# RESEARCH



# Linear self-acceptance and nonlinear social comparison: interacting influences on adolescent depression



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# Abstract

**Background** This research builds on the understanding that low self-acceptance is an important feature of adolescent depression, and that social comparison is a critical factor in self-concept formation during adolescence. However, there are gaps in our understanding of their interactive effects and the non-linear features between these factors in influencing adolescent depression.

**Aim** The study attempts to test two main hypotheses: (1) increased levels of self-acceptance will correlate with reduced depressive symptoms and moderate the negative effects of social comparison on depression; and (2) the relationship between social comparison and depression will exhibit nonlinearity at different levels of self-acceptance.

**Method** The study involved 243 adolescents undergoing psychiatric assessment, using dyadic polynomial regression analysis and response surface analysis. These methods were used to assess linearity or nonlinearity and interaction effects between self-acceptance, social comparison and depression.

**Results** Significant findings included a strong negative correlation between self-acceptance and depression. Self-acceptance also showed a negative correlation with social comparison. Polynomial regression revealed a non-linear relationship between social comparison and depression, with moderate levels being beneficial but excessive levels being detrimental. The interaction effect suggested that high self-acceptance might buffer the negative effects of intense social comparison. Furthermore, response surface analysis revealed complex, non-linear interactions between these variables.

**Conclusions** This study highlights the protective role of self-acceptance against depression and the complex, non-linear effects of social comparison. It highlights the importance of promoting self-acceptance and a balanced approach to social comparison in adolescent mental health interventions.

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**Keywords** Adolescent depression, Self-Acceptance, Social comparison, Polynomial regression analysis, Response surface analysis, Nonlinearity

# Introduction

Research has identified low self-acceptance as a salient feature of adolescent depression, suggesting a direct correlation between the degree of self-acceptance and the severity of depressive symptoms [1, 2]. Adolescence is a developmental period marked by significant changes, including heightened self-awareness, identity exploration, and increased susceptibility to mental health challenges like depression. During this time, social comparison, the process of evaluating oneself against others, becomes particularly pronounced, playing a key role in the formation of self-concept. Understanding the interplay of self-acceptance and social comparison during this critical developmental stage is therefore crucial for addressing adolescent depression. Untreated adolescent depression can have profound and lasting consequences, increasing the risk of recurrent depressive episodes, anxiety disorders, substance abuse, and difficulties in academic, social, and occupational functioning in adulthood [3]. During this time, social comparison, the process of evaluating oneself against others, becomes particularly pronounced [4], playing a key role in the formation of self-concept. Furthermore, the patterns of social comparison established during adolescence may persist into adulthood, influencing self-esteem, relationship satisfaction, and overall well-being [5]. Therefore, understanding the interplay of self-acceptance and social comparison during this crucial developmental stage is essential not only for immediate well-being but also for long-term mental health trajectories. This study aims to investigate this complex interplay, focusing on the potential protective role of self-acceptance against the negative impacts of social comparison on adolescent depression.

#### Self-acceptance as a protective factor against depression

Self-acceptance is a multi-faceted construct in psychology, fundamentally involving an individual's acceptance of all aspects of themselves, including their strengths and weaknesses [6]. This concept differs from mere selfesteem, which is often dependent on external successes or failures. Self-acceptance is unconditional, a stable acknowledgment and embrace of one's true self [7]. Selfacceptance plays a central role in mental wellbeing, acting as a buffer against a range of mental health problems, including depression [8, 9]. It provides a stable foundation of self-worth that is not easily shaken by external circumstances or internal emotional states. This stability is crucial in the face of life's challenges, where those with higher levels of self-acceptance are less likely to internalise difficulties as a reflection of their self-worth, thereby reducing the risk of depressive symptoms [10, 11].

The protective influence of self-acceptance is particularly important during adolescence, a developmental stage characterised by increased self-awareness and vulnerability to depression [12, 13]. Adolescents with higher levels of self-acceptance show greater resilience in the face of stressors typical of this developmental period, such as peer pressure, academic challenges and identity exploration [14]. They are less likely to fall into patterns of negative self-evaluation and rumination, which are potent risk factors for depression [15]. We may explain mechanisms underlying the protective role of self-acceptance against depression. Firstly, self-acceptance encourages a more compassionate and less judgmental attitude towards oneself, reducing the impact of negative self-critique, a common feature in depression [2]. A longitudinal study showed that higher levels of self-compassion, a key component of self-acceptance, were significantly associated with lower levels of depression, anxiety and stress [16]. This relationship held true even when controlling for other factors such as life events and general coping styles. Secondly, it fosters a sense of authenticity, allowing individuals to live in a manner congruent with their true self, which has been shown to correlate with better mental health outcomes [17]. Thirdly, self-acceptance contributes to better emotional regulation, enabling individuals to handle emotional distress more effectively without falling into depressive states [18].

