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Magic mirror, who is the fairest one of all? testing the mediating effect between short- video social media exposure and appearance anxiety

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Abstract

Our aim was to examine the relationship between short-video social media exposure and appearance anxiety among female youth, as well as the serial mediation of capitalization of sexual attractiveness and upward social media appearance comparison. In this study, 585 female youths from China were selected as participants. The Short-Video Social Media Exposure Scale, Capitalization of Sexual Attractiveness Scale, Upward Social Media Appearance Comparison Scale, and Appearance Anxiety Scale were used to measure participants. The findings revealed that the short-video social media exposure positively predicted appearance anxiety. Additionally, the capitalization of sexual attractiveness and upward social media appearance comparison mediated the relationship between short-video social media exposure and appearance anxiety, respectively. Furthermore, the capitalization of sexual attractiveness and upward social media appearance comparison also had a serial mediation effect. The result explained that short-video social media exposure not only predicts appearance anxiety through the mediating effects of capitalization of sexual attractiveness and upward social media appearance comparison, but also by a serial mediation of capitalization of sexual attractiveness and upward social media appearance comparison.

Keywords Short-video social media exposure, Appearance anxiety, Capitalization of sexual attractiveness, Upward social media appearance comparisons, Female youth

With the development of global we-media areas, the use of short-video social media has experienced explosive growth in China. According to the 54th Statistical Report on Internet Development in China released by the China Internet Network Information Center, as of June 2024, the scale of online video users in China reached 1.068 billion,

accounting for 97.10% of overall internet users [1]. Among these, the number of short video users was 1.050 billion, accounting for 95.50% of overall internet users [1]. In China, the excessive use of short video social media has become a distinctive social phenomenon, with various types of internet celebrities, fashion videos, cosmetics sales hosts, and short video dramas flooding the online space, exhibiting characteristics of forced implantation, widespread dissemination, and exposure. Female youth are one of the primary groups creating, posting, sharing, and using social media platforms [2, 3]. Many female youths are exposed to a social media environment dominated by body materials of movie stars, online celebrities,

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beauties, and models almost every day [3]. Moreover, driven by fear of missing out, short-video social media use has become an indispensable behavior and lifestyle for many female youths [4]. Particularly for female youth who place great emphasis on their appearance, social media provides a perfect platform for them to construct a “virtual self-image” [5].

However, After female youth watched short videos of female appearance and bodies on TikTok, Kwai, Bilibili, and RED, they will indiscriminately accept the behavior system of female virtual characters portrayed by short-video anchors and video content, internalizing these unrealistic and irrational standards, thereby triggering appearance anxiety [6, 7]. Appearance anxiety is a common type of anxiety among female youth, which poses a significant threat to their health [8]. Research has demonstrated that female youth with higher levels of appearance anxiety are more likely to engage in abnormal plastic surgery, use non-prescribed weight loss drugs, have low self-esteem, experience depression, and appear to have eating disorders [9–11].

The social-cultural Tripartite model points out that media, peers, and parents are important factors in influencing individuals' body image [12]. This theory has been widely applied in research on the relationship between social media and body image [13, 14]. Based on the Tripartite model, some studies have found a positive correlation between social media use and body image, restrictive eating, body dissatisfaction, and social appearance anxiety [12–14]. It is obvious that frequent social media use is closely related to body image [14, 15]. Currently, short social media videos are very popular among female youth, and their frequent viewing of short social media videos may be associated with appearance anxiety [15]. Therefore, this study aims to explore the predictive role of short-social media video exposure on appearance anxiety in female youth and the social psychological mechanisms involved.

