

Interoceptive Awareness Among the General Public in Saudi Arabia: A Cross-Sectional Study

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Abstract

Background

Interoception refers to the cognitive process of perceiving internal bodily states. This encompasses various physiological indicators, including heart rate fluctuations, stomach distention, internal temperature, hydration levels, sensory input from free nerve terminals in the fascia and muscles, as well as hormonal, stretch, and pain receptors. This study aimed to examine the interoceptive awareness among the general public in Saudi Arabia.

Methods

A cross-sectional online survey was undertaken in Saudi Arabia to investigate the level of interoceptive awareness within the overall population of the country in October 2023. This research used a previously developed questionnaire named the Multidimensional Assessment of Interoceptive Awareness, version 2 (MAIA-2). In a binary logistic regression analysis, the mean interoceptive awareness score of the participants was utilized as the dummy variable to determine the variables that influence interoceptive awareness.

Results

A total of 814 participants were involved in this study. Overall, the study participants demonstrated a marginal level of interoceptive awareness with a mean score of 94.3 (standard deviation (SD): 29.3) out of 185 (representing 51.0% of the maximum attainable score). The mean interoceptive score was not consistent across different subscales and ranged between 37.7% and 63.3%. The highest mean interoceptive score was observed for the Trusting subscale (9.5 (SD: 4.5) out of 15) (representing 63.3% of the maximum attainable score for this subscale). The lowest mean interoceptive score was observed for the Not-Distracting subscale (11.3 (SD: 6.9) out of 30) (representing 37.7% of the maximum attainable score for this subscale). Binary logistic regression analysis did not identify any statistically significant difference in the likelihood of having a higher level of interoceptive awareness among the participants based on their demographic characteristics ($p>0.05$).

Conclusion

The participants in our research demonstrated a modest degree of interoceptive awareness. The study's results suggest that the participants demonstrated a heightened inclination towards internal experiences rather than being attentive to their bodily sensations. Further investigation is required to examine interoceptive awareness across various cohorts.

Categories: Psychiatry, Psychology, Public Health

Keywords: survey, saudi arabia, interoception, public, awareness

Introduction

Interoception pertains to the perception of interior bodily states, encompassing several physiological indicators such as fluctuations in heart rate, stomach distention, internal temperature, hydration levels, sensory input from free nerve terminals in the fascia and muscles, as well as hormonal, stretch, and pain receptors [1]. The concept of interoception is closely linked to emotion and motivation, since it pertains directly to the body's homeostatic condition. It plays a crucial role in our perception of self, consciousness, and overall well-being, including mental well-being [2-6].

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Affective and motivational states might be conceptualized as emerging from the interpretations of and alterations in interoceptive signals [6, 7]. For example, certain physiological states such as dehydration or the accumulation of carbon dioxide in the bloodstream can elicit sensations of fear via the process of interoception [8]. Sufficient interoceptive awareness (IA), sensitivity, and precision play a crucial role in self-regulation, enabling the brain to generate homeostatic predictions regarding present and future requirements and subsequently take appropriate measures to fulfill those needs (such as resting or consuming fluids) [6, 9]. Consequently, a diminished capacity for interoceptive sensitivity or awareness might result in increased ambiguity and difficulty in regulating internal states. Nevertheless, an excessive amount of interoceptive sensitivity or awareness can also have negative consequences. This is because heightened interoception can result in overpowering or invasive feelings that offer little adaptive benefit [10]. Therefore, there is a spectrum of interoceptive capacity that includes persons who exhibit hypo-awareness or sensitivity as well as those who exhibit hyper-awareness or sensitivity.

Consistent with the significance of interoception in facilitating adaptive self-regulation [9, 10], contemporary theories of psychopathology propose that an individual's inability to obtain accurate, consistent, or dependable information regarding their internal state (i.e., impaired or disrupted interoception and deficient integration of bodily and neural processes) or distortions in the interpretation of these interoceptive signals can result in substantial challenges in adaptive regulation, such as anxiety and depression [5, 6, 9]. Disorders such as anxiety or depression, sleep disorders, obsessive-compulsive disorder, eating disorders, addiction, certain physical conditions, and challenges with social interactions can be comprehended within this framework as disruptions in the capacity to process and incorporate interoceptive information, resulting in a limited foundation for adaptive predictions and essential self-regulation [4, 11-16]. Consistent with this viewpoint, the majority of mental disorders exhibit diverse issues related to autonomic dysfunctions and emotion dysregulation [17-19]. Additionally, disrupted interoception is linked to several mental diseases and is also associated with a higher likelihood of developing psychopathology in the future [3, 20, 21]. Moreover, recent studies indicate that therapies, such as interoceptive training, have the potential to mitigate symptoms of anxiety and depression while also enhancing overall functioning [22-24].

The investigation of several facets of interoception, encompassing interoceptive consciousness, holds significance in comprehending mental well-being. Psychology of the general public was the interest of previous research in multiple studies in the Middle East region [25-31]. However, there are limited studies that examined this area of research worldwide and in the Middle East specifically. Therefore, this research aims to examine the interoceptive awareness among the general public in Saudi Arabia. The specific objectives are: (1) To assess the level of interoceptive awareness among the general public in Saudi Arabia. (2) To identify interoceptive awareness predictors among the general public in Saudi Arabia.

Materials And Methods

Study design and settings

A cross-sectional online survey was undertaken in Saudi Arabia to investigate the level of interoceptive awareness within the overall population of the country in October 2023.

