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Hedonic capacity in a Chinese community population sample: psychometric properties of the dimensional anhedonia rating scale (DARS) and exploration of gender differences

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Abstract

Background A reduction in the hedonic capacity, that is, anhedonia, is closely associated with the onset of depression, which negatively affects mental health and life satisfaction. However, simple and comprehensive tools to assess hedonic capacity in community-dwelling adults are lacking.

Methods An online survey was conducted from March to April 2023, recruiting 678 community-dwelling adults. We assessed the psychometric properties of the Chinese version of the Dimensional Anhedonia Rating Scale (DARS) and used multivariate linear regression to examine gender differences in hedonic capacity and its contributing factors.

Results The Chinese version of the DARS demonstrated excellent reliability and validity in the non-clinical sample. Higher education levels and being female were associated with better hedonic capacity, while sleep disturbances and living alone were linked to lower hedonic capacity. Additionally, gender differences were found in the factors affecting hedonic capacity: for males, living alone and sleep disturbances had a negative impact, whereas for females, higher education levels were positively associated with hedonic capacity.

Limitations There was a lack of structured diagnoses among community samples.

Conclusion The Chinese version of the DARS is an effective tool for assessing hedonic capacity, i.e. screening for depression in community-dwelling populations. The observed gender differences in hedonic capacity imply that future mental health services could be more effective if adapted based on gender.

Keywords Hedonic capacity, Dimensional anhedonia rating scale, Psychometric properties, Gender differences, Community-dwelling adults

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Introduction

The healthy hedonic capacity significantly influences individuals' experience of happiness and mental wellbeing [1]. It supports people in dealing with stress, overcoming life's challenges, and fostering more harmonious social relationships. Impaired hedonic capacity might affect a person's ability to experience or appreciate life's pleasures [2].Impaired hedonic capacity, a hallmark of anhedonia, is also considered a common symptom across many psychiatric disorders [3-9]. Anhedonia signifies not only a reduced capacity to experience pleasure but also encompasses impairments in areas such as reward anticipation, motivation, reward learning, and decisionmaking. Psychiatric diseases characterized by anhedonia typically exhibit a more extensive impairment of hedonic capacity [10]. Additionally, it indicates increased severity of the illness [11–12], an increased likelihood of suicide [13–14], a poorer response to treatment [15], and a more extensive psychosocial damage [16–17].

Hedonic capacity varies across individuals, those with reduced hedonic capacity may be more susceptible to depression [2, 18]. Clinical researches have indicated that reduced hedonic capacity may serve as a predictor of psychosis or Major depression disorder (MDD) and is linked to adverse social behaviors [19–21]. Nevertheless, the proportion of individuals in China who actively seek mental health care remains low [22],leading to missed opportunities for professional screening among the general population. Therefore, an anhedonia rating scale that integrates neuropsychological, behavioral, and self-report components would be an ideal assessment tool with broad applicability [23].

The healthy hedonic capacity is modulated by the complicated reward processing, which can be categorized into following components: desire/interest (the inclination to be rewarded), anticipated rewards (the anticipation or pleasure derived from them), effort (the actual calculation of the reward and the exertion put in) and consummatory pleasure (enjoy) [10, 24-25]. Dysfunction of any part of the process may lead to anhedonia [2]. The early anhedonia rating scales were primarily self-assessment instruments that measured an individual's level of consummatory pleasure experienced in recent or current days. Among them, the Snaith-Hamilton Pleasure Scale (SHAPS) has been widely validated in clinical and nonclinical individuals because of its wide applicability and limited cultural bias, and it is generally considered one of the most reliable methods for assessing anhedonia in patients with MDD [18, 25-27].