In summary, self-acceptance offers a robust defense against depression, particularly during the tumultuous period of adolescence. By fostering self-compassion, promoting authenticity, and enhancing emotional regulation, self-acceptance equips individuals with the resilience needed to navigate life's challenges and maintain mental well-being.

# Social comparison and its relationships to self-acceptance and depression in adolescents

Social comparison, a process where individuals evaluate themselves against others, becomes particularly significant during adolescence, a critical period for identity formation and self-concept development [19]. Originating from Festinger's theory [20], it highlights an innate drive for self-evaluation, often in relation to others. This behaviour is particularly prevalent in adolescents as they navigate complex social dynamics. Research suggests that this tendency to compare has implications for adolescents' self-esteem and psychological well-being [21]. In addition, this process is closely tied to the concept of "optimal distinctiveness" (Brewer & Roccas, 2015), which suggests that individuals strive for a balance between belongingness and individuality. While moderate social comparison can contribute to self-understanding and a sense of place within a social group, excessive or predominantly upward comparisons can disrupt this balance, potentially leading to negative self-evaluation and increased vulnerability to depression.

An important aspect of how adolescents manage social comparison lies in their level of self-acceptance. One study suggest that higher self-acceptance correlates with lesser engagement in social comparison [22]. This indicates that a robust sense of self-worth can mitigate the impact of continuous self-evaluation against others, which could otherwise lead to negative emotional outcomes. Conversely, another study found that frequent upward social comparisons (comparing oneself to perceived superiors) are associated with lower self-acceptance and increased depression levels [23]. This implies that the nature of social comparison (whether upward or downward) can significantly influence adolescent selfperception and mood.

Further exploring the relationship between social comparison and depression, studies demonstrate a clear link between a propensity for social comparison and depressive symptoms in adolescents. These findings suggest that a high orientation towards social comparison could be a risk factor for developing or exacerbating depressive symptoms [24, 25].

In the contemporary digital age, the influence of online social comparison on adolescent mental health is becoming increasingly relevant. The passive use of social media, often involving comparison with others, has been linked to decreased well-being and heightened depressive symptoms [26]. The idealized portrayals of peers' lives on these platforms can intensify feelings of envy and inadequacy, further impacting self-acceptance and contributing to depression.

#### **Current understanding and limitations**

Studies have consistently highlighted the protective role of self-acceptance against depression and the potential risks associated with a high inclination for social comparison. However, several critical gaps remain in our understanding of how these factors interact and influence adolescent depression, particularly when considering the linear and nonlinear features of these interactions. Clarifying the interactive effects of self-acceptance and social comparison can help tailor interventions to individual needs, maximizing their potential impact. Furthermore, exploring the potential non-linearity of these relationships can refine our understanding of the "tipping points" at which social comparison becomes detrimental, allowing for more precise and effective prevention and intervention efforts.

# Gap 1: interaction between self-acceptance and social comparison

While existing studies have explored self-acceptance and social comparison in isolation, there is a paucity of research examining their interactive effects on adolescent depression [27]. The interaction hypothesis suggests that the impact of social comparison on depression may vary depending on the level of self-acceptance. Adolescents with high self-acceptance might be less affected by negative social comparisons than those with low self-acceptance. This potential buffering effect remains under-explored in the current literature.

#### Gap 2: linear versus nonlinear

Another significant gap is the exploration of linear versus nonlinear features in the relationship between self-acceptance, social comparison, and depression. Most existing research assumes a linear relationship, where changes in self-acceptance or social comparison directly correspond to changes in depressive symptoms. However, the realworld interaction of these factors might exhibit nonlinear characteristics. For instance, moderate social comparison might help individuals understand where they stand in their social environment, contributing positively to selfacceptance and mental health. There may be threshold effects of "optimal distinctiveness", where the influence of social comparison on depression significantly changes at certain levels of self-acceptance. This complexity has not been adequately addressed in current research.