Sampling procedure

The sample for this research was selected through a method referred to as convenience sampling. This type of sampling falls within the category of non-probability sampling. The present study encompassed individuals who satisfied the predetermined criteria for inclusion and expressed their willingness to partake in the research. At the commencement of the questionnaire, participants were presented with an informed consent form, affording them the opportunity to either proceed with their involvement in the study or opt to withdraw from it. In order to enhance patients' understanding of the significance of their involvement, the research objectives were clearly presented in their entirety. The invitation letter for the study provided a detailed overview of the inclusion criteria.

Study population and recruitment

The population for this study comprised individuals who are at least 18 years old and are residents of Saudi Arabia, belonging to the general community. There are no restrictions based on the gender. Any participant who did not meet the inclusion criteria or did not provide consent for participation was excluded from the study. The survey hyperlink was disseminated across several social media platforms, including Facebook, Snapchat, WhatsApp, and Twitter, with the aim of fostering increased engagement and involvement.

Study tool

This research used a previously developed questionnaire named the Multidimensional Assessment of Interoceptive Awareness, version 2 (MAIA-2) to examine the interoceptive awareness among the general public in Saudi Arabia [32, 33]. The MAIA-2 is a questionnaire consisting of 37 items that are categorized into eight distinct subscales (See the Appendices). The constructs of the study include: (1) Noticing (four

items), which refers to the ability to recognize and be aware of neutral, pleasant, and uncomfortable bodily sensations; (2) Not-Distracting (six items), which pertains to the tendency to either ignore or acknowledge bodily sensations of discomfort or pain; (3) Not-Worrying (five items), which involves the capacity to maintain emotional balance despite experiencing sensations of discomfort or pain; (4) Emotional Awareness (five items), which relates to the awareness of the connection between bodily sensations and emotional states; (5) Attention Regulation (seven items), which encompasses the capability to control or sustain attention towards bodily sensations; (6) Body Listening (three items), which refers to the ability to actively listen to one's body sensations for insight; (7) Self-Regulation (four items), which involves the ability to alleviate distress by directing attention towards bodily sensations; and (8) Trusting (three items), which pertains to the experience of perceiving one's body sensations as reliable and safe sources of information [33]. The MAIA-2 questionnaire comprises a total of 37 items, each of which is responded to using a 6-point Likert scale. The scale ranges from 0, representing "never," to 5, representing "always." It is worth noting that nine of the items are reverse-scored. The initial iteration of MAIA-2 exhibited Cronbach's alpha coefficients ranging from 0.64 to 0.83 across its eight scales [33]. Two variables, namely Noticing (0.64) and Not Worrying (0.67), fell below the established threshold of 0.70. All correlations between items and the scale met the predetermined criteria of 0.30 [33].

The items in the study were evaluated using a Likert scale consisting of six points. The scale ranged from 0, indicating "never," to 5, indicating "always." Items 5, 6, 7, 8, 9 and 10 on Not-Distracting, and items 11, 12 and 15 on Not-Worrying are reverse-scored. Higher scores on the scale were indicative of increased levels of self-reported interoceptive awareness, which was considered to be more advantageous [32, 33]. In addition, participants' demographic characteristics (age, gender, nationality, education, monthly income category, smoking status, employment status, and marital status) were collected from the study participants.

Survey translation

To promote the involvement of the general population in Saudi Arabia, the Arabic version of the questionnaire instrument was used [32]. The validity of the original 8-factor structure of the MAIA-2 was supported by confirmatory factor analyses conducted on the Arabic version. The internal consistency of the Arabic version was assessed and found to be reliable, as indicated by McDonald's ω coefficients ranging from 0.86 to 0.93 for the subscales. The present study examines the measurement invariance of the Arabic version of the MAIA-2 across gender. In conclusion, the dimensions of the Arabic MAIA-2 exhibited significant positive correlations with the intuitive eating component known as "Reliance on Hunger and Satiety Cues," hence offering empirical evidence in favor of convergent validity.

Piloting of the questionnaire tool

The questionnaire instrument was evaluated and validated by medical professionals affiliated with the Saudi Ministry of Health. The participants were queried regarding the clarity, comprehensibility, and face validity of the questions, in addition to any difficulties encountered in understanding them. Furthermore, the participants were requested to provide feedback regarding any inquiries that they perceived as unpleasant. Furthermore, a preliminary investigation was conducted using a limited sample from the target audience to assess their comprehension of the survey instrument prior to its extensive implementation.

Sample size

The minimum required sample size was 385 individuals using a 95% confidence interval, a 0.5 standard deviation (SD), and a 5% margin of error.

Ethical approval

This study was reviewed and approved by the Institutional Review Board at the Ministry of Health, Jeddah, Saudi Arabia (Ref: A01744).

Statistical analysis

Using SPSS version 27 (IBM Corp., Armonk, NY, USA), this study's data were analysed. A histogram and normality metrics were used to examine the normality of interoceptive awareness score. Based on the normality of the data, interoceptive awareness score was presented as the mean (SD). In a binary logistic regression analysis, the mean interoceptive awareness score of the participants (which was equal to 94.3 (standard deviation: 29.3)) was utilized as the dummy variable to determine the variables that influence interoceptive awareness. To determine statistical significance, a two-sided p-value less than 0.05 was utilized.

