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Evaluating the efficacy of a modified mindfulness program in enhancing psychosocial wellbeing and cognitive functions of community dwelling older adults

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Abstract

Objective: To assess the effects of a modified Mindfulness for Senior Wellbeing (MSW) program on older adults' psychosocial wellbeing (flourishing, sleep quality, self-transcendence, purpose and meaning) and cognitive functions (working memory, episodic memory, speed of processing, cognitive flexibility).

Methods: Twenty-eight community dwelling older adults were recruited to participate in the 5-week mindfulness training out of which nineteen (mean age = 69.7 years) who met the training requirements were included in the data analysis. Due to practical limitations, a single-group pre–post study design was adopted. Participants completed the outcome measures before and after the training program.

Results: Participants experienced significant improvements in their levels of mindfulness, sleep quality, and some aspects of cognitive functions (working memory, episodic memory, cognitive flexibility), and reduced worrying thoughts related to a financial subscale of flourishing. Other outcome measures showed slight improvements albeit not statistically significant.

Conclusion: Taken together, these preliminary findings shed light on the feasibility and potential of the locally tailored mindfulness program to bring about positive benefits to the older adults.

Keywords

Mindfulness, older adults, well-being, flourishing, cognitive functions

Introduction

Mindfulness is an attentional practice that raises awareness through a non-judgemental and present moment focus.[1–3] Shapiro et al. proposed that mindfulness is characterized by three components i.e., intention, attention, and attitude.[4] Mindfulness practice is the intentional process to be present and fully engaged in the here and now, encompassing a dynamic and evolving inner motivation within the individuals. Attention involves closely observing one's internal and external experiences non-judgmentally, while attitude refers to the underlying mental and emotional stance towards the practice. These three components work together to facilitate the cultivation of mindfulness and ultimately a shift in how the individuals engage with their life experiences.

Mindfulness has also been linked to flourishing.[5–7] Human flourishing extends beyond one's happiness and mental state, encompassing their overall well-being holistically, considering different domains such as life satisfaction, and sense of purpose.[8] Human flourishing is posited to encompass five key domains of human life including happiness and life satisfaction, mental and physical health, meaning and purpose, character and virtue, and lastly, close social

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relationships. Additionally, financial and material stability is considered an integral aspect of human flourishing as it could influence the other domains. Ivtzan et al.'s study revealed that mindfulness-based-strength-practices increased participants' levels of well-being and flourishing.[9] Mindfulness is posited to have enabled the participants to gain insight into their character strengths. By gaining a deeper understanding of their signature strengths and increased awareness of strengths they might not regularly engage, these participants could enhance their well-being and flourishing. However, there is a need for further research to focus on the effectiveness of mindfulness' training on older adults' flourishing in relation to their age group. This is due to the varying levels of life stressors and subjective well-being that continue to fluctuate well into old age.[10,11]

Correspondingly, age-related sleep changes are frequently observed in seniors compared to younger persons leading to worsened sleep quality.[12,13] This has also been linked to heightened anxiety and depression amongst older adults in later stages of life.[13,14] This can often lead to lowered quality of life, difficulty concentrating and excessive daytime sleepiness, behavioural changes and worsen current health conditions through increased stress and anxiety.[15] Mindfulness training has been observed to reduce anxiety and depression in seniors and improve mental health to reduce insomnia[16] contributing to improvement in sleep quality.[14,17] Lau et al. asserted that mindfulness training cultivates both awareness (monitoring of the inner and outer environment) and acceptance (ability to be non-judgemental and non-reactive toward oneself and one's surroundings) which could positively impact one's sleep quality.[18] The ability to disengage from ruminated thoughts and daily stress may be strongly attributed to the relationship between awareness and acceptance,[19] and hence reduced psychological distress, better sleep quality, and overall better quality-of-life.[16,20,21]

The psychological benefits of mindfulness practice have been demonstrated such as reduced depressive symptoms, lower stress levels, and improved coping abilities with negative emotions, which contribute to better quality of life and wellbeing.[22–28] The heightened non-judgmental awareness of one's thoughts may attenuate the tendency to spiral into catastrophizing one's undesirable experiences and amplification of the resultant negative thought patterns[29,30] and hence reducing the associated psychological risks.[31] A study conducted on 158 Singaporean Chinese adults randomly assigned into the mindfulness-based stress reduction (MBSR) or music therapy–based stress reduction (MTSR) supported the beneficial effects of mindfulness on improved depressive symptoms and self-compassion, though no significant effects on telomere length associated with ageing.[32]