Moreover, the Dimensional Anhedonia Rating Scale (DARS) is a useful supplement to the assessment components of hedonic capacity. It was developed to measure not only consummatory pleasure but also the three other specific components of interest/ desire, anticipated

rewards, and effort [10]. The DARS has been primarily utilized in the evaluation of MDD in China [28]. Current evidence suggests that hedonic capacity varies across individuals, with differences forming a spectrum that extends from healthy individuals to those with subthreshold depression and MDD. The DARS has been validated as a reliable instrument for detecting subtle changes in an individual's ability to experience pleasure in non-clinical adolescent sample [29]. Its good design has led to its widespread use across diverse populations in multiple countries [2, 10, 28-30]. However, the psychometric properties of the Chinese version of the DARS has not been examined in non-clinical adults' sample. In addition, DARS may be more appropriate than other selfreport depression scales for screening adults at high risk of depression in the community sample because of its reduced stigma.

To address these gaps in the field, this study sought to evaluate the psychometric properties of the DARS in community-dwelling adults. Notably, studies suggest that there are emotional differences between men and women [31], but results on gender differences in hedonic capacity are mixed [32–34]. Therefore, the second aim of this study was to explore whether gender influences individual hedonic capacity and to identify the factors underlying gender differences in hedonic capacity.

Methods

Participants

This study aimed to assess pleasure measured by the DARS scale and explore factors influencing hedonic capacity in a sample of community population Chinese adults. An online survey was conducted between March and April 2023 via WeChat, including a self-designed questionnaire and psychological status scales. Participants who gave informed consent and completed the survey received a small voucher. Eligibility criteria included being at least 18 years old, literate, with no history of neurological or psychiatric disorders, and a native Chinese speaker [2, 18, 35]. The study was approved by the Ethics Committee of Peking University Sixth Hospital.

Sample size calculating

The sample size estimation for this study was based on the number of scale items and psychometric analysis techniques. Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were employed, with sample size requirements considered for each approach. According to Thompson [36],CFA requires a sample size that is 10–20 times the number of observed variables. Additionally, Comrey [37] and Cattell [38] recommended that EFA requires a minimum sample size of over 500 cases. Given that the DARS scale contains 17 items, we applied a factor of 20 to the number of observed items for calculation, resulting in a CFA sample size of $17 \times 20 = 340$. Therefore, a roughly sample size of 500 was deemed sufficient for the psychometric analysis in this study.

Instruments and procedures

The hedonic capacity of the community-dwelling adult sample in this study was assessed using the Chinese version of the DARS [28, 39]. The DARS is a 17-item selfreport instrument that evaluates four types of rewards (pastimes/hobbies, foods/drinks, social activities, and sensory experiences) and four components of reward processing (desire/interest, anticipated reward, effort and consummatory pleasure) [10].Participants identified 2-3 personalized reward experiences for each reward type (e.g., listing at least two favorite foods/drinks). They then responded to standardized questions based on their experiences to assess their current desire, effort, and level of consummatory pleasure (e.g., "I want these foods/drinks"). Each question was rated on a 5-point Likert scale ranging from "not at all" (0) to "very much" (4). Total scores ranged from 0 to 68, with higher scores indicating greater hedonic capacity, i.e., lower levels of anhedonia. The scale has been validated among both depressed and healthy individuals in Canada and Germany [2, 10], and has demonstrated excellent reliability and validity among depressed individuals in China (Cronbach's $\alpha = 0.95 \sim 0.97$) [28, 39].

The Chinese version of the SHAPS was also used to measure hedonic capacity as a gold standard in this study. The SHAPS is a 14-item self-report instrument that evaluates hedonic experiences across four domains: interest/pastimes, social interaction, sensory experiences, and food/drink. Each item is rated on a 4-point Likert scale (1 = Definitely Agree, 2 = Agree, 3 = Disagree, 4 = Definitely Disagree).Total scores range from 14 to 56, with higher scores indicating lower hedonic capacity, or greater anhedonia [40].The Chinese version of the SHAPS has demonstrated good internal consistency in both clinical and non-clinical samples, with Cronbach's α values of 0.91 and 0.90, respectively [27, 40].

The Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms [41].The PHQ-9 is a selfreport depression scale included in the Primary Care Evaluation of Mental Disorders (PRIME-MD) diagnostic tool [42].This scale evaluates the severity and frequency of depressive symptoms experienced over the past two weeks, with each item rated from 0 ("not at all") to 3 ("nearly every day").Total scores range from 0 to 27, with higher scores indicating more severe depressive symptoms [41].The Chinese version of the PHQ-9 has been extensively used in clinical samples, as well as in community and healthy populations, to assess depressive symptoms, demonstrating strong reliability and validity [43–45].