Results

A total of 814 participants were involved in this study. More than half of the participants (56.4%; n=459) were females and married (62.9%; n=512). Around one-quarter (23.1%; n=188) of the participants were aged 41-50 years. Around 56.6% (n=461) of the participants reported that they hold a diploma. Around one-quarter (24.3%; n=198) of the participants reported that their family monthly income category is between

5001 and 10000 Saudi Arabia riyal (SAR). Almost one-third (34.2%; n=278) of the study participants reported that they work outside the healthcare sector. The vast majority of the study participants (92.3%; n=751) were Saudis. Almost one-fifth (22.7%; n=185) of the study participants reported that they are current smokers. Besides, around one-third (30.3%; n=247) of the study participants reported that they have other comorbidity history. For further details on the demographic characteristics of the study participants, refer to Table 1.

| Variable | Frequency | Percentage |
|---------------------------------------|-----------|------------|
| Gender | | |
| Females | 459 | 56.4% |
| Age categories | | |
| 18-23 years | 78 | 9.6% |
| 24-30 years | 151 | 18.6% |
| 31-40 years | 143 | 17.6% |
| 41-50 years | 188 | 23.1% |
| 51-60 years | 177 | 21.7% |
| 61 years and older | 77 | 9.5% |
| Marital status | | |
| Single | 239 | 29.4% |
| Married | 512 | 62.9% |
| Divorced | 45 | 5.5% |
| Widowed | 18 | 2.2% |
| Education | | |
| Secondary school or lower | 110 | 13.5% |
| Diploma | 461 | 56.6% |
| Bachelor's degree | 164 | 20.1% |
| Higher education | 79 | 9.7% |
| Family monthly income | | |
| Less than 5000 SAR | 138 | 17.0% |
| 5001-10000 SAR | 198 | 24.3% |
| 10001-15000 SAR | 164 | 20.1% |
| 15001-20000 SAR | 151 | 18.6% |
| 20001 SAR and above | 163 | 20.0% |
| Employment status | | |
| Retired | 141 | 17.3% |
| Unemployed | 180 | 22.1% |
| Working in the healthcare sector | 164 | 20.1% |
| University student | 51 | 6.3% |
| Working outside the healthcare sector | 278 | 34.2% |
| Nationality | | |
| Saudi | 751 | 92.3% |
| Current smokers (Yes) | 185 | 22.7% |

| | | |
|---------------------------|-----|-------|
| Comorbidity history (Yes) | 247 | 30.3% |
|---------------------------|-----|-------|

TABLE 1: Participants' demographic characteristics.

SAR: Saudi Arabia riyal; The data has been represented as frequency and percentage.

Interoceptive awareness profile

Table 2 presents the mean interoceptive awareness score stratified by sub-scale. Overall, the study participants demonstrated a marginal level of interoceptive awareness with a mean score of 94.3 (SD: 29.3) out of 185 (representing 51.0% of the maximum attainable score). The mean interoceptive score was not consistent across different subscales and ranged between 37.7% and 63.3%. The highest mean interoceptive score was observed for the Trusting subscale (9.5 (SD: 4.5) out of 15) (representing 63.3% of the maximum attainable score for this subscale). The lowest mean interoceptive score was observed for Not-Distracting subscale (11.3 (SD: 6.9) out of 30) (representing 37.7% of the maximum attainable score for this subscale).

| Scale | Questions | Mean score (standard deviation) | Percentage of maximum attainable score |
|---------------------------------------|-----------|---------------------------------|--|
| Noticing score | Q1-Q4 | 10.7 (5.5) | 53.5% |
| Not-Distracting score | Q5-Q10 | 11.3 (6.9) | 37.7% |
| Not-Worrying score | Q11-Q15 | 10.8 (4.2) | 43.2% |
| Attention Regulation score | Q16-Q22 | 18.0 (8.4) | 51.4% |
| Emotional Awareness score | Q23-Q27 | 15.5 (6.9) | 62.0% |
| Self-Regulation score | Q28-Q31 | 11.0 (5.4) | 55.0% |
| Body Listening score | Q32-Q34 | 7.5 (4.3) | 50.0% |
| Trusting score | Q35-Q37 | 9.5 (4.5) | 63.3% |
| Overall interoceptive awareness score | Q1-Q37 | 94.3 (29.3) | 51.0% |

TABLE 2: Mean interoceptive awareness score stratified by sub-scale

The data has been represented as Mean \pm Standard deviation and as a percentage of the total score for each sub-scale.

Predictors of a higher level of interoceptive awareness

Binary logistic regression analysis did not identify any statistically significant difference in the likelihood of having a higher level of interoceptive awareness among the participants based on their demographic characteristics ($p > 0.05$) (Table 3).

| Variable | Odds ratio of having a higher level of interoceptive awareness | P-value |
|-------------------------------|--|---------|
| Gender | | |
| Females (Reference group) | 1.00 | |
| Males | 0.78 (0.59-1.03) | 0.077 |
| Age categories | | |
| 18-23 years (Reference group) | 1.00 | |
| 24-30 years | 1.06 (0.61-1.84) | 0.850 |
| 31-40 years | 1.08 (0.62-1.90) | 0.787 |
| 41-50 years | 0.96 (0.56-1.64) | 0.881 |
| 51-60 years | 0.97 (0.56-1.66) | 0.907 |