#### The present study

The current research has established a foundational understanding of the distinct roles played by self-acceptance and social comparison in the context of adolescent depression. Recognizing the existing gaps in this domain, our study embarks on an in-depth investigation into the interplay between these variables. We posit three central hypotheses: (1) Elevated levels of self-acceptance will correlate with reduced depressive symptoms; (2) Self-acceptance will moderate the relationship between social comparison and depression, mitigating the adverse effects of social comparison; and (3) The relationship between social comparison and depression will exhibit nonlinearity at different levels of self-acceptance.

## Method

# Participants

The study included 243 adolescents, aged 12 to 18 years, who sought clinical services at a psychiatric hospital between July and December 2022. Inclusion criteria required that participants be adolescents or young

adults with normal Chinese character reading and writing skills, and informed consent had to be provided by both the participants and their families. Exclusion criteria included individuals with severe mental illnesses or those in an acute exacerbation phase, those who refused to sign the informed consent form, and those with severe organic diseases. Power analysis was conducted by G\*Power 3.1(effect size  $(f^2) = 0.15$ , significance level  $(\alpha) = 0.05$ , power  $(1 - \beta) = 0.95$  and predictors = 5) indicated that a minimum of 138 participants would be required to achieve the desired statistical power, and our sample size exceeded this requirement.

Each participant underwent a standard registration process at the hospital, followed by an individual mental health assessment by a qualified psychiatrist. Prior to the assessment, both the patients and their parents or guardians were provided with comprehensive information about the assessment process and the instruments to be used. Written informed consent was obtained from each patient and their parent or guardian, in accordance with the hospital's ethical guidelines. The study procedures conformed to the ethical standards of the relevant national and institutional bodies for human experimentation and to the tenets of the Declaration of Helsinki of 1975, as amended in 2008. In addition, the research protocol was approved by the Institutional Review Board of the Seventh People's Hospital of Wenzhou with reference number EC-KY-2,022,048, ensuring compliance with ethical research practices.

#### Measures

#### Demographic information

Demographic data were collected using self-administered questionnaires, which sought to ascertain basic personal information such as gender and age. Gender was categorized as a binary variable, with the assignment of numerical codes for identification purposes: 0 representing male and 1 representing female. Age, on the other hand, was recorded as a continuous variable, expressed in terms of years.

#### Self-acceptance

Self-acceptance was assessed utilizing the Self-Acceptance Questionnaire (SAQ), which comprises 16 items segregated into two distinct subscales: Self-acceptance and Self-evaluation. The Self-acceptance subscale encompasses eight items, each reverse-scored, and these are appraised utilizing a 4-point Likert-type scale that ranges from 1 (denoting strong disagreement), to 4(representing strong agreement) [28]. Self-Evaluation subscale is comprised of eight positively formulated items. The aggregation of scores within each subscale facilitates the quantification of self-acceptance, with elevated aggregate scores indicating enhanced self-acceptance. The SAQ has demonstrated validity and reliability within adolescent populations(with Cronbach's  $\alpha = 0.89$ )<sup>2</sup>. In this particular study, the SAQ demonstrated commendable internal consistency, as evidenced by a Cronbach's  $\alpha$  value of 0.89.

#### Social comparison

Social comparison was measured by Iowa-Netherlands Comparison Orientation Measure (INCOM), an 11-item instrument that is extensively recognized for its efficacy in assessing individuals' inclination to compare themselves with others [29]. Responses to each item on the INCOM are recorded on a 5-point Likert scale, commencing at 1 (strongly disagree) and culminating at 5 (strongly agree). Total scores on this measure are indicative of the degree of social comparison orientation, with higher scores denoting a stronger tendency. The INCOM has also demonstrated validity and reliability within adolescent populations(with Cronbach's  $\alpha = 0.85$ ) [30].

Within the present investigation, the INCOM demonstrated substantial internal consistency, as evidenced by a Cronbach's  $\alpha$  coefficient of 0.82.

#### Depression

Depression was assessed utilizing the Patient Health Questionnaire-9 (PHQ-9), a widely recognized tool is a self-report questionnaire specifically designed to evaluate the presence and severity of depressive symptoms [31]. The PHQ-9 consists of nine items, each corresponding to the diagnostic criteria for major depressive disorder as outlined in the DSM-IV. The scale ranges from 0 (not at all) to 3 (almost every day). The total score ranges from 0 to 27, with higher scores indicating more severe depressive symptoms. PHQ-9 is a reliable tool for assessing depression in both clinical and research settings (Cronbach's  $\alpha$  = 0.89 within adolescent populations) [32], with Cronbach's  $\alpha$  = 0.92 in current study.

