.1%)
	Calming the mind	153 (63%)
	Participating in competitions	69 (28.4%)
	Part of the lifestyle	110 (45.3%)
Do you prefer running alone or with a group?	Alone	168 (69.1%)
	With a group	132 (54.3%)
Do you use tools such as running apps (e.g., Strava, Nike Run Club)?	Yes	210 (86.4%)
	No	33 (13.6%)
The area where you usually run?	Urban (highways/sidewalks)	169 (69.5%)
	Green areas (parks/forests)	138 (56.8%)
	Stadium running track	98 (40.3%)
Do you find that running helps improve your focus and self-awareness?	Yes	227 (93.4%)
	No	1 (0.4%)
	Not sure	15 (6.2%)

Sources: Personal data.

Running frequency and duration are high, with 71.6% running 30-60 minutes per session and 44% running 3-5 times a week. Most also use a runner application (86.4%), indicating active involvement in tracking progress and self-motivation. This finding confirms that running is not only a regular physical activity but can also be a profound mindfulness practice, especially if done with balanced body and mind awareness.

Table 3. Item properties of the State Mindfulness Scale for Physical Activity (SMS-PA) in Indonesian Runners

Items	**Response scale (%)**				**Descriptive**			
	1	**2**	**3**	**4**	**Mean**	**SD**	**Skewness**	**Kurtosis**
M1	13%	27%	41%	20%	2.671	0.871	-0.257	-0.789
M2	10%	26%	46%	18%	2.725	0.766	-0.331	-0.539
M3	10%	20%	44%	26%	2.867	0.832	-0.491	-0.528
M4	11%	24%	44%	22%	2.763	0.831	-0.372	-0.633
M5	3%	13%	50%	35%	3.179	0.547	-0.669	0.230
M6	1%	10%	48%	41%	3.288	0.472	-0.673	0.212
M7	3%	9%	48%	40%	3.254	0.548	-0.875	0.687
M8	2%	7%	45%	46%	3.350	0.486	-0.969	1.006
M9	2%	7%	49%	43%	3.329	0.454	-0.833	0.836
M10	1%	12%	54%	33%	3.192	0.463	-0.497	0.107

Notes: Response Scale (1;Never, 2;Rarely, 3;Often,4;Very Often)

Sources : Personal data.

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Before conducting ESEm and Confirmatory Factor Analysis (CFA) analysis, a descriptive analysis was first carried out to assess the response distribution of each item. This analysis included calculating the mean, standard deviation (SD), skewness, and kurtosis to assess whether the data met the assumption of univariate normality. When this assumption is satisfied, Likert scale data can be treated as continuous variables. As shown in Table 3, the skewness values for all items ranged between -1 and 1, indicating that the response distributions were approximately normal (Muthén & Kaplan, 1985). These findings justified the use of Confirmatory Factor Analysis (CFA) and Item Factor Analysis (IFA), even if the Likert scale was considered ordinal. In this study, CFA was ultimately chosen.

CFA Models

Consistent with the analytical procedures outlined in the planning phase, the results of the CFA models are presented in Tables 4 and 5. In accordance with analytical procedures, CFA is used to test whether the data fits the original theoretical structures. Specifically, it evaluates multiple competing models: a unidimensional model (where all items load onto a single factor), a correlated two-factor model (representing mind and body dimensions), and a bifactor model. Below we will explain the 4 CFA models, which are carried out as follows.

First, Model 1, the unidimensional model in which all 10 items loaded on a single SMS-PA factor, yielded poor fit to the data (χ^2 = 485.169, *df* = 35, CFI = .839, TLI = .793, RMSEA = .231, SRMR = .118). All fit indices fell substantially below acceptable thresholds, indicating that a single-factor structure was inadequate for capturing the multidimensionality inherent in the SMS-PA items. Standardized factor loadings ranged from .613 (item 4) to .852 (item 9), and modification indices suggested that a single-factor model did not adequately account for the covariance among the items.

Model 2, the two-factor correlated CFA in which SMM and SMB were estimated as distinct but correlated first-order factors, showed a substantial improvement in fit (χ^2 = 109.300, *df* = 34, CFI = .973, TLI = .964, RMSEA = .096, SRMR = .044). The CFI surpassed the .95 threshold, and the TLI approached it closely. Standardized factor loadings were strong for both factors: SMM loadings ranged from .747 to .802, and SMB loadings ranged from .671 to .878. The interfactor correlation between SMM and SMB was moderate (r = .522, p < .001), suggesting that the two dimensions are related but empirically distinct.