| | | |
|---|------------------|-------|
| 61 years and older | 0.93 (0.49-1.76) | 0.817 |
| Marital status | | |
| Single (Reference group) | 1.00 | |
| Married | 0.92 (0.67-1.26) | 0.590 |
| Divorced | 0.68 (0.36-1.29) | 0.233 |
| Widowed | 1.30 (0.47-3.57) | 0.616 |
| Education | | |
| Secondary school or lower (Reference group) | 1.00 | |
| Bachelor's degree | 1.00 (0.65-1.52) | 0.986 |
| Higher education | 1.14 (0.70-1.87) | 0.606 |
| Diploma | 0.75 (0.42-1.34) | 0.326 |
| Family monthly income | | |
| Less than 5000 SAR (Reference group) | 1.00 | |
| 5001-10000 SAR | 1.12 (0.72-1.74) | 0.628 |
| 10001-15000 SAR | 0.97 (0.62-1.54) | 0.909 |
| 15001-20000 SAR | 0.93 (0.59-1.49) | 0.773 |
| 20001 SAR and above | 1.18 (0.74-1.88) | 0.481 |
| Employment status | | |
| Retired (Reference group) | 1.00 | |
| Unemployed | 0.95 (0.61-1.49) | 0.823 |
| Working in the healthcare sector | 1.06 (0.67-1.68) | 0.803 |
| University student | 0.60 (0.32-1.15) | 0.124 |
| Working outside the healthcare sector | 1.02 (0.68-1.54) | 0.922 |
| Nationality | | |
| Saudi (Reference group) | 1.00 | |
| Non-Saudi | 1.55 (0.89-2.68) | 0.121 |
| Current smoker | | |
| No (Reference group) | 1.00 | |
| Yes | 1.30 (0.93-1.82) | 0.130 |
| Comorbidity history | | |
| No (Reference group) | 1.00 | |
| Yes | 0.79 (0.59-1.07) | 0.135 |

TABLE 3: Predictors of higher level of interoceptive awareness

SAR: Saudi Arabia riyal; The data has been represented as odds ratio with 95% confidence interval; *p<0.05, **p<0.01; ***p<0.001

Discussion

Interoception is the mechanism through which the nervous system detects, understands, and combines signals arising from within the body. This process creates a continuous representation of the body's internal state, operating both consciously and unconsciously [3]. Indeed, interoception involves sensing several physiological indicators in our internal body states like heart rate, stomach fullness, and temperature, and

connects to emotions and motivation, influencing how we perceive ourselves and our well-being [1, 6]. Therefore, this study aimed to examine the interoceptive awareness among the general public in Saudi Arabia.

This study was conducted using MAIA-2 tool to assess the level of interoceptive awareness among the study participants, where MAIA tool holds significant advantages that allow more differentiated assessment of essential psychological aspects of the perception and evaluation of body sensations [3]. Furthermore, MAIA is considered as one of the few tools that enable a comprehensive assessment of interoceptive body awareness by involving multiple dimensions of analysis [54]. Indeed, the MAIA comprises eight scales that encompass five key dimensions of body awareness, where these scales provide a comprehensive understanding of different aspects of body awareness through eight subscales including “Noticing”, which involves being aware of body sensations, and “Not-Distracting” and “Not-Worrying”, which relate to emotional reactions and attentional responses to sensations. “Attention Regulation” measures the capacity to regulate attention, while “Emotional Awareness” focuses on understanding mind-body integration. Additionally, “Self-Regulation” and “Body Listening” further explore the awareness of mind-body integration. Lastly, the “Trust” scale evaluates one’s confidence in trusting body sensations [33].

Most of the previous research in Iran [35], Korea [36], Japan [37], Colombia [34], and Turkey [38] examined the MAIA reliability and validation to be used and applied among different study populations. This tool was validated to suit populations with different languages, and also to suit different sociocultural groups, where these validations allow clinicians and researchers to use MAIA among these populations [34-39].

In this study, the participants exhibited a marginal level of interoceptive awareness, with an overall mean score of 94.3 out of 185, indicating that they achieved approximately 51.0% of the maximum attainable score. In fact, the level of self-awareness may vary from culture to culture, depending on how individuals process their own interoceptive self-information [40], where bodily sensation and interoceptive awareness level are found to be mediated and controlled by the right anterior insular cortex that contributes the intensity of negative emotions [41]. However, after examining the relationship between interoceptive awareness and emotional susceptibility, it was found that there is an independence between interoceptive accuracy and interoceptive awareness measures [42]. Indeed, the variation in the awareness scores across different subscales highlights the heterogeneity in individuals’ awareness of their internal bodily sensations, where lack of interoceptive awareness and low interoceptive sensitivity were found to be associated with self-objectification [43].

After examining the scores on different subscales, this study found a nuanced understanding of interoceptive awareness, where the “Trusting” subscale, where individuals trust their internal sensations, showed the highest mean score (63.3% of the maximum attainable score). Therefore, self-trust is found to be important to understand how individuals may interpret and respond to any interoceptive stimuli [44], where self-trust is a crucial prerequisite for both personal independence and self-esteem [45], and it shows how individuals reflect and interpret their emotional response [46].

On the other hand, the “Not-Distracting” subscale, indicating the ability to not distract oneself from uncomfortable sensations, exhibited the lowest mean score (37.7% of the maximum attainable score), where this suggests that while individuals might be attuned to their bodily sensations, they struggle with managing or accepting certain discomforts, leading to distractions, in fact, avoiding or distracting attention from emotion-related physical sensations seems logical when someone refuses to acknowledge negative feelings, where the connection with trait anxiety suggests that individuals with this trait might tend to overlook discomforting bodily sensations [47].