#### **Statistics analysis**

Firstly, descriptive statistics and Pearson's correlation were used to describe the demographic composition of the sample. This preliminary analysis, which included mean, standard deviation and frequency distribution calculations, provided a basic understanding of the study participants. Pearson's correlation was used to identify linear associations between pairs of variables, providing a first insight into potential relationship between variables.

Secondly, computing the dyadic polynomial regression model [33]. The dyadic polynomial regression model was constructed from a polynomial regression model, in which  $X_1$  and  $X_2$  stand for social comparison and self-acceptance, respectively. Y stand for depression, this polynomial regression equations can be written as follows:

	Gender	Age	Self-Acceptance	Social Comparison	Depression
Gender	1				
Age	-0.07	1			
Self-Acceptance	-0.21****	0.21***	1		
Social Comparison	0.13*	0.09	-0.32***	1	
Depression	0.22***	-0.24***	-0.75****	0.33***	1
М	()	14.95	31.33	34.88	14.83
SD	()	1.55	9.06	8.44	8.28

 Table 1
 Descriptive statistics and correlations of the study variables

$$\begin{array}{l}Y\!=\!b0\!+\!b1\!*\,X_{1}\!+\!b2\!*\,X_{2}\!+\!b3\!*\,{X_{1}}^{2}\\ +\,b4\!*\,(X_{1}\!*\,X_{2})\!+\!b5\!*\left(X_{2}^{-2}\right)\end{array}$$

Finally, response surface analysis based on congruence and incongruence between social comparison and self-acceptance provides a graphical representation of the results of polynomial regressions that can help to interpret polynomial regressions [34]. In which,  $a_1$ ,  $a_2$ ,  $a_3$ ,  $a_4$  four parameters indicate the relation among social comparison, self-acceptance and depression. The  $a1(a_1=b_1+b_2)$  indicates a linear slope of the line of congruence, and  $a_2$  ( $a_2=b_3+b_4+b_5$ ) indicates a curvature of the line of congruence. The  $a_3$  ( $a_3=b_1-b_2$ ) represents a linear slope of the line of the line of incongruence that illustrates the effect of incongruence direction on outcome variables and  $a_4$  ( $a_4=b_3-b_4+b_5$ ), a curvature of the line of incongruence.

All statistical analyses in this study were executed using R (version 4.3.2), employing the "state", "rsm", and "RSA" packages, with a significance level set at p < 0.05 for two-sided tests.

### Result

The sample for this study included 243 participants, of whom 82 (33.7%) were male. The average age of participants was 14.95 ± 1.55 years (More information refer to Table 1). All variables meet the normal distribution criteria (|kurtosis|< 2,| skewness|< 2). Bivariate correlational analyses examined relationships between key variables in this study. Self-acceptance demonstrated significant negative correlations with both social comparison (r = -0.32, p < 0.001) and depression (r = -0.75, p < 0.001), higher self-acceptance was associated with lower social comparison and depression. Moreover, gender was positively correlated with depression (r=0.22, p < 0.001) and social comparison (r=0.13, p < 0.05), age positively correlated self-acceptance (r=0.21, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively with depression (r = -0.24, p < 0.001) and negatively (r = -0.24, p < 0.001) and ne

# Dyadic polynomial regression model *Linear effects*

The model revealed significant negative linear effects for both social comparison ( $b_1 = -0.91$ ) and self-acceptance ( $b_2 = -1.14$ ) on depression. This means that, individually,

 Table 2
 Dyadic polynomial regression coefficients of the social comparison - self-acceptance on depression

Parameter	β	SE	95%CI	р
b <sub>1</sub>	-0.91	0.28	[-1.46, -0.37]	0.001
b <sub>2</sub>	-1.14	0.30	[-1.73, -0.56]	< 0.001
b <sub>3</sub>	0.01	0.003	[0.004, 0.02]	0.001
b <sub>4</sub>	0.01	0.003	[0.003, 0.02]	0.01
b <sub>5</sub>	0.004	0.004	[-0.01, 0.01]	0.47

Note: Regression model: Depression= $b_0+b_1*$ Social Comparison+ $b_2*$ Self-Acceptance+ $b_3*$  Social Comparison <sup>2</sup> +  $b_4*$ (Social Comparison \* Self-Acceptance)+ $b_5*$ (Self-Acceptance [2])

increases in social comparison and self-acceptance are associated with decreases in depression scores. The stronger effect of self-acceptance ( $b_2$  is larger in magnitude than  $b_1$ ) suggests that self-acceptance may be a more potent individual predictor of lower depression levels than social comparison.