Model 3, the higher-order CFA in which a single second-order SMS-PA factor was specified over the SMM and SMB first-order factors, was not identified. With only two first-order factors, the second-order structure is just identified, making it empirically indistinguishable from the correlated two-factor model (Chen, West, & Sousa, 2006). This model was therefore excluded from further comparison.

Model 4, the bifactor CFA, demonstrated the best fit among the CFA specifications (χ^2 = 72.677, *df* = 25, CFI = .983, TLI = .969, RMSEA = .089, SRMR = .030). In this model, all items loaded on a general SMS-PA factor, while simultaneously loading on their respective specific factors (SMM or SMB), with all three factors constrained to be orthogonal. The general factor loadings were heterogeneous, ranging from .436 (item 3) to .945 (item 9), with SMB items generally showing stronger general factor loadings (.485–.945) than SMM items (.436–.476). For the SMM specific factor, loadings were substantial and ranged from .544 to .696, indicating that SMM items retained meaningful specific variance beyond the general factor. In contrast, the SMB specific factor showed a pattern of declining loadings: items 5 (.558) and 6 (.573) retained substantial specific variance, while items 9 (.086, p = .591) and 10 (.143, p = .201) had nonsignificant loadings, suggesting that these items were largely accounted for by the general factor.

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Table 4. CFA and ESEM Measurement Models

Model	Type	χ^2	df	CFI	TLI	RMSEA	SRMR	Meets Criteria
Confirmatory Factor Analytical Models								
Model 1	Unidimensional	485.169	35	.839	.793	.231	.118	Poor
Model 2	Correlated Model	109.300	34	.973	.964	.096	.044	Good
Model 3	Hierarchical	*Not identified due to only two first-order factors*						Not identified
Model 4	Bifactor Model	72.677	25	.983	.969	.089	.030	Excellent
Exploratory Structural Equation Models								
Model 5	Correlated ESEM	119.743	26	.966	.942	.123	.032	Good
Model 6	Hierarchical ESEM	*Not identified due to only two first-order factors*						Not identified
Model 7	Bifactor ESEM	74.551	18	.980	.949	.114	.025	Good

Note. χ^2 = chi-square; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual. Models 3 and 6 were not identified because only two first-order factors were specified in the higher model, resulting in an underidentified second-order structure.
Sources : Personal data.

ESEM Models

Consistent with the analytical procedures outlined in the planning phase, the results of the ESEM models are presented in Tables 4 and 5. The ESEM approach was utilized to account for the structural complexity of the SMS-PA construct by allowing items to cross-load across factors.

Model 5, the two-factor correlated ESEM model with target rotation, demonstrated strong comparative fit and low residual variance (χ^2 = 119.743, *df* = 26, CFI = .966, TLI = .942, SRMR = .032). However, its absolute fit index fell outside the acceptable threshold (RMSEA = .123, relative to the target criterion of < .08, precluding it from being classified as a well-fitting model on purely global grounds. Target loadings were well defined: SMM primary loadings ranged from .679 to .835, and SMB primary loadings ranged from .721 to .893. Cross-loadings were generally small, though minor but statistically significant cross-loadings were observed for Item 5 on SMM ($\lambda = -.159$, $p = .002$), as well as Items 9 ($\lambda = .170$, $p = .001$) and 10 ($\lambda = .122$, $p = .021$) on SMM. The interfactor correlation (r = .493) was lower than its CFA counterpart (r = .522), consistent with the established tendency of CFA to inflate factor correlations by constraining cross-loadings to zero (Marsh et al., 2009, 2010).

Table 5. Standardized Factor Loadings Across CFA and ESEM Measurement Models of the SMS-PA

	Model 1	Model 2		Model 4			Model 5		Model 7		
	Unidimensional	*Correlated CFA*		*Bifactor CFA*			*Correlated ESEM*		*Bifactor ESEM*		
Item	SMS-PA	SMM	SMB	GEN	SMM	SMB	SMM	SMB	GEN	SMM	SMB
SMM Items											
Item 1	.683	.802	—	.448	.675	—	.823	−.020	.416	.695	−.055