This study underscores the importance of cultivating self-trust and managing emotional discomforts, offering valuable insights into the interplay of internal sensations and mental well-being within the Saudi Arabian context. The concept of self-awareness is frequently linked to enhanced emotional control and overall psychological well-being [48]. Individuals who exhibit lower susceptibility to distraction may potentially enhance their mental well-being by cultivating mindfulness towards their emotions and body sensations [48]. The presence of heightened concern for body sensations can potentially contribute to the development and exacerbation of anxiety and stress. Individuals exhibiting lower levels of worry may demonstrate greater resilience in mitigating the adverse effects of interior sensations on their overall mental well-being [48]. Individuals who possess the ability to redirect and regulate their attention away from unpleasant bodily sensations may exhibit more proficiency in stress management and the preservation of mental well-being [48]. The practice of body listening has the potential to augment self-awareness and yield significant insights on an individual’s mental and physical condition. The increased level of consciousness facilitates enhanced emotional regulation, hence leading to enhanced mental well-being. Individuals who possess the ability to proficiently regulate their emotional and physiological reactions are more adept at managing challenges and preserving their psychological well-being [48].

Future research could delve deeper into the cultural and social factors influencing interoceptive awareness, where longitudinal studies might track changes in interoceptive awareness over time or following specific interventions, providing valuable insights into the malleability of this construct. Moreover, qualitative

research methods, such as interviews or focus groups, may offer a richer understanding of individuals' experiences related to interoceptive awareness, as well as future interventions could focus on enhancing self-trust and coping mechanisms to promote holistic self-awareness and emotional resilience among individuals in this population.

The main limitation of this study is the cross-sectional study design, which restricted our ability to examine causality among the study variables. In addition, there are limited studies that examined this research area, which restricted our ability to make comparison with other study populations.

Conclusions

The participants in our study exhibited a marginal level of interoceptive awareness. The findings of the study indicate that the individuals involved exhibited a greater reliance on their internal sensations as opposed to being attentive to their body sensations. The results of our investigation revealed a lack of appropriate interoceptive awareness. Furthermore, the results of the study highlight the significance of including therapies that especially focus on interoceptive awareness within clinical settings. Additional research is necessary to investigate interoceptive awareness among different cohorts. Gaining insight into the progression of interoceptive awareness during different stages of life, as well as its modulation in relation to significant life events or therapeutic interventions, might provide valuable knowledge for the design and implementation of mental health therapies that are more precise and efficacious. Further research should investigate the impact of cultural norms, social situations, and environmental elements on individuals' subjective experiences of interior sensations. This can provide valuable insights for the development of culturally sensitive therapies and lead to a more comprehensive and nuanced comprehension of interoceptive awareness.

Appendices

| Below you will find a list of statements. Please indicate how often each statement applies to you generally in daily life. | Circle one number on each line | | | | | |
|--|--------------------------------|---|---|---|---|---|
| 1. When I am tense I notice where the tension is located in my body. | 0 | 1 | 2 | 3 | 4 | 5 |
| 2. I notice when I am uncomfortable in my body. | 0 | 1 | 2 | 3 | 4 | 5 |
| 3. I notice where in my body I am comfortable. | 0 | 1 | 2 | 3 | 4 | 5 |
| 4. I notice changes in my breathing, such as whether it slows down or speeds up. | 0 | 1 | 2 | 3 | 4 | 5 |
| 5. I ignore physical tension or discomfort until they become more severe. | 0 | 1 | 2 | 3 | 4 | 5 |
| 6. I distract myself from sensations of discomfort. | 0 | 1 | 2 | 3 | 4 | 5 |
| 7. When I feel pain or discomfort, I try to power through it. | 0 | 1 | 2 | 3 | 4 | 5 |
| 8. I try to ignore pain | 0 | 1 | 2 | 3 | 4 | 5 |
| 9. I push feelings of discomfort away by focusing on something | 0 | 1 | 2 | 3 | 4 | 5 |
| 10. When I feel unpleasant body sensations, I occupy myself with something else so I don't have to feel them. | 0 | 1 | 2 | 3 | 4 | 5 |
| 11. When I feel physical pain, I become upset. | 0 | 1 | 2 | 3 | 4 | 5 |
| 12. I start to worry that something is wrong if I feel any discomfort. | 0 | 1 | 2 | 3 | 4 | 5 |
| 13. I can notice an unpleasant body sensation without worrying about it. | 0 | 1 | 2 | 3 | 4 | 5 |
| 14. I can stay calm and not worry when I have feelings of discomfort or pain. | 0 | 1 | 2 | 3 | 4 | 5 |
| 15. When I am in discomfort or pain I can't get it out of my mind | 0 | 1 | 2 | 3 | 4 | 5 |
| 16. I can pay attention to my breath without being distracted by things happening around me. | 0 | 1 | 2 | 3 | 4 | 5 |
| 17. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me. | 0 | 1 | 2 | 3 | 4 | 5 |
| 18. When I am in conversation with someone, I can pay attention to my posture. | 0 | 1 | 2 | 3 | 4 | 5 |
| 19. I can return awareness to my body if I am distracted. | 0 | 1 | 2 | 3 | 4 | 5 |
| 20. I can refocus my attention from thinking to sensing my body. | 0 | 1 | 2 | 3 | 4 | 5 |
| 21. I can maintain awareness of my whole body even when a part of me is in pain or discomfort. | 0 | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 22. I am able to consciously focus on my body as a whole. | 0 | 1 | 2 | 3 | 4 | 5 |
| 23. I notice how my body changes when I am angry. | 0 | 1 | 2 | 3 | 4 | 5 |
| 24. When something is wrong in my life I can feel it in my body. | 0 | 1 | 2 | 3 | 4 | 5 |
| 25. I notice that my body feels different after a peaceful experience. | 0 | 1 | 2 | 3 | 4 | 5 |
| 26. I notice that my breathing becomes free and easy when I feel comfortable. | 0 | 1 | 2 | 3 | 4 | 5 |
| 27. I notice how my body changes when I feel happy/joyful. | 0 | 1 | 2 | 3 | 4 | 5 |
| 28. When I feel overwhelmed I can find a calm place inside. | 0 | 1 | 2 | 3 | 4 | 5 |
| 29. When I bring awareness to my body I feel a sense of calm. | 0 | 1 | 2 | 3 | 4 | 5 |
| 30. I can use my breath to reduce tension. | 0 | 1 | 2 | 3 | 4 | 5 |
| 31. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing. | 0 | 1 | 2 | 3 | 4 | 5 |
| 32. I listen for information from my body about my emotional state. | 0 | 1 | 2 | 3 | 4 | 5 |
| 33. When I am upset, I take time to explore how my body feels. | 0 | 1 | 2 | 3 | 4 | 5 |
| 34. I listen to my body to inform me about what to do. | 0 | 1 | 2 | 3 | 4 | 5 |
| 35. I am at home in my body. | 0 | 1 | 2 | 3 | 4 | 5 |
| 36. I feel my body is a safe place. | 0 | 1 | 2 | 3 | 4 | 5 |
| 37. I trust my body sensations. | 0 | 1 | 2 | 3 | 4 | 5 |