## Quadratic effects

The significant quadratic term for social comparison ( $b_3 = 0.01$ ) indicates a non-linear relationship with depression. As social comparison levels increase, the initial decrease in depression levels off and begins to reverse, leading to increased depression at higher levels of social comparison. The non-significant quadratic term for self-acceptance ( $b_5 = 0.004$ ) suggests that the relationship between self-acceptance and depression does not display this curvilinear pattern and is better described as linear.

#### Interaction effect

The significant interaction term ( $b_4$ =0.01) highlights that the impact of social comparison on depression is moderated by the level of self-acceptance. This suggests that the effect of one predictor depends on the value of the other. In other words, self-acceptance may buffer or amplify the effects of social comparison on depression. (see Table 2 for details)

## Alternative directional models

To explore potential bidirectional relationships, we tested two alternative models. The first model examined how social comparison and depression predict self-acceptance. Results showed a significant linear effect of social comparison on self-acceptance ( $b_1 = -1.16$ , p < 0.001), while depression's effect was marginal ( $b_2 = -0.51$ , p = 0.07). No significant quadratic or interaction effects were found. The second model testing how depression and self-acceptance predict social comparison revealed no significant linear, quadratic, or interaction effects (all p > 0.05), suggesting that neither depression nor self-acceptance strongly predicts social comparison levels (see Tables S2 and S3 for detailed results).

#### Response surface analysis on the interrelation effect

This analysis provides a three-dimensional view of how social comparison and self-acceptance jointly influence depression (see Table 3; Fig. 1).

#### Line of congruence (LOC)

On the LOC, where social comparison and self-acceptance are equal, there is a significant negative linear effect  $(a_1 = -2.05, p < 0.001)$ , indicating that when both predictors increase in tandem, depression initially decreases. However, the positive quadratic effect  $(a_2 = 0.02, p = 0.002)$  suggests that this beneficial effect plateaus and begins to reverse beyond a certain point, leading to increased depression. This reflects a "too much of a good thing" scenario, where moderate levels are beneficial, but extreme levels could be detrimental.

#### Line of incongruence (LOIC)

On the LOIC, where social comparison and self-acceptance diverge, the non-significant effects ( $a_3 = 0.23$ , p > 0.05;  $a_4 = 0.004$ , p > 0.05) suggest that imbalance between these factors does not have a clear linear or

 Table 3
 Response surface parameters of the social comparison - self-acceptance on depression

Parameters	Estimate	SE	95%CI	р
a <sub>1</sub>	-2.05	0.46	[-2.96, -1.15]	< 0.001
a <sub>2</sub>	0.02	0.01	[0.01, 0.04]	0.002
a <sub>3</sub>	0.23	0.35	[-0.45, 0.92]	0.50
a <sub>4</sub>	0.004	0.004	[-0.004, 0.01]	0.34

Note:  $a_1 = b_1 + b_2$ ;  $a_2 = b_3 + b_4 + b_5$ ;  $a_3 = b_1 - b_2$ ;  $a_4 = b_3 - b_4 + b_5$ 

curvilinear relationship with depression. This could indicate that when self-acceptance and social comparison are not aligned, other factors may be more influential in determining depression levels, or the effects may be too individualized to be captured by this model.

In essence, these analyses suggest that both self-acceptance and social comparison are important to consider in relation to adolescent depression, but their effects are not straightforward. High self-acceptance generally predicts lower depression, while the effect of social comparison is more complex and depends on its interaction with self-acceptance.

### Discussion

Our findings provide support for all three hypotheses proposed in this study. First, we found a strong negative correlation between self-acceptance and depression (r =-0.75, p < 0.001), confirming our hypothesis that higher self-acceptance correlates with reduced depressive symptoms. Second, the significant interaction term in our polynomial regression analysis ( $b_4 = 0.01$ , p = 0.01) supports our hypothesis that self-acceptance moderates the relationship between social comparison and depression.

a1: -2.05\*\*\* a2: 0.02\*\* a3: -0.23 a4: 0.004



Fig. 1 Response surface analysis graphs for the effects of social comparison - self-acceptance on depression

Third, the significant quadratic term for social comparison ( $b_3 = 0.01$ , p = 0.001) confirms our hypothesis about the nonlinear relationship between social comparison and depression at different levels of self-acceptance. These results provide a comprehensive picture of how self-acceptance and social comparison interact to influence depression in adolescents.