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	Model 1	Model 2		Model 4			Model 5		Model 7		
	Unidimensional	*Correlated CFA*		*Bifactor CFA*			*Correlated ESEM*		*Bifactor ESEM*		
Item	SMS-PA	SMM	SMB	GEN	SMM	SMB	SMM	SMB	GEN	SMM	SMB
Item 2	.683	.797	—	.466	.639	—	.769	.035	.397	.695	.119[a]
Item 3	.650	.798	—	.436	.696	—	.835	−.033	.414	.703	−.076
Item 4	.613	.747	—	.476	.544	—	.679	.082	.428	.581	.016
SMB Items											
Item 5	.615	—	.671	.485	—	.558	−.159*	.780	.615	−.091	.376
Item 6	.813	—	.847	.673	—	.573	−.069	.893	.767	−.003	.442*
Item 7	.779	—	.806	.670	—	.463	.022	.792	.724	.070	.377*
Item 8	.820	—	.846	.726	—	.446	−.052	.883	.791	−.020	.317
Item 9	.852	—	.878	.945	—	.086[ns]	.170*	.774	1.066^H	−.030	−.329
Item 10	.761	—	.798	.801	—	.143[ns]	.122*	.721	.759	.073	.094
r (SMM, SMB)	—	.522		*Orthogonal*			.493		*Orthogonal*		

Note. Boldface values indicate primary target loadings. GEN = General SMS-PA factor. SMM = State Mindfulness of Mind. SMB = State Mindfulness of Body. Model 1 = unidimensional CFA; Model 2 = two-factor correlated CFA; Model 4 = bifactor CFA; Model 5 = two-factor correlated ESEM; Model 7 = bifactor ESEM. Dashes (—) indicate that the loading was not estimated (items not specified to load on that factor in CFA models). [a]Statistically significant cross-loading ($p < .05$). [ns] Nonsignificant loading ($p > .05$). [H]Heywood case: standardized loading exceeds 1.0 with negative residual variance. All models were estimated with WLSMV and delta parameterization. ESEM models used target rotation. Bifactor models constrained all factors to be orthogonal.

Sources : Personal data

Model 6, the higher-order ESEM (H-ESEM), was not identified for the same reason as Model 3: with only two first-order ESEM factors, the second-order level is empirically underidentified. Model 7, the bifactor ESEM model with orthogonal target rotation, yielded higher numerical fit indices (CFI = .980, TLI = .949, SRMR = .025) but similarly showed an elevated RMSEA (RMSEA = .114). Although designed to separate general and specific variance, Model 7 suffered from severe estimation issues: Item 9 produced an inadmissible primary general loading ($\lambda = 1.066$) and an undefined residual variance (R^2) , signalling a Heywood case. This indicates that the bifactor ESEM framework was overparameterized for these data, with the general factor over-absorbing variance from Item 9 (Morin et al., 2016).

Although the bifactor CFA model yielded slightly superior global fit metrics (CFI = .983, TLI = .969, RMSEA = .089, SRMR = .030), Model 5 was justified and retained as the primary structural solution. Model 5 is justified not as a model of optimal global fit, but as the most substantively interpretable and empirically acceptable solution. The bifactor specifications demonstrated clear empirical vulnerabilities, specifically, an inadmissible Heywood case in Model 7 and substantial parameter degradation on the SMB specific factor in the bifactor CFA (characterised by weak loadings on Items 9 and 10). In contrast, Model 5 provides well-defined target loadings, realistic factor correlations, and an absence of estimation anomalies. Consequently, despite its elevated RMSEA, the correlated two-factor ESEM (Model 5)

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represents the most psychometrically stable and substantively defensible model for the SMS-PA construct.

Discussion

This study addresses two objectives, namely, (1) to adapt the Self-Awareness Scale for Physical Activity (SMS-PA) to the context of runners in Indonesia and test its validity and reliability using Exploratory Structural Equation Modelling (ESEM) and Confirmatory Factor Analysis (CFA) methods. In addition, this study also aims (2) to identify the demographic characteristics of recreational runners in Indonesia and explore how the dimensions of body and mind awareness while running can contribute to the understanding of improving well-being through mindful physical activity.

For the first objective, the CFA results indicated that the bifactor model (Model 4) provided the superior numerical fit. This finding underscores that general mindfulness is a core, prominent component of mindfulness in physical activity (SMS-PA). While the domain-specific dimensions remain relevant, the substantial general factor indicates that the construct retains strong unidimensional properties; thus, concluding that mindfulness in physical activity cannot be reduced to a general construct would be an overstatement.

Within this structure, Item 9 ("*Saya memperhatikan sensasi yang muncul di tubuh saya saat berlari*" [SMB]) warrants careful psychometric scrutiny. Item 9 exhibited an exceptionally strong general factor loading ($\lambda = .945$, the highest across all items) alongside high endorsement rates. Conversely, its loading on the SMB-specific factor was non-significant, demonstrating that its variance is almost entirely absorbed by the general mindfulness factor. Rather than indicating a stand-alone body-awareness dimension, Item 9 captures a core aspect of body awareness that is fully saturated by the general mindfulness experience. This high saturation on the general factor also directly explains the estimation difficulties encountered in the bifactor ESEM model (Model 7), where Item 9 triggered an inadmissible Heywood case ($\lambda > .1.0$). Taken together, these patterns indicate that Item 9 acts as a primary anchor for general physical activity mindfulness, but offers negligible unique variance to the specific SMB subscale.