TABLE 4: Multidimensional Assessment of Interoceptive Awareness Version 2



اللجنة المحلية لأخلاقيات البحوث
جدة

Final approval letter
Institutional Review Board -Jeddah

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Research Title: Interceptive awareness among the general public in Saudi Arabia: a cross-sectional study

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IRB Approval Number: A01744

Dear investigator/s

This letter to inform you that the above titled research grants the final approval of the local IRB in Jeddah health affairs via review according to KACST (GCP) regulations and after ascertaining the completion of all what stated in the initial approval. The permission to publish scientific research subsequently granted. The committee is requesting for an electronic copy of the study article as soon as the manuscript is published.

Best Regards,

Chairman, Institute Review Board

Jeddah

Dr. Ola Akram AbdulRashid ,MD

FIGURE 1: Ethical approval

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Institutional Review Board at Ministry of Health, Jeddah, Saudi Arabia issued approval Ref: A01744. This study was reviewed by the Institutional Review Board at the Ministry of Health, Jeddah, Saudi Arabia (Ref: A01744). **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

- Ceunen E, Vlaeyen JW, Van Diest I: On the origin of interoception. *Front Psychol.* 2016, 7:743. [10.3389/fpsyg.2016.00743](https://doi.org/10.3389/fpsyg.2016.00743)
- DeVile DC, Kerr KL, Avery JA, et al.: The neural bases of interoceptive encoding and recall in healthy adults and adults with depression. *Biol Psychiatry Cogn Neurosci Neuroimaging.* 2018, 3:546-554. [10.1016/j.bpsc.2018.03.010](https://doi.org/10.1016/j.bpsc.2018.03.010)
- Khalsa SS, Adolphs R, Cameron OG, et al.: Interoception and mental health: a roadmap. *Biol Psychiatry Cogn Neurosci Neuroimaging.* 2018, 3:501-513. [10.1016/j.bpsc.2017.12.004](https://doi.org/10.1016/j.bpsc.2017.12.004)
- Quadt L, Critchley HD, Garfinkel SN: The neurobiology of interoception in health and disease. *Ann N Y Acad Sci.* 2018, 1428:112-128. [10.1111/nyas.13915](https://doi.org/10.1111/nyas.13915)
- Seth AK: Interoceptive inference, emotion, and the embodied self. *Trends Cogn Sci.* 2013, 17:565-573. [10.1016/j.tics.2013.09.007](https://doi.org/10.1016/j.tics.2013.09.007)
- Sterling P: Allostasis: a model of predictive regulation. *Physiol Behav.* 2012, 106:5-15. [10.1016/j.physbeh.2011.06.004](https://doi.org/10.1016/j.physbeh.2011.06.004)
- Wiens S, Mezzacappa E, Katkin E: Heartbeat detection and the experience of emotions. *Cogn Emot.* 2000, 14:417-427. [10.1080/0269993000378905](https://doi.org/10.1080/0269993000378905)
- Garner M, Attwood A, Baldwin DS, James A, Munafò MR: Inhalation of 7.5% carbon dioxide increases threat processing in humans. *Neuropsychopharmacology.* 2011, 36:1557-1562. [10.1038/npp.2011.15](https://doi.org/10.1038/npp.2011.15)
- Barrett LF, Quigley KS, Hamilton P: An active inference theory of allostasis and interoception in depression. *Philos Trans R Soc Lond B Biol Sci.* 2016, 371:10.1098/rstb.2016.0011
- Hoyer J, Klein A: Self-reflection and well-being: is there a healthy amount of introspection? *Psychol Rep.* 2000, 86:135-141. [10.2466/pr0.2000.86.1.135](https://doi.org/10.2466/pr0.2000.86.1.135)
- Arnold AJ, Winkelman P, Dobkins K: Interoception and social connection. *Front Psychol.* 2019, 10:2589. [10.3389/fpsyg.2019.02589](https://doi.org/10.3389/fpsyg.2019.02589)