# The negative correlation between self-acceptance, social comparison and depression in adolescents

One of our study's contributions is the elucidation of the negative correlation between self-acceptance and both social comparison and depression among adolescents, a group particularly susceptible to self-esteem and identity challenges [35, 36]. We have discovered that higher levels of self-acceptance in adolescents are linked to a reduced tendency for social comparison. This finding is in line with psychological theories that suggest individuals with greater self-acceptance are less likely to seek validation through external comparisons, instead deriving their self-worth from internal sources [37].

Moreover, our research supports existing psychological theories and empirical evidence by demonstrating a strong negative correlation between self-acceptance and depression in adolescents. This reinforces the notion that self-acceptance serves as a protective barrier against depressive symptoms, highlighting the crucial role of a positive self-image in mental health [38]. Adolescents with higher self-acceptance are likely to exhibit increased resilience against depression, emphasizing the importance of nurturing self-acceptance to bolster mental well-being.

The non-significant quadratic term for self-acceptance suggests that while a linear model captures the protective effect of self-acceptance against depression, even when considering social comparison. Therefore, fostering selfacceptance seems a viable strategy to mitigate depression among adolescents. However, considering the interaction effect of self-acceptance and social comparison, we need to delve into the nuances to fully understand and leverage this relationship.

The examination of alternative directional models provides important insights into the nature of relationships among our key variables. While our primary model demonstrated complex nonlinear interactions between self-acceptance, social comparison, and depression, the alternative models showed simpler, predominantly linear relationships or no significant relationships at all. Specifically, when testing depression as a predictor, we found it had a linear relationship with self-acceptance but showed no significant relationship with social comparison. This asymmetry in relationships suggests that the pathway from self-acceptance and social comparison to depression, as proposed in our primary model, may be more robust than alternative directional pathways. However, this interpretation should be considered with caution given the cross-sectional nature of our data.

#### Social comparison: a double-edged sword?

Our findings introduce a complex narrative regarding the relationship between social comparison and depression in adolescents, highlighting that this interaction is not merely linear but is characterized by dynamic shifts and potential tipping points.

The observed negative linear effect of social comparison on depression, as per the dyadic polynomial regression model (b1 = -0.91, p = 0.001), suggests that, to a certain point, engaging in social comparison can have a depressive-diminishing effect [39]. This could be interpreted through the lens of Festinger's Social Comparison Theory, which posits that individuals determine their own social and personal worth based on how they stack up against others [5]. Initially, this comparison may foster a sense of belonging or provide a metric for self-improvement, which can be affirming and hence inversely related to depression. However, when the adolescents have very low self-acceptance, the depression scores are the highest, while moderate social comparison can make them less serious, indicating its adaptive value.

However, the study's findings also reveal a significant quadratic term (b3 = 0.01, p = 0.001), indicating that beyond a certain threshold, increased social comparison correlates with an increase in depression levels. This nonlinear pattern is crucial to understanding the complex role of social comparison in adolescent mental health. The turning point suggests that when social comparison escalates beyond moderate, healthy levels, it may become detrimental, possibly due to the emergence of envy, feelings of inadequacy, or reduced self-esteem [40]. This aligns with research indicating that negative outcomes of social comparison are amplified when individuals consistently perceive themselves as inferior to those, they compare themselves with [41].

The implications of such a non-linear relationship are profound. They suggest that interventions should not aim to eliminate social comparison altogether, as it serves an important function in the initial establishment of selfconcept [42]. Instead, strategies should focus on fostering healthy comparison processes, such as promoting critical thinking about social media portrayals, and educating adolescents on the potentially distorting nature of comparison targets.

This observation resonates with Selye's stress theory concepts of 'eustress' and 'distress'. In this light, moderate social comparison might serve as eustress, offering motivation and a framework for self-improvement and identity formation—key aspects of adolescent development. Conversely, excessive social comparison might tip into distress, fostering negative self-evaluation and increasing susceptibility to depression. This dual nature of social comparison underscores its complex role in adolescent mental health and development.