In a similar vein, research has shown the potential of mindfulness practice to mitigate age-related cognitive decline.[33] There are encouraging albeit preliminary findings on the effects of mindfulness practice on cognitive functioning such as attention, memory, executive function, processing speed, and on brain structure and function which could have important implications for an ageing population.[34–37] The meta-analysis conducted by Whitfield et al. acknowledged the varying rigor of previous studies but provided partial support on the positive influence of mindfulness training on cognitive functions in adults, including both clinical and non-clinical populations.[38] In a Singapore-based study, a 3-month mindfulness intervention has been shown to enhance the functional brain connectivity and recognition memory in community-dwelling older adults with mild cognitive impairment (MCI) compared to an active control group undergoing a heath education program.[39] Contrastingly, another local study investigated the effects of mindfulness intervention compared to health education program in older adults with MCI from the community and found that both groups showed improved emotional health (lower depression and anxiety) at 9 months but did not show significant changes in cognitive functions.[40]

Self-transcendence has been purportedly linked to mindfulness, representing a mental state where the discriminations between one's sense of self and others become dissolved.[41–43] This shared relationship could plausibly be facilitated by a process of decentering.[43] Research has highlighted the significance of mindfulness and its positive impact on the spiritual well-being of older adults, which in turn can have an influence on their physical and mental wellness. Mindfulness enables an individual to create a positive relationship with oneself and the society which could involve transcending self-centered desires and reinforcing pro-social aspects of self-transcendence, fostering a sense of interconnectedness that contributes to spiritual well-being.[44] Interestingly, self-transcendence has similarly been associated with one's enhanced capacity in the endurance to suffering.[45]

Mindfulness has also been shown to have a positive effect on an individual's sense of purpose and meaning in life.[46] Relatedly, Pandya's studies[47,48] found that seniors who engaged in a meditation program experienced higher levels of happiness and self-rated health, contributing to a heightened sense of purpose in life. Crego et al. similarly reported the positive effects of mindfulness in reducing the mental health symptoms and enhanced levels of happiness and sense of purpose in life.[49] The meta-analysis by Chu and Mak further highlights the significant positive relationship between mindfulness and a sense of meaning in life.[50] This suggests the potential for mindfulness practice to enhance the individuals' perceptions of purpose and significance in their lives, and ultimately contributing to improved well-being and life satisfaction.[51]

Research aims

Mindfulness programs have shown promise in promoting mental and emotional well-being and enhancing overall quality of life as discussed. While mindfulness research has garnered growing recognition for its potential wide-ranging benefits, its impacts on seniors within the unique cultural and social context of Singapore have begun to attract a growing interest in understanding its effectiveness in this demographic. The modification of the mindfulness program to create a shortened and localized version has been undertaken by the Centre for Mindfulness in Singapore, known as Mindfulness for Senior Wellbeing (MSW). This 5-week program, based on the Mindfulness-Based Wellbeing Enhancement (MBWE) program,[52] typically consists of a series of guided practices and exercises (refer to Appendix A on program overview). These include meditation, breathing,

light movements, walking and other mindfulness techniques and reflections. These are taught in an inclusive, supportive, and nurturing environment. Participants learn to focus their attention on their breath, bodily sensations, thoughts, and emotions, and to observe them without judgment or attachment. With practice, participants will be able to develop greater awareness of their thoughts and emotions, and the ability to respond to them in a more positive and constructive way. Drawing upon the foundational principles of Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT), MBWE specifically aims not only to alleviate stress and psychological symptoms but also to actively enhance positive aspects of mental health and wellbeing. The preliminary participant-reported outcomes were suggestive of the potential efficacy of the MBWE program which warrants further empirical investigation.[52] Considering the documented effectiveness of low-dose mindfulness programs,[53–55] the adaptations made for the MSW program include a reduced 5-week (10-h) format, simplified didactic components, utilisation of a distinct set of metaphors for meditations, reduced home practices for better manageability, and distinct thematic content for each session. Formal and informal mindfulness practices taught in the MSW are limited to body scan, mindful perception, awareness of breath, five-finger gratitude practice, mindful movement, loving kindness meditation, mindful walking, and raisin practice. These practices are also present in the MBWE curriculum.