The Generalized Anxiety Disorder-7 (GAD-7) scale was used in this study to assess the severity and frequency of anxiety symptoms experienced by participants over the past two weeks [46].According to the DSM-IV-TR [47], the GAD-7 captures the most essential diagnostic criteria for generalized anxiety disorder. Each item on the GAD-7 is rated on a 4-point scale: 0 ("not at all"), 1 ("several days"), 2 ("more than half the days"), and 3 ("nearly every day").Total scores range from 0 to 21, with higher scores indicating more severe anxiety symptoms [46]. The GAD-7 has been extensively validated in primary care settings and large samples of the general population [48–50].

The self-designed questionnaire included demographic characteristics, work pressure, dwelling state and sleep disturbance (The 'sleep disturbance' item in the questionnaire was assessed through the following question: 'Do you experience difficulty falling asleep on a daily basis?), etc.

Statistical analyses

Validity and reliability

The structure of the Chinese version of the DARS was evaluated using EFA with PROMAX rotation, following the methodology used in previous studies on the Spanish version of the DARS [30].Factor loadings with an absolute value of 0.5 or higher were considered to have a significant impact on the overall explained variance [51].The suitability of the data for factor analysis was confirmed by the Kaiser-Meyer-Olkin (KMO) measure.

The factor structure of the DARS was evaluated using CFA with robust maximum likelihood estimation. The criteria for a robust model included indices such as the followings: a chi-square/degrees of freedom ratio (\leq 3 indicates a strong fit); and fit indices such as the goodness-of-fit index (GFI) [52], comparative fit index (CFI) [53],Tucker–Lewis index (TLI) [54],and normed fit index (NFI) [55].Values for these indices approaching 1 indicate a strong model fit (>0.90, acceptable; > 0.95, good; > 0.97, very good) [56].Additionally, the root-mean-square error of approximation (RMSEA) within the range of 0 to 0.08 signifies a good fit [56].

Internal reliability was assessed using Cronbach's alpha, with values above 0.8 indicating strong reliability [57– 58]. Construct reliability (CR) was calculated to assess the consistency of the variables in representing the latent constructs. Additionally, the Omega coefficient (ω) was calculated to further evaluate reliability, particularly to address the potential underestimation of true reliability by Cronbach's alpha [59]. Convergent validity between the total DARS score, its subscales, and the SHAPS score was examined using Pearson correlation analysis. Average variance extracted (AVE) were also calculated to assess discriminant validity.

Factors influencing hedonic capacity and gender differences

Spearman correlation analysis was initially conducted to identify demographic variables that showed a significant association with the total DARS score; these were selected as pre-identified variables. To examine the impact of demographic characteristics on hedonic capacity across different gender groups, multiple linear regression analyses were performed using the total DARS score as the dependent variable, with variables entered using the enter method. This approach was used to identify characteristics that were independently associated with hedonic capacity. Variables with a *P*-value < 0.05 were considered significantly related to hedonic capacity.

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 23.0 and AMOS version 26.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses for categorical variables were presented as rates (percentages). To enhance the presentation of the data, all quantitative variables were reported as mean \pm standard deviation, and either a t-test or a non-parametric test was applied based on the characteristics of the data. Unless otherwise specified, a significance level of *P* < 0.05 was used for all statistical analyses.

Results

Demographic and the distribution of clinical characteristics A total of 760 completed questionnaires were collected. Participants were instructed to answer the questions as accurately and truthfully as possible. However, 82 questionnaires were excluded due to the "landmine question." (Description of the landmine question: Participants were asked to recall the year they started primary school, and responses that were clearly illogical were filtered out.) As a result, 678 questionnaires were deemed suitable for statistical analysis.

The community sample included participants aged 18 to 83 years, with the majority being female (361 women, representing 53.2% of the total sample). Among the participants, 274 (40.4%) had completed college or higher education, 445 (65.6%) were married, and 188 (27.7%) reported sleep disturbances. Gender differences were observed in hedonic capacity (women are better), as indicated by the DARS scale and its subscales. However, no significant differences were found between males and females in terms of general demographic factors such as age, education level, or symptoms of anxiety and depression (Table 1).