We suppose that a certain degree of social comparison might be adaptive and motivating, acting as a catalyst for aspiration and personal growth. This aligns with the tenets of social comparison theory, which posits that individuals engage in both upward (comparing to those better off) and downward (comparing to those worse off) social comparisons to regulate self-esteem and emotional well-being [43]. However, our results suggest that when social comparison becomes excessive, it likely contributes to increased depressive symptoms, indicating a need for a balanced approach in its manifestation.

In addition, the significant interaction effect between social comparison and self-acceptance (b4=0.01, p=0.01) suggests that self-acceptance could potentially mitigate the adverse effects of social comparison. This finding is pivotal as it implies that interventions enhancing self-acceptance might provide adolescents with a buffer against the negative impacts of excessive social comparison. Previous studies have shown that self-compassion, a construct related to self-acceptance, can moderate the effects of negative social comparison on well-being [44].

#### Limitation and future implications

One limitation of this study is its cross-sectional design, which restricts our ability to infer causality between selfacceptance, social comparison, and depressive symptoms. The findings reflect associations at a single point in time rather than longitudinal changes or causal relationships, which should be considered when interpreting the results. Another limitation concerns the sample, comprising 243 adolescents seeking clinical services at a psychiatric hospital. While this setting allowed for a focused examination of mental health, the specificity introduces potential limitations in generalizability [45]. The unique context of a psychiatric hospital may influence the nature and severity of mental health issues observed, raising questions about the applicability of our findings to the broader adolescent population. Moreover, all participants were Han Chinese and socioeconomic status (SES) data were not collected, so the sample lacked diversity in demographic information. This limited representation limits the generalizability of our findings to other ethnic or socioeconomic groups. Additionally, the study's reliance on self-administered questionnaires introduces the possibility of response biases [46]. Adolescents may provide socially desirable responses, impacting the accuracy of self-reported data. Moreover, the nature of the psychiatric hospital setting may contribute to response biases, as participants may be influenced by the clinical environment. It is essential to acknowledge these potential biases and their implications for the interpretation of our results.

This study suggests several key directions for future research and clinical applications. Longitudinal studies are needed to establish causal relationships between self-acceptance, social comparison, and depression, while cross-cultural research would help determine the generalizability of our findings. Future studies should also examine these relationships in the context of social media use, which increasingly influences adolescents' social comparison processes. Our findings have important implications for clinical practice. The protective role of self-acceptance suggests incorporating acceptancebased therapeutic approaches into treatment protocols for adolescent depression. The non-linear relationship between social comparison and depression indicates that clinicians should help adolescents develop balanced approaches to social comparison rather than attempting to eliminate it. These findings also support developing school-based prevention programs that foster self-acceptance and healthy social comparison habits, potentially reducing the risk of depression in adolescent populations.

#### Conclusion

The study investigates the relationship between selfacceptance, social comparison, and depression in adolescents. It reveals that high self-acceptance correlates with reduced social comparison and depression, suggesting it acts as a protective factor. The study also finds a complex, non-linear relationship between social comparison and depression, with moderate levels being potentially beneficial, but excessive levels increasing susceptibility to depression. The interaction between self-acceptance and social comparison is intricate, indicating that high selfacceptance might mitigate the adverse effects of social comparison. These insights highlight the importance of fostering self-acceptance and a balanced approach to social comparison in adolescent mental health.

#### Abbreviations

95%CI	95% Confidence Interval
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, Fourth
	Edition
INCOM	Iowa-Netherlands Comparison Orientation Measure
IRB	Institutional Review Board
LOC	Line of Congruence
LOIC	Line of Incongruence
Μ	Mean
PHQ-9	Patient Health Questionnaire-9
RSA	Response Surface Analysis
SAQ	Self-Acceptance Questionnaire
SD	Standard Deviation
SE	Standard Error
SES	Socioeconomic Status

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#### Author contributions

Qian-Nan Ruan: Data collection, draft writing; Guang-Hui Shen: Data analysis; Yu-Wei Wu: writing; Dongwu Xu: Considerate contributions to the manuscript revision; Wen-Jing Yan: conceptualization.

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#### Data availability

The data supporting the findings of this study are available upon reasonable request from the corresponding author.

#### Declarations

#### Ethics approval and consent to participate

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects/patients were approved by IRB in Wenzhou Seventh People's Hospital (EC-KY-2022048).

All procedures were performed in accordance with relevant guidelines from declaration of Helsinki statement.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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