Meanwhile, in the best-fitting correlated ESEM model (Model 5), one of the strongest-performing items was Item 6, *"Saya merasa hadir sepenuhnya di tubuh saya selama berlari."* (SMB). This item showed a very high main loading on the SMB factor ($\lambda = .893$), with a small and insignificant cross-loading on the SMM ($\lambda = -.069$). This finding suggests that Item 6 is a strong, "clean" indicator of the body mindfulness dimension, as it loads predominantly on the appropriate factor with little overlap with other dimensions.

A higher-order ESEM model (Model 6) was not identified, suggesting that mindfulness in this context is better conceptualised as parallel dimensions rather than a hierarchical structure. Although the bifactor ESEM model (Model 7) demonstrated acceptable overall fit, estimation issues (e.g., in Heywood's case, particularly for highly body-oriented items like *"Saya sepenuhnya menyadari sensasi tubuh saya"* indicated overparameterization, with the general factor absorbing most of the reliable variance and diminishing the role of specific factors.

Overall, the correlated two-factor ESEM model (model 5) appears to be the most stable and easily interpreted representation. These findings suggest that mindfulness during running is best understood as two related dimensions, SMM and SMB, within an integrated experiential framework, where cognitive awareness (e.g., monitoring thoughts) and bodily awareness (e.g., sensing movement and breathing) interact dynamically rather than functioning as entirely independent constructs.

These findings align with previous literature suggesting that mindfulness during physical activities, such as running, can be conceptualised as an integrated experience encompassing both mental and bodily awareness (Díaz-Silveira et al., 2020; Remskar et al., 2024). The emergence of the two-factor structure also resonates with theoretical frameworks of mindfulness-based interventions that emphasize embodied awareness alongside mental observation (Baer et al., 2006; Wang et al., 2023).

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Unlike generic mindfulness scales such as the Freiburg Mindfulness Inventory (FMI; Walach et al., 2006) or the Toronto Mindfulness Scale (TMS; Lau et al., 2006), which were primarily designed for clinical or meditation retreat settings and measure mindfulness as a broad, general trait or state, the contextualised SMS-PA offers enhanced situational sensitivity tailored specifically to the dynamic physical experience of running.

From a practical perspective, distinguishing between State Mindfulness of Mind (SMM) and State Mindfulness of Body (SMB) offers promising theoretical implications for sport psychology and athletic training. Theoretically, screening athletes on these two dimensions could let coaches and practitioners design targeted mental or somatic conditioning routines. For instance, runners exhibiting high SMM but low SMB might hypothetically benefit from somatic feedback training to better recognise internal physical warning signals, a mechanism previously discussed in long-distance running interventions to mitigate overuse strain (De Petrillo et al., 2009; Hernández-Florez et al., 2025). Conversely, runners with lower baseline SMM might utilise cognitive acceptance techniques to manage psychological fatigue and attentional focus during endurance tasks (Kelemen et al., 2025). Although testing the efficacy of such interventions was beyond the scope of this psychometric study, these conceptual applications highlight the potential utility of a dual-dimensional state mindfulness measure in athletic settings.

Regarding demographics, the sample was predominantly productive-age urban professionals and academics (aged 20–39). While this aligns with the demographic profile of urban recreational runners seeking lifestyle balance, these characteristics primarily describe the sample rather than support population-wide generalisability.

Several methodological limitations must be noted. First, the sample was limited to Indonesian recreational runners, so caution is needed when extending these findings to other athletic populations, such as elite runners or clinical samples. Second, this study did not directly compare the psychometric properties of contextualised items against non-contextualised generic items. Although contextualization is theoretically assumed to enhance ecological validity, future studies could employ advanced psychometric approaches, such as Contextual Item Integration Analysis (CIIA; Widhiarso et al., 2025) to empirically verify whether adding a physical activity context significantly improves measurement precision. Third, reliance on self-report measurements leaves the findings susceptible to social desirability bias and variations in subjective interpretations of mindfulness concepts.