Validity and reliability

In our sample, the KMO value was 0.962, and Bartlett's test of sphericity yielded a *P*-value of less than 0.001.

Factor analysis revealed that the communalities for the 17 items of the Chinese version of the DARS ranged from 0.698 to 0.976 (Table S1). Moreover, the four-factor structure identified closely matched that of the original revision [10] (Fig. 1).The fit indices indicated a satisfactory to excellent fit for the four-factor model (GFI = 0.929, CFI = 0.979, NFI = 0.972, TLI = 0.975, RMSEA = 0.061, χ^2 / df = 3.544).As expected, all items loaded well above the 0.80 threshold, supporting the validity of the four-factor model. The total variance explained by the four principal components was 86.1% (Table S1).

The correlation heatmaps provided empirical support for the relationships between each subscale of the DARS and its constituent items, as well as their strong correlations with the overall SHAPS score. Specifically, the correlation between the total DARS score and SHAPS is -0.69, while the correlations between the four DARS subscales and SHAPS range from -0.53 to -0.68(Fig. 2). The AVE scores for all constructs ranged from 0.75 to 0.87, exceeding the 0.50 threshold [60].Standardized factor loadings for all items ranged from 0.82 to 0.94, surpassing the 0.7 criterion [61].Construct reliability ranged from 0.92 to 0.96, exceeding the required minimum of 0.70 [60] (Table 2). These results indicate that the DARS demonstrates good convergent validity and CR (Table 2). The DARS also showed strong discriminant validity, as evidenced by the fact that the average variance extracted for each domain in our sample was greater than the corresponding inter-item correlation coefficient (i.e., the diagonal value exceeded the off-diagonal values) [60] (Table 3).

The internal consistency of the total score on the DARS was strong (Table 4), with Cronbach's alpha and Omega ω coefficients both reaching 0.971, well above the 0.80 threshold [57–58]. The Cronbach's alpha and Omega ω coefficients for the four subscales, categorized by reward type, were all greater than 0.92. Additionally, analysis of the changes in the scale coefficient after item deletion revealed that removing any item did not lead to an increase in the alpha coefficient of the scale (Table 4).

Factors that influence hedonic capacity in different genders

In the full sample, Spearman correlation analysis revealed significant associations between hedonic capacity (DARS total score) and several sample characteristics, including gender, work stress, sleep disturbances, education level, living situation, and symptoms of anxiety and depression (Tables S2-S3). A subsequent multiple linear regression analysis showed that hedonic capacity was significantly associated with gender, sleep disturbances, education level, and living situation. Specifically, females exhibited a 2.796-unit increase in hedonic capacity compared to males (β = 0.087, 95% CI [0.407, 5.186]).Individuals with