- Jenkinson PM, Taylor L, Laws KR: Self-reported interoceptive deficits in eating disorders: a meta-analysis of studies using the eating disorder inventory. *J Psychosom Res.* 2018, 110:38-45. [10.1016/j.jpsychores.2018.04.005](https://doi.org/10.1016/j.jpsychores.2018.04.005)
- Paulus MP, Stein MB: Interoception in anxiety and depression. *Brain Struct Funct.* 2010, 214:451-463. [10.1007/s00429-010-0258-9](https://doi.org/10.1007/s00429-010-0258-9)
- Wei Y, Van Someren EJW: Interoception relates to sleep and sleep disorders. *Curr Opin Behav Sci.* 2020, 33:1-7. [10.1016/j.cobeha.2019.11.008](https://doi.org/10.1016/j.cobeha.2019.11.008)
- Yoris A, García AM, Traiber L, et al.: The inner world of overactive monitoring: neural markers of interoception in obsessive-compulsive disorder. *Psychol Med.* 2017, 47:1957-1970. [10.1017/S0033291717000368](https://doi.org/10.1017/S0033291717000368)
- Paulus MP, Tapert SF, Schulteis G: The role of interoception and alliesthesia in addiction. *Pharmacol Biochem Behav.* 2009, 94:1-7. [10.1016/j.pbb.2009.08.005](https://doi.org/10.1016/j.pbb.2009.08.005)
- Cattaneo LA, Franquillo AC, Grecucci A, Beccia L, Caretti V, Dado H: Is low heart rate variability associated with emotional dysregulation, psychopathological dimensions, and prefrontal dysfunctions? An integrative view. *J Pers Med.* 2021, 11:872. [10.3390/jpm11090872](https://doi.org/10.3390/jpm11090872)
- Cludius B, Mennin D, Ehring T: Emotion regulation as a transdiagnostic process. *Emotion.* 2020, 20:37-42. [10.1037/emo0000646](https://doi.org/10.1037/emo0000646)
- Heiss S, Vaschillo B, Vaschillo EG, Timko CA, Hormes JM: Heart rate variability as a biobehavioral marker of diverse psychopathologies: a review and argument for an "ideal range". *Neurosci Biobehav Rev.* 2021, 121:144-155. [10.1016/j.neubiorev.2020.12.004](https://doi.org/10.1016/j.neubiorev.2020.12.004)
- Brewer R, Murphy J, Bird G: Atypical interoception as a common risk factor for psychopathology: a review. *Neurosci Biobehav Rev.* 2021, 130:470-508. [10.1016/j.neubiorev.2021.07.036](https://doi.org/10.1016/j.neubiorev.2021.07.036)
- Murphy J, Brewer R, Catmur C, Bird G: Interoception and psychopathology: a developmental neuroscience perspective. *Dev Cogn Neurosci.* 2017, 23:45-56. [10.1016/j.dcn.2016.12.006](https://doi.org/10.1016/j.dcn.2016.12.006)
- Eggart M, Valdés-Stauber J: Can changes in multidimensional self-reported interoception be considered as outcome predictors in severely depressed patients? A moderation and mediation analysis. *J Psychosom Res.* 2021, 141:110331. [10.1016/j.jpsychores.2020.110331](https://doi.org/10.1016/j.jpsychores.2020.110331)
- Quadt L, Garfinkel SN, Mulcahy JS, et al.: Interoceptive training to target anxiety in autistic adults (ADIE): a single-center, superiority randomized controlled trial. *EClinicalMedicine.* 2021, 39:101042. [10.1016/j.eclinm.2021.101042](https://doi.org/10.1016/j.eclinm.2021.101042)
- Sugawara A, Terasawa Y, Katsunuma R, Sekiguchi A: Effects of interoceptive training on decision making, anxiety, and somatic symptoms. *Biopsychosoc Med.* 2020, 14:7. [10.1186/s13030-020-00179-7](https://doi.org/10.1186/s13030-020-00179-7)
- Abuhamdah SM, Naser AY: Smart phone addiction and its mental health risks among university students in Jordan: a cross-sectional study. *BMC Psychiatry.* 2023, 23:812. [10.1186/s12888-023-05322-6](https://doi.org/10.1186/s12888-023-05322-6)
- Abuhamdah SM, Naser AY, Abdelwahab GM, AlQatawneh A: The prevalence of mental distress and social