Consequently, the present research aimed to conduct an evaluation study on the modified mindfulness program for seniors in Singapore i.e., Mindfulness for Senior Wellbeing (MSW) on several domains of interest including psychosocial wellbeing (flourishing, sleep quality, self-transcendence, purpose and meaning) and cognitive functions (working memory, episodic memory, speed of processing). This would contribute to new understanding to fill the knowledge gap and determine the efficacy of the locally adapted program compared to more traditional, Western-centric mindfulness programs. Additionally, understanding the impact of mindfulness on seniors in Singapore is pertinent for addressing the well-being and healthcare needs of this growing demographic.

Hypotheses

We hypothesised that participants would experience significant improvements in their psychosocial well-being (i.e., flourishing, sleep quality, self-transcendence, purpose and meaning) and cognitive functions (i.e., working memory, episodic memory, speed of processing, cognitive flexibility) after completing the mindfulness program.

Methods

Participants

The project team collaborated closely with a community partner, who helped with participant recruitment and logistical support (e.g., training facility). The program executive in charge helped with disseminating information about the study through promotional flyers to recruit interested participants. Initially, 28 older adults (aged 50 years old and above) were recruited for the study. However, after applying the training criteria (requiring completion of 50% and above for training frequency and attendance), a total of 19 participants was included in the study's subsequent analysis. Participants (5 males and 14 females) were on average 69.7 years old (SD = 7.23) with average 11.1 years of education (SD = 4.03).

Procedures

For participants who agreed to take part, the research team followed up to arrange a visit with the participants at the community partner's designated venue to brief them and obtain their informed consent. Upon consent, the participants underwent the pre-test assessments based on the outcome measures (details of each assessment are described below). After the completion of pre-tests by all participants, the community partner assisted in organizing group training sessions, which were conducted by a certified trainer from the Center for Mindfulness. Over the course of the training, participants engaged in 5 weekly training sessions (conducted in Mandarin) held at the community partner's training facility, in addition to daily home-based training exercises. Following the training phase, post-tests were administered, based on the same outcome measures as in the pre-tests, to evaluate the effects of the training program.

The data collected during the pre- and post-evaluation phases were analysed using paired-sample t-test. This statistical test was chosen to determine whether there were statistically significant differences in the outcome measures before and after undergoing the mindfulness program. The level of significance was set at $p < .05$.

Measures

Mindful attention awareness scale. The MAAS, a 15-item scale, measures the core characteristic of mindfulness, which is a receptive state of mind in which attention, guided by a sensitive awareness of what is occurring in the present, simply observes what is taking place.[56] The MAAS serves the purpose of manipulation check to verify participants' engagement with mindfulness training.

Flourishing measure (Harvard). The "Flourish" measure encompasses five key domains: happiness and life satisfaction, mental and physical health, meaning and purpose, character and virtue, and close social relationships.[8] Two specific questions or items are included within each domain, on a rating scale ranging from 0 to 10. Additionally, the "Secure Flourish" measure incorporates two additional questions on financial and material stability which may provide insight into an individual's capacity to sustain their state of flourishing.

Single-item sleep quality scale. The SQS is a single-item, self-rated assessment tool designed to measure an individual's overall sleep quality over a 7-day recall period.[57]

Self-transcendence scale. The Self-Transcendence Scale (STS) measures a major psychosocial/spiritual resource of

developmental maturity, i.e., self-transcendence.[58] "Self-transcendence" refers to the capacity to expand personal boundaries and be oriented toward perspectives, activities, and purposes beyond the self without negating the value of the self and the present context. The STS is a one-dimensional scale, consisting of 15 items that identify characteristics of a matured view of life that expand boundaries of the self.

Meaning in life questionnaire. The Meaning in Life Questionnaire (MLQ) measures the presence of meaning in life, that is, the subjective sense that one's life is meaningful, and the search for meaning in life, reflecting one's drive and orientation toward finding such meaning.[59]

Digit span. Digit Span tests verbal working and short-term memory by instructing participants to repeat random sequences of numerals in original and reverse order.[60] Digit Span is at large a measure of working memory but is also described to be of importance in evaluating everyday simple attention.