Variable	Full Sample(A)	Male (B)	Female (C)	t/Z/χ ²	Р	Contrast
	(n=678)	(n=317)	(<i>n</i> =361)			
Age	39.98±13.91	39.26±13.61	40.61±14.16	-1.265 ^a	0.206	-
Education						
College and above	274(40.4%)	117(36.9%)	157(43.5%)	3.036 ^b	0.085	-
Others	404(59.6%)	200(63.1%)	204(56.5%)			
Marital Status						
Married	445(65.6%)	199(62.8%)	246(68.1%)	2.156 ^b	0.146	-
Others	233(34.4%)	118(37.2%)	115(31.9%)			
Dwelling State						
Alone	89(13.1%)	49(15.5%)	40(11.1%)	2.836 ^b	0.110	-
Others	589(86.9%)	268(84.5%)	321(88.9%)			
Presence of work pressure						
Yes	288(42.5%)	144(45.4%)	144(39.9%)	2.118 ^b	0.161	-
No	390(57.5%)	173(54.6%)	217(60.1%)			
Sleep disturbance:						
Yes	188(27.7%)	94(29.7%)	94(26.0%)	1.100 ^b	0.303	-
No	490(72.3%)	223(70.3%)	267(74.0%)			
DARS total Score	47.87±16.11	45.97 ± 16.64	49.55 ± 15.45	-2.904 ^a	0.004	B <c△< td=""></c△<>
Based on type of reward:						
Pastimes/Hobbies	11.28 ± 4.36	10.85 ± 4.24	11.66 ± 4.28	-2.421 ^a	0.016	B <c△< td=""></c△<>
Food/Drink	10.95 ± 4.17	10.47 ± 4.36	11.36 ± 3.94	-2.770 ^a	0.006	B <c△< td=""></c△<>
Social activities	11.43 ± 4.28	11.01 ± 4.47	11.80 ± 4.07	-2.385 ^a	0.017	B <c△< td=""></c△<>
Sensory Experience	14.21 ± 5.27	13.63 ± 5.37	14.72 ± 5.14	-2.706 ^a	0.007	B <c△< td=""></c△<>
Based on components of re	eward processing:					
Consummatory	11.43 ± 3.86	10.95 ± 3.96	11.86 ± 3.74	-3.076 ^a	0.002	B <c△< td=""></c△<>
Effort	11.05 ± 3.88	10.62 ± 4.02	11.43 ± 3.71	-2.730 ^a	0.006	B <c∆< td=""></c∆<>
Desire	17.20 ± 5.78	16.55 ± 5.94	17.78±5.58	-2.778 ^a	0.006	B <c△< td=""></c△<>
Motivation	8.18±3.11	7.85 ± 3.25	8.48 ± 2.95	-2.630 ^a	0.009	B <c∆< td=""></c∆<>
SHAPS total Score	24.58 ± 7.67	25.59 ± 7.78	23.70 ± 7.48	-3.651 ^c	< 0.001	B>C△
PHQ-9 total Score	5.11 ± 4.71	5.44 ± 5.15	4.82 ± 4.27	-0.996 ^c	0.319	-
GAD-7 total Score	3.36 ± 3.97	3.76 ± 4.38	3.00 ± 3.55	-1.706 ^c	0.088	-

Table 1	Demo	graphics a	and clinical	characteristics	of all sub	iects (n = 678)
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Notes: a, Independent Samples t-test; b, Chi-Square Test; c, Mann-Whitney U test, \triangle Indicates items with significant between-group differences after ANCOVA controlling for education and dwelling state

sleep disturbances had a 3.356-unit decrease in hedonic capacity compared to those with normal sleep patterns (β = -0.093, 95% CI [-6.288, -0.425]).Those with at least a bachelor's degree experienced a 4.196-unit increase in hedonic capacity compared to individuals with less education (β =0.128, 95% CI [1.755, 6.636]).Furthermore, people living alone had a 5.828-unit decrease in hedonic capacity compared to those living with others (β = -0.122, 95% CI [-9.345, -2.312]) (Table S4, Fig. 3A).

Subsequent gender-based subgroup analyses were performed, and separate multiple linear regression models were developed for each gender to examine the factors influencing hedonic capacity. Among females, those with at least a college degree reported a 4.501-unit higher hedonic capacity (β = 0.145, 95% CI [1.286, 7.715]) compared to females with lower educational levels (Tables S5-S6, Fig. 3B). In males, sleep disturbances were associated with a 4.968-unit decrease in hedonic capacity (β = -0.137, 95% CI [-9.460, -0.475]) compared to those with normal sleep. Additionally, males who lived alone had a 6.533-unit lower hedonic capacity (β = -0.142, 95% CI [-11.492, -1.573]) than those who did not live alone (Tables S7-S8, Fig. 3C).