Conclusion

In conclusion, this study provides initial evidence supporting the structural validity and psychometric properties of the Indonesian adaptation of the State Mindfulness Scale for Physical Activity (SMS-PA) among recreational runners. The empirical findings indicate that running mindfulness is meaningfully represented through a correlated two-factor framework comprising State Mindfulness of Mind (SMM) and State Mindfulness of Body (SMB). While the bifactor CFA analysis highlighted a strong general mindfulness factor, the two-factor ESEM model provided a more stable and interpretable representation by accommodating cross-loadings without distorting parameters.

Overall, the CFA and ESEM findings indicate that the SMS-PA instrument for Indonesian runners demonstrates a robust and meaningful factorial structure. While the CFA results support a strong general mindfulness factor alongside specific dimensions, the ESEM results offer a more flexible, empirically stable representation, confirming that running mindfulness is best conceptualised as two related but distinct dimensions: state mindfulness of mind (SMM) and state mindfulness of body (SMB). This dual-dimensional structure reflects the integrated yet differentiated nature of cognitive and bodily awareness during running. Importantly, the superior correlated two-factor ESEM model suggests that allowing cross-loadings yields a more realistic representation of the construct than more restrictive or overly complex models. Therefore, the SMS-PA instrument provides initial evidence supporting the structural validity of the Indonesian adaptation for recreational runners. Future research should aim to replicate the factor structure using a larger, independent sample; test external validity; evaluate

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measurement invariance across relevant groups; and examine the instrument's relationship with relevant external variables to provide additional evidence of validity.

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Conflict of Interest

Declaration by the authors that they do not have any conflicts of interest to declare.

Authors Contribution

TD is responsible for determining the research topic, reviewing research reports, providing guidance, collecting field data, conducting data analysis, and drafting the methodology. AR is responsible for data analysis, item development, drafting the methodology, organising results, writing the discussion, and collecting field data. SIS and STU are assigned to draft the introduction, research methodology, and discussion.

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Appendix A

The State Mindfulness Scale for Physical Activity (SMS-PA) instrument in Indonesian runners - 2025

The State Mindfulness Scale for Physical Activity (SMS-PA) instrument in Indonesian runners - 2025 is an adapted instrument based on the State Mindfulness Scale for Physical Activity (SMS-PA) by Cox et al. (2016). This scale is designed to assess an individual's state of mindfulness while running, capturing both mental and physical awareness during the activity. The adaptation process included linguistic translation, cultural adjustments, and psychometric validation to ensure its applicability in the Indonesian running context. This version consists of 10 items divided into two main dimensions:

1. Mindfulness of the Mind (4 items) – Evaluating cognitive aspects of mindfulness, such as attention and awareness during running.
2. Mindfulness of the Body (6 items) – Assessing bodily sensations and physical awareness while engaging in running activities.

Participants respond to each item using a 4-point Likert scale, ranging from 1 (Rarely) to 4 (Very Often), with higher scores indicating greater mindfulness during running. The instrument underwent a rigorous validation process using Exploratory Structural Equation Modeling (ESEM) and Confirmatory Factor Analysis (CFA) to ensure its construct validity, reliability, and measurement invariance within Indonesian running populations. For researchers and practitioners interested in utilizing the State Mindfulness Scale for Physical Activity (SMS-PA) instrument Indonesian runners, the full instrument is provided below. Proper citation and acknowledgment are required when using or modifying this scale for academic and applied purposes.

No	Original Item MRS-IV	Adaptasi Item MRS-IV	Tidak pernah	Jarang	Sering	Sangat Sering
1	I was aware of different emotions that arose in me.	Saya menyadari berbagai emosi yang muncul dalam diri saya saat berlari.				
2	I noticed pleasant and unpleasant emotions.	Saya memperhatikan emosi yang menyenangkan dan tidak menyenangkan selama berlari.				
3	I noticed emotions come and go.	Saya menyadari bahwa pikiran datang dan pergi saat saya berlari.				
4	It was interesting to see the patterns of my thinking.	Saya merasa tertarik mengamati pola-pola pikiran saya selama berlari.				
5	I focused on the movement of my body.	Saya fokus pada gerakan tubuh saya saat berlari.				
6	I felt present in my body.	Saya merasa hadir sepenuhnya di tubuh saya selama berlari.				
7	I listened to what my body was telling me.	Saya mendengarkan apa yang tubuh saya coba sampaikan kepada saya selama berlari.				
8	I was aware of how my body felt.	Saya menyadari bagaimana tubuh saya terasa selama berlari.				
9	I noticed the sensations in my body.	Saya memperhatikan sensasi yang muncul di tubuh saya saat berlari.				
10	I was in tune with how hard my muscles were working.	Saya selaras dengan seberapa keras otot-otot saya bekerja selama berlari.				

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