Logical memory (story recall). The Logical Memory test is a standardized assessment of narrative episodic memory.[61] A short story is orally presented, and the examinee is asked to recall the story verbatim (immediate recall). Approximately 20 or 30 min later, free recall of the story is again elicited (delayed recall).

Trail making test. Trail Making Tests A and B assess processing speed and executive functions respectively. Part A requires participants to connect numbers in ascending order, while Part B involves alternating between numbers and their corresponding number of dots in circles (in a modified version replacing linguistic demand of alphabets) in increasing numerical order.[62]

Results

Table 1

Discussion

Following mindfulness training, the participants showed an overall improvement in their mindfulness levels as measured by the Mindful Attention Awareness Scale (Table 1). This also serves as a manipulation check that demonstrated the feasibility of the locally tailored Mindfulness for Senior Wellbeing (MSW) program. The observed positive changes in mindfulness levels post-training highlights the practicality and effectiveness of this program to bring about meaningful changes in individuals' mindfulness.

Contrary to initial expectation, our study did not reveal a significant difference in participants' overall levels of flourishing at post-training, which encompassed various sub-domains such as life satisfaction, mental and physical health, purpose in life, character and virtue, and relationships (Table 1). Although there was a notable positive trend in these aspects, the magnitude of the change was not substantial enough to achieve statistical significance. Interestingly, the additional sub-domain of financial and material stability showed a significant improvement in participant ratings. A closer look at the underlying items within this sub-domain revealed that they pertained to financial worries. This intriguing finding implies that mindfulness training might have played a role in attenuating participants' worrying thoughts in this regard.

Consistent with prior research findings, participants reported significant improvement in their sleep quality following the mindfulness training (Table 1). The influence of mindfulness on sleep quality may be explained by its role in promoting relaxation and reducing rumination. The positive association between mindfulness and improved sleep quality

Table 1. Observed pre-test and post-test means, standard deviations, and pre-post comparisons (n = 19).

	Pre-test		Post-test				
Measures	*M*	*SD*	*M*	*SD*	*t*(18)	*p*	Cohen's *d*
Mindful Attention Awareness Scale (MAAS)	4.45	0.67	4.70	0.57	3.15	**.006****	0.72
Flourishing Measure (overall)	7.86	1.30	8.12	0.85	1.73	.101	0.40
Flourishing Measure (life satisfaction)	16.00	2.65	16.05	2.27	0.134	.895	0.03
Flourishing Measure (mental & physical health)	14.21	3.41	15.00	2.52	1.66	.114	0.38
Flourishing Measure (meaning & purpose)	16.58	2.50	17.11	1.79	1.70	.106	0.39
Flourishing Measure (character & virtue)	15.42	3.08	15.42	2.76	W[a] 51.5	.65	0.14[a]
Flourishing Measure (close social relationships)	16.32	2.98	16.58	1.71	0.52	.610	0.12
Flourishing Measure (financial & material stability)	15.79	4.21	17.32	2.47	2.26	**.037***	0.52
Single-Item Sleep Quality Scale	5.95	2.12	7.32	2.31	4.19	**.001*****	0.96
Self-Transcendence Scale	49.7	5.53	51.7	6.03	2.04	.056	0.47
Meaning in Life Questionnaire (overall)	55.3	7.67	56.3	6.07	0.73	.472	0.17
Meaning in Life Questionnaire (search for meaning)	27.5	3.84	27.5	4.39	0.06	.955	0.01
Meaning in Life Questionnaire (presence of meaning)	27.8	4.91	28.8	3.24	1.17	.256	0.27
Digit Span Forward	11.95	2.48	13.84	2.69	3.18	**.005****	0.73
Digit Span Backward	7.11	2.54	7.58	2.97	0.72	.479	0.17
Logical Memory (immediate)	6.95	2.76	11.16	2.36	8.54	**.001*****	1.96
Logical Memory (delayed)	6.42	2.59	10.37	2.65	5.86	**.001*****	1.35
Trail Making Test A (seconds)	34.26	11.85	30.09	8.80	1.75	.097	0.40
Trail Making Test B (seconds)	70.03	24.49	58.10	17.70	2.73	**.014***	0.63

Note. *p < .05, **p < .01, ***p < .001.