Discussion

This study aimed to evaluate the psychometric properties of the Chinese version of the DARS in the communitydwelling adults' sample. Similar to the original English version, the Chinese DARS demonstrated a stable and reliable four-factor structure encompassing pastimes/ hobbies, food/drink, social activities, and sensory experiences [10].It also showed strong convergent and discriminant validity, along with high internal consistency. Our findings suggested that demographic factors influenced hedonic capacity: it was generally higher among females and those with higher education levels, while sleep disturbances and living alone were associated with reduced hedonic capacity. For males, these challenges had a more



Fig. 1 The confirmatory factor analysis of the Chinese version of the DARS. **A/B/C/D** represents the four subscales of DARS. (**A**, PH, Pastimes/Hobbies; **B**, FD, Food/Drinks; **C**, SA, Social activities; **D**, SE, Sensory experiences). All items loaded well above the 0.8 threshold. The fit indices indicated that the four-factor model demonstrated a satisfactory to good fit (GFI=0.929, CFI=0.979, NFI=0.972, TLI=0.975, RMSEA=0.061, χ 2/df=3.544). All the DARS components are given as statements relating to their respective domains. The specific explanation is as follows: A1, "I would enjoy these activities"; A2, "I would spend time doing these activities"; A3, "I want to do these activities"; A4, "These activities would interest me"; B1, "I would make an effort to get/ make these foods/drinks"; B2, "I would enjoy these foods/drinks"; B3, "I want to have these foods/drinks"; B4, "I would eat as much of these foods as I could"; C1, "Spending time doing these things would make me happy"; C2, "I would be interested in doing things that involve other people"; C3, "I would be the one to plan these activities"; D3, "I were to have these experiences I would savor every moment"; D4, "I want to have these experiences"; D5, "I would make an effort to spend time having these experiences"; D5, "I would make an effort to spend time having these experiences"

pronounced negative effect. In contrast, education positively impacted the hedonic capacity of females.

CFA results indicated that the four-factor model had an acceptable to good fit, with significant item loadings, supporting its suitability for the sample of Chinese community-dwelling adults [2]. Our findings confirmed that the DARS maintains a robust four-factor structure. The DARS has also proven effective for assessing anhedonia in various countries, including Canada, Spain, Germany, and China [2, 10, 29-30, 39], demonstrating measurement invariance across ages and cultures. This may be due to the DARS requiring personalized examples, minimizing age-related bias [62]. This study confirmed previous findings [2, 10, 29–30, 39], showing high internal consistency for the Chinese DARS in both total and subscale scores (Cronbach's $\alpha = 0.89 - 0.97$). The DARS showed a strong negative correlation with the SHAPS (r = -0.69), consistent with the original and Spanish versions in clinical samples [10, 30] (Fig. 2). All components had AVE scores above 0.50 [60], confirming strong convergent validity. These results support the DARS as a reliable tool for assessing hedonic capacity in the Chinese community-dwelling adults.

Previous studies have shown that hedonic capacity can decrease even in the general population [26].While most research has focused on clinical samples of patients with schizophrenia or depression, it is important to recognize that the general population may also exhibit "subthreshold" psychiatric symptoms to some extent [33]. In the general population, reduced hedonic capacity has been linked to poor social functioning in adulthood and an increased risk of developing depression [63]. The DARS is widely regarded as a reliable tool for detecting subtle changes in hedonic capacity in the general population, people with subthreshold depression, and patients diagnosed with MDD [11-12].Many individuals in the general population may not receive a formal psychiatric diagnosis due to various factors, including stigma, discrimination, lack of cultural knowledge, etc. There is an urgent need for comprehensive screening, intervention, and prevention efforts for high-risk groups [64]. Given the strengths of the DARS, it can serve as a key instrument for identifying individuals at high risk of depression within the Chinese community, as it effectively captures subtle variations in hedonic capacity.

In our subsequent multiple linear regression analyses, we found no correlations between anxiety and depressive symptoms and hedonic capacity. These findings are consistent with the Research Domain Criteria (RDoC) framework and previous studies [28, 65].Furthermore, we identified key factors that enhance our understanding of the drivers of hedonic capacity. Higher levels of education and being female have a positive influence on hedonic capacity, a finding that is consistent with results from other psychological studies. However, a few studies suggest the opposite view, with factors like women's underground economic status and aging potentially affecting the consistency of the findings. Moreover, the