- support among university students in Jordan: a cross-sectional study. *Int J Environ Res Public Health*. 2021, 18:11622. [10.3390/ijerph182111622](https://doi.org/10.3390/ijerph182111622)
27. Alhemedi AJ, Qasaimeh MG, Abdo N, et al.: Depression among university students in Jordan after the COVID-19 pandemic: a cross-sectional study. *Psychol Res Behav Manag*. 2023, 16:4237-4249. [10.2147/PRBM.S436295](https://doi.org/10.2147/PRBM.S436295)
 28. Alwafi H, Naser AY, Aldhahir AM, et al.: Prevalence and predictors of nomophobia among the general population in two middle eastern countries. *BMC Psychiatry*. 2022, 22:520. [10.1186/s12888-022-04168-8](https://doi.org/10.1186/s12888-022-04168-8)
 29. Fekih-Romdhane F, Daher-Nashif S, Stambouli M, et al.: Mental illness stigma as a moderator in the relationship between religiosity and help-seeking attitudes among Muslims from 16 Arab countries. *BMC Public Health*. 2023, 23:1671. [10.1186/s12889-023-16622-7](https://doi.org/10.1186/s12889-023-16622-7)
 30. Fekih-Romdhane F, Daher-Nashif S, Stambouli M, et al.: Suicide literacy mediates the path from religiosity to suicide stigma among Muslim community adults: cross-sectional data from four Arab countries. *Int J Soc Psychiatry*. 2023, 69:1658-1669. [10.1177/00207640231174359](https://doi.org/10.1177/00207640231174359)
 31. Fekih-Romdhane F, Jahrami H, Stambouli M, et al.: Cross-cultural comparison of mental illness stigma and help-seeking attitudes: a multinational population-based study from 16 Arab countries and 10,036 individuals. *Soc Psychiatry Psychiatr Epidemiol*. 2023, 58:641-656. [10.1007/s00127-022-02403-x](https://doi.org/10.1007/s00127-022-02403-x)
 32. Fekih-Romdhane F, Malaeb D, Fawaz M, Chammas N, Soufia M, Obeid S, Hallit S: Psychometric properties of an Arabic translation of the multidimensional assessment of interoceptive awareness (MAIA-2) questionnaire in a non-clinical sample of Arabic-speaking adults. *BMC Psychiatry*. 2023, 23:577. [10.1186/s12888-023-05067-2](https://doi.org/10.1186/s12888-023-05067-2)
 33. Mehling WE, Price C, Daubenmier JJ, Acree M, Bartmess E, Stewart A: The multidimensional assessment of interoceptive awareness (MAIA). *PLoS One*. 2012, 7:e48230. [10.1371/journal.pone.0048230](https://doi.org/10.1371/journal.pone.0048230)
 34. Montoya-Hurtado O, Gómez-Jaramillo N, Bermúdez-Jaimes G, et al.: Psychometric properties of the multidimensional assessment of interoceptive awareness (MAIA) questionnaire in Colombian University students. *J Clin Med*. 2023, 12:2937. [10.3390/jcm12082937](https://doi.org/10.3390/jcm12082937)
 35. Abbasi M, Ghorbani N, Hatami J, Lavasani MG: Validity and reliability of multidimensional assessment of interoceptive awareness (MAIA) in Iranian students. *J Sabzevar Univ Med Sci*. 2018, 25:47-59.
 36. Gim W-S, Sim K-L, Cho O-K: Korean multidimensional assessment of interoceptive awareness (K-MAIA): development and validation. *Korean J Stress Res*. 2016, 24:177-192. [10.17547/kjsr.2016.24.3.177](https://doi.org/10.17547/kjsr.2016.24.3.177)
 37. Shoji M, Mehling WE, Hautzinger M, Herbert BM: Investigating multidimensional interoceptive awareness in a Japanese population: validation of the Japanese MAIA-J. *Front Psychol*. 2018, 9:1855. [10.3389/fpsyg.2018.01855](https://doi.org/10.3389/fpsyg.2018.01855)
 38. Özpınar S, Dunder E, Demir Y, Akyol M: Multidimensional assessment of interoceptive awareness (MAIA 2): psychometric properties of the Turkish version. *J Health Sci Med*. 2021, 4:132-136. [10.32322/jhsm.836361](https://doi.org/10.32322/jhsm.836361)
 39. Willem C, Gandolphe M-C, Nandrino J-L, Grynberg D: French translation and validation of the Multidimensional Assessment of Interoceptive Awareness (MAIA-FR). *Can J Behav Sci*. 2022, 54:234-240. [10.1037/cbs0000271](https://doi.org/10.1037/cbs0000271)
 40. Maister L, Tsakiris M: My face, my heart: cultural differences in integrated bodily self-awareness. *Cogn Neurosci*. 2014, 5:10-16. [10.1080/17588928.2013.808613](https://doi.org/10.1080/17588928.2013.808613)
 41. Bechara A, Naqvi N: Listening to your heart: interoceptive awareness as a gateway to feeling. *Nat Neurosci*. 2004, 7:102-103. [10.1038/nn0204-102](https://doi.org/10.1038/nn0204-102)
 42. Cali G, Ambrosini E, Picconi L, Mehling WE, Committeri G: Investigating the relationship between interoceptive accuracy, interoceptive awareness, and emotional susceptibility. *Front Psychol*. 2015, 6:1202. [10.3389/fpsyg.2015.01202](https://doi.org/10.3389/fpsyg.2015.01202)
 43. Emanuelsen L, Drew R, Kötteles F: Interoceptive sensitivity, body image dissatisfaction, and body awareness in healthy individuals. *Scand J Psychol*. 2015, 56:167-174. [10.1111/sjop.12183](https://doi.org/10.1111/sjop.12183)
 44. Dunne J, Flores M, Gawande R, Schuman-Olivier Z: Losing trust in body sensations: interoceptive awareness and depression symptom severity among primary care patients. *J Affect Disord*. 2021, 282:1210-1219. [10.1016/j.jad.2020.12.092](https://doi.org/10.1016/j.jad.2020.12.092)
 45. Govier T: Self-trust, autonomy, and self-esteem. *Hypatia*. 1993, 8:99-120. [10.1111/j.1527-2001.1993.tb00630.x](https://doi.org/10.1111/j.1527-2001.1993.tb00630.x)
 46. Walton AE: The development of self-trust in DBS patients. *AJOB Neurosci*. 2021, 12:194-196. [10.1080/21507740.2021.1904044](https://doi.org/10.1080/21507740.2021.1904044)
 47. Efinger L, Thuillard S, Dan-Glauser ES: Distraction and reappraisal efficiency on immediate negative emotional responses: role of trait anxiety. *Anxiety Stress Coping*. 2019, 32:412-427. [10.1080/10615806.2019.1597859](https://doi.org/10.1080/10615806.2019.1597859)
 48. Hanley AW, Mehling WE, Garland EL: Holding the body in mind: Interoceptive awareness, dispositional mindfulness and psychological well-being. *J Psychosom Res*. 2017, 99:13-20. [10.1016/j.jpsychores.2017.05.014](https://doi.org/10.1016/j.jpsychores.2017.05.014)