[a]Based on non-parametric Wilcoxon signed rank test (all other tests met the normality assumption); Reliability analysis of the translated bilingual questionnaires, as measured by Cronbach's alpha, is detailed in Appendix B.

may be further attributed to reduced psychological distress, anxiety, and depression through mindfulness practice as individuals develop more effective ways of managing stress and negative emotional states.[16,20]

Our study also observed an appreciable increase in participants' self-transcendence levels, although this increase was only marginally significant (Table 1). Self-transcendence involves an individual's capacity to shift their attention away from a self-centered focus and towards a broader awareness of others and the world around them.[63] This cognitive and emotional shift may be facilitated as one develops the ability to observe the present moment with mindfulness, which enables the individuals to detach from their subjective interpretations. As their mindfulness practice deepens, they may increasingly recognize the interconnectedness of their experiences and the world around them to be able to transcend their immediate concerns and self-centered interpretations. This initial observation, while only marginally significant, is worth further exploration on how mindfulness can facilitate an individual's deeper connection with others.

One unexpected finding from our study was the absence of a significant change in participants' levels of meaning in life, including both the search for meaning and the presence of meaning subscales (Table 1). Although there was a slight increase in the ratings post-training, it did not reach statistical significance. To start with, participants' levels of meaning in life are comparable to other reported norms.[64] The mindfulness training did not significantly raise the participants' levels of meaning in life beyond the typical norms in this sample of participants. At most, the participants appeared to maintain their pre-existing levels of meaning in life following the training. To better understand this observation, it is essential to consider various factors, including the potential limitations of the study and the specific design of the training component that addressed this aspect.

The mindfulness training also led to noteworthy changes in some aspects of the participants' cognitive functions, although not uniformly (Table 1). Specifically, participants demonstrated significant improvements in their short-term memory (assessed using the Digit Span Forward test) and episodic memory (as measured by the Logical Memory Test). Furthermore, the training had a positive impact on cognitive flexibility and task-switching abilities (assessed using the Trail Making Test B). Other aspects of cognitive functions (working memory and processing speed) however, showed a general improvement but did not reach statistical significance. Collectively, the findings suggest that mindfulness training has the potential to enhance various cognitive functions although the effects may not be uniform across all cognitive domains. The positive findings show that mindfulness training holds promise in supporting cognitive health. It could have an important implication for an ageing population as these cognitive benefits could translate into a better quality of life for older individuals.

Limitations

A notable limitation is the reduced sample size after excluding the participants who did not meet the training requirements. This could have potentially affected the statistical power of the study, making it more challenging to detect significant differences in some of the mixed findings. Future research with larger sample sizes is warranted to confirm these findings and enhance the generalizability of the observed effects. Further studies with larger and more diverse samples from the Singapore population are recommended to verify the replicability and relevance of these findings across different subgroups.

Additionally, the current study design did not include a control group for comparison due to practical constraints and challenges encountered, which could have strengthened the robustness of the results. As mindfulness practice often yields more enduring effects with prolonged engagement, the observed changes might not capture the full extent of the potential effects. The study's training duration may have been relatively short for certain long-lasting changes to be evident.

Conclusion

The current study shed light on the multifaceted impacts of mindfulness training on various aspects of well-being and cognitive functioning in older adults. The preliminary results on the positive outcomes as discussed support the feasibility of the locally tailored Mindfulness for Senior Wellbeing (MSW) program. However, the observed lower adherence to home practice routines also presents an opportunity for program enhancement (such as incorporating effective nudges or motivating reminders).

It highlights the potential for expanding similar programs to cater to the needs of older individuals in promoting mindfulness as a valuable tool for enhancing the lives of older individuals. It is essential to also acknowledge certain limitations as discussed, which can be further addressed in future research.

Appendix

Appendix A

Mindfulness for senior wellbeing (MSW) program overview. The 5-week Mindfulness for Senior Wellbeing (MSW) program is an adaptation of the Mindfulness-Based Wellbeing Enhancement (MBWE) program.[52] An outline of the course content is included herein.

Course logistics

Course format. Five weekly 2 hour classes

Class size. Minimum: 8, Maximum: 30

Course materials. Yoga mats will be provided.

Intake process. All participants are required to complete a pre-course survey.

Participant materials. Participants are provided with

- a journal
- guided practice recordings via a download link or on CDs

Participant support. Participants have WhatsApp, email and phone support from Centre for Mindfulness for questions and support outside of class times.