Fig. 2 Correlation matrix heatmap of 17 items of DARS, four subscales and SHAPS total score. A/B/C/D represents the four subscales of DARS. (A, Pastimes/Hobbies; B, Food/Drinks; C, Social activities; D, Sensory experiences); Red indicates a negative correlation, blue indicates a positive correlation, and darker shades represent stronger correlations

stability of the results might be influenced by the relevance of the assessment scale used [34]. Despite this, females consistently report higher levels of happiness than males across all educational levels [66]. This disparity continues to widen with higher educational attainment, as females experience greater subjective well-being as their education level increases [66]. It has been shown that males and females differ in how they process past experiences and information. Specifically, females are more likely to experience happiness through meaningful social interactions, while males tend to derive happiness from engaging in pleasurable activities alone [67]. These gender differences in hedonic capacity can be explained by these factors. Two key characteristics that negatively impact hedonic capacity are sleep disturbance and living in solitude. Previous studies have demonstrated that sleep disturbance is often linked to reduced activation of brain regions involved in the reward system, both during the reception and anticipation of rewards. This reduced activation can also lead to less effort in seeking rewards [68–69].Living alone can lead to social isolation, which has become increasingly common in today's society. Social isolation can severely affect an individual's physical and emotional well-being, potentially leading to higher suicide rates and lower overall quality of life and longevity [70–71].Social isolation may also increase male susceptibility to reduced hedonic capacity by triggering inflammatory responses in the body [72].However,

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Table	2 Conver	gent validity of Chinese ve	ersion of the DARS				
Path			Standardized factor loadings	Standard Error	Р	AVE	CR
A1	~	Pastimes/Hobbies	0.888			0.837	0.954
A2	←	Pastimes/Hobbies	0.919	0.028	***		
A3	\leftarrow	Pastimes/Hobbies	0.940	0.026	***		
A4	\leftarrow	Pastimes/Hobbies	0.912	0.028	***		
B1	←	Food/Drinks	0.822			0.748	0.922
B2	←	Food/Drinks	0.905	0.034	***		
B3	\leftarrow	Food/Drinks	0.917	0.034	***		
B4	\leftarrow	Food/Drinks	0.809	0.038	***		
C1	\leftarrow	Social activities	0.926			0.871	0.964
C2	\leftarrow	Social activities	0.921	0.023	***		
C3	\leftarrow	Social activities	0.865	0.027	***		
C4	\leftarrow	Social activities	0.921	0.023	***		
D1	\leftarrow	Sensory experience	0.918			0.841	0.964
D2	\leftarrow	Sensory experience	0.925	0.023	***		
D3	\leftarrow	Sensory experience	0.899	0.025	***		
D4	\leftarrow	Sensory experience	0.925	0.024	***		
D5	\leftarrow	Sensory experience	0.917	0.024	***		

Notes: A/B/C/D represents the four subscales of DARS. (A, Hobbies; B, Food and Drinks; C, Social activities; D, Sensory experiences). CR: construct reliability; AVE: average variance extracted; ***, P<0.001; For more information, refer to the annotations in Fig. 1

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Sensory experience	Social activities	Food/Drinks	Pastimes/Hobbies
0.917			
0.864**	0.933		
0.829**	0.856**	0.964	
0.662**	0.674**	0.718**	0.915
0.841	0.871	0.748	0.837
	Sensory experience 0.917 0.864** 0.829** 0.662** 0.841	Sensory experience Social activities 0.917 0.864** 0.933 0.829** 0.856** 0.662** 0.662** 0.674** 0.871	Sensory experience Social activities Food/Drinks 0.917 0.864** 0.933 0.829** 0.856** 0.964 0.829** 0.856** 0.964 0.718** 0.662** 0.871 0.748

Notes: **P*<0.05; ***P*<0.01; AVE: average variance extracted

Table 4 Internal reliability of Chinese version of the DARS

Types of reward (17 items of DARS scale) <i>n</i> = 678	Cronbach α	Coefficient omega ω
A. DARS-Pastimes/Hobbies	0.953ª	0.954 ^c
1. I would enjoy these activities	0.944 ^b	0.945 ^d
2. I would spend time doing these activities	0.938 ^b	0.938 ^d
3. I want to do these activities	0.934 ^b	0.934 ^d
4. These activities would interest me	0.940 ^b	0.940 ^d
B. DARS-Food/Drinks	0.921 ^a	0.923 ^c
5. I would make an effort to get/make these foods/drinks	0.905 ^b	0.909 ^d
6. I would enjoy these foods/drinks	0.891 ^b	0.892 ^d
7. I want to have these foods/drinks	0.885 ^b	0.886 ^d
8. I would eat as much of these foods as I could	0.908 ^b	0.912 ^d
C. DARS- Social activities	0.949 ^a	0.950 ^c
9. Spending time doing these things would make me happy	0.929 ^b	0.930 ^d
10. I would be interested in doing things that involve other people	0.930 ^b	0.931 ^d
11. I would be the one to plan these activities	0.945 ^b	0.945 ^d
12. I would actively participate in these social activities	0.929 ^b	0.930 ^d
D. DARS- Sensory experiences	0.963 ^a	0.963 ^c
13. I would actively seek out these experiences	0.955 ^b	0.955 ^d
14. I get excited thinking about these experiences	0.953 ^b	0.953 ^d
15. If I were to have these experiences I would savor every moment	0.957 ^b	0.957 ^d
16. I want to have these experiences	0.953 ^b	0.953 ^d
17. I would make an effort to spend time having these experiences	0.954 ^b	0.954 ^d
Total Score	0.971	0.971



Fig. 3 Analysis of the elements that influence hedonic state in different populations. (A) Factors that influence the hedonic functional state in all observed samples; (B) Factors that influence the hedonic functional state in all observed female samples; (C) Factors that influence the hedonic functional state in all observed male samples. **P*<0.05; ***P*<0.01

females tend to be less affected by this phenomenon due to their greater ability to integrate social resources [73]. These behavioral differences may also be linked to the societal organizations, social structures, and traditional social roles that males and females occupy [67].While relying on subjective self-report measures limits definitive conclusions, these preliminary findings suggest a potential pathway for identifying reduced hedonic capacity in the general population.

Nevertheless, it is important to acknowledge several limitations. This study was a cross-sectional analysis that relied primarily on online measurements. The use of a single assessment, rather than a combination of methods such as clinical evaluation, behavioral tests and self-reports, affects the validity of the results [18]. In summary, given its reliance on data from a single online assessment, further validation of our conclusions with larger, more diverse samples is needed.

Conclusion

In summary, our study confirmed the robust psychometric properties of the Chinese version of the DARS in a community-dwelling adult sample from China. It also offers a reliable alternative method for assessing hedonic capacity, which encompasses four distinct domains: pastimes/hobbies, foods/drinks, social activities, and sensory experiences. Our findings revealed significant gender differences in the decline of hedonic capacity, suggesting that gender-specific mental health services should be considered in the future.

Abbreviations

DARS	Dimensional Anhedonia Rating Scale
MDD	Major depression disorder
SHAPS	Snaith-Hamilton Pleasure Scale
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
PHQ-9	The Patient Health Questionnaire-9
PRIME-MD	Primary Care Evaluation of Mental Disorders
GAD-7	Generalized Anxiety Disorder-7
KMO	Kaiser-Meyer-Olkin
GFI	goodness-of-fit index
CFI	Comparative fit index

TLI	Tucker–Lewis index
NFI	Normed fit index
RMSEA	Root-mean-square error of approximation
CR	Construct reliability
AVE	Average variance extracted
SPSS	Statistical Package for the Social Sciences
CI	Confidence Interval
RDoC	Research Domain Criteria

Supplementary Information

The online version contains supplementary material available at https://doi.or g/10.1186/s40359-025-02740-x.

Supplementary Material 1

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Not applicable.

Author contributions

TMS, YAS, YKW, and QW conceived and coordinated the study, designed, performed, and analysed the experiments, and wrote the paper. YKW, QW, YAS, YSZ, and KQL carried out the data collection and coordinated the project. TMS, YAS, YSZ, and KQL contributed data interpretation and revisions to the paper. All authors reviewed the results and approved the final version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Peking University Sixth Hospital and was conducted in strict accordance with the Declaration of Helsinki. All participants provided informed consent online before the formal survey.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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