Program overview. Mindfulness for Senior Wellbeing (MSW) is a program that is designed to support seniors to improve their mental and physical health, reduce stress, and increase overall well-being through the practice of mindfulness. Mindfulness is the state of being present and fully engaged in the present moment, without judgment or distraction.

This 5-week program, based on the Mindfulness-Based Wellbeing Enhancement (MBWE) program, typically consists of a series of guided practices and exercises. These include: meditation, breathing, light movements, walking and other mindfulness techniques and reflections. These are taught in an inclusive, supportive and nurturing environment. Participants learn to focus their attention on their breath, bodily sensations, thoughts, and emotions, and to observe them without judgment or attachment. With practice, they develop greater awareness of their thoughts and emotions, and the ability to respond to them in a more positive and constructive way.

Research has shown that mindfulness training can be particularly beneficial for seniors, as it can help to reduce symptoms of depression, anxiety, and chronic pain, and improve cognitive function and overall wellbeing. It is also an effective tool for managing stress, which can be especially important for seniors who may be dealing with a range of health issues and life changes.

Program outline

Week 1. This session includes an introduction to the program and the guidelines for an effective learning contract with the participants. The participants are experientially introduced to a metaphor, mindful eating, mindful perception and body scan. Home practice is assigned using the first guided recording (body scan meditation) as a means of beginning to learn to become familiar with mindful awareness of the body and cultivate curiosity.

Week 2. This session includes 30 min of body scan and awareness of breath, and learning the various ways to sit for meditation. The rest of the time is dedicated to focused dialogue and reflection. The participants will also be introduced to the reactivity of the brain and how mindfulness supports response-ability. Home practices are assigned with an emphasis on the regular daily practice of the body scan for a second week, plus the introduction of short periods of sitting meditation, and gratitude journalling.

Week 3. Participants practice mindful movement, awareness of breath, loving kindness meditation and gratitude for about 60 min. Home practices are assigned with an emphasis on the daily practice of alternating between the body scan and the mindful movement, a short sitting meditation, loving kindness meditation and a gratitude practice.

Week 4. The intensive nature of this 2 hour session, conducted as a shorter form of the traditional silent retreat, is intended to support participants in firmly establishing the use of mindfulness skills. All the practices learned in the program will be guided without any interaction among the participants. Home practices are assigned with an emphasis on the daily practice of mindful walking, awareness of breath and loving kindness meditation.

Week 5. In this final session, experiential mindfulness practices continue and participants are introduced to the happiness paradigm which helps them learn to direct their attention to the positive, accept the negative and generate different perspectives in their everyday life. The program includes an evaluation that focuses on daily techniques to preserve and enhance the skills acquired throughout its duration. It aims to provide a gratifying conclusion for participants, recognising the end of the program while acknowledging the start of a new chapter in their lives. Home practices are assigned with an emphasis on the sustained daily practice of mindfulness.

Appendix B

Table A1. Cronbach's alpha test of reliability on translated bilingual questionnaires.

Measures	No. of Items	Cronbach's α	
		Pre-test	Post-test
Mindful Attention Awareness Scale (MAAS)	15	0.846	0.850
Flourishing Measure (overall)	12	0.933	0.874
Flourishing Measure (life satisfaction)	2	0.896	0.831
Flourishing Measure (mental & physical health)	2	0.613	0.663
Flourishing Measure (meaning & purpose)	2	0.800	0.776
Flourishing Measure (character & virtue)	2	0.859	0.304
Flourishing Measure (close social relationships)	2	0.988	0.876
Flourishing Measure (financial & material stability)	2	0.915	0.828
Self-Transcendence Scale	15	0.846	0.921
Meaning in Life Questionnaire (overall)	10	0.861	0.762
Meaning in Life Questionnaire (search for meaning)	5	0.703	0.813
Meaning in Life Questionnaire (presence of meaning)	5	0.897	0.670

Note. Cronbach's alpha values above 0.7 are acceptable. Values below 0.7 warrant caution in interpretation.

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Author contributions

All authors designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content.

Declaration of conflicting interests

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Ethical statement

Ethical approval

This study was approved by the Ethics Committee of Temasek Polytechnic, Singapore (Study code: RP04-GEM-2023).

Informed consent

Written informed consent was obtained from all subjects before the study.

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Data availability statement

All data generated or analysed during the present study are available from the corresponding author on reasonable request.

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