Short-video social media exposure refers to individuals immersing themselves in widely showcased content on short-video social media platforms, which includes a substantial amount of information about the appearance and physical features of fashion personalities such as internet celebrities, movie stars, and models [16]. The main forms of expression include hot IP dramas, beautiful female outfits, and beauty experts. In order to gain click-through rates and internet traffic to maximize profit, short-video social media often extensively promote the appearance and physique of film stars and online celebrities. This has led to the formation of a singular aesthetic standard for female youth, including features such as an “A4 waist,” a “palm-sized face,” a “pointed chin,” “big eyes,” and “stick-thin legs” [11]. As a result, female youth develop cognitive biases towards their appearance and physique [17,

18]. Female youth invest more time and energy into social media, the more likely they are to scrutinize themselves through the strict aesthetic standards promoted on these platforms, leading to a higher likelihood of experiencing negative emotion [19]. Relevant research has also indicated a significant correlation between social media use and depression, body dissatisfaction, and appearance anxiety among youth [20–23]. Moreover, based on the attribution theory of anxiety, it is understood that female youth generate appearance anxiety when they become aware of disparity between the idealized beauty portrayed in social media and their physical appearance [24]. When female youth attribute this disparity to their physical features, it triggers noticeable appearance anxiety [24, 25]. Based on these findings, the following research hypothesis is proposed:

Hypothesis 1 Short-video social media exposure positively predicts appearance anxiety among female youth. Capitalization of sexual attractiveness refers to the beliefs of female utilizing their sexual attractiveness as a form of capital to exchange for better economic and social resources [26]. With the rapid development of social media, the phenomenon of sexual attractiveness capitalization is becoming increasingly prevalent. Some short videos, live-streaming videos, and articles propagate that the key factor for female youth to achieve higher social status, career advancement, and life success is to meet the appearance standards portrayed in social media [9, 27]. This gradually ingrains the belief that “a beautiful face and a seductive figure are the ultimate keys to success” in the minds of female youth and enhances their awareness of sexual attractiveness capitalization [9, 28]. Relevant studies also have demonstrated a significant correlation between fashion media exposure and the capitalization of sexual attractiveness [9].

However, the capitalization of sexual attractiveness has a greater negative impact on female youth [28]. Female youth with a pronounced inclination towards sexual attractiveness capitalization perceive it as the most important condition for acquiring social resources, career success, economic advantages, and market advantages in marriage [28–30]. These female youth focus more on shaping their appearance, comparing their appearance to that of film stars, models, and online celebrities portrayed in short-video social media [31]. After making comparisons, female youth feel a big difference between themselves and these film stars, models, and online celebrities, which leads to anxiety, depression, low happiness, and appearance dissatisfaction [25, 32]. Furthermore, Lazarus's cognitive-appraisal theory of emotion suggests that emotion is a complex response, encompassing environmental, cognitive, and behavioral aspects [33]. Specifically, individuals will make cognitive appraisals

of the beneficial or harmful nature of the environmental stimuli events, ultimately leading to corresponding emotions [33, 34]. For example, when women are often exposed to content that promotes the idea that physical appearance is a crucial condition for success, they may be influenced by this environmental factor and come to accept the messages conveyed by the media [9, 27, 28]. Gradually, they may start to pay more attention to their appearance, which can increase anxiety, depression, and dissatisfaction with their looks [25, 32]. Based on these findings, the following research hypothesis is proposed:

Hypothesis 2 Capitalization of sexual attractiveness plays a mediating role between short-video social media exposure and appearance anxiety among female youth.

Social media appearance comparison is the process by which individuals compare their physical characteristics with other users based on selfies or videos posted on social networking sites [9]. This is a new form of social comparison, which can be categorized into upward social media appearance comparison and downward social media appearance comparison [35, 36]. It is considered that upward social media appearance comparisons are automatic comparisons, and female youth will automatically compare themselves to idealized female appearances on social media [35]. The socio-cultural tripartite influence model also indicates that media, peers, and parents are important sources of influence on body image, and appearance comparison and internalization of idealized appearances play a mediating role between socio-cultural factors and appearance satisfaction [12, 37]. Research has also shown a significant correlation between social media exposure and upward social media appearance comparison [38]. Additionally, social comparison theory suggests that individuals' self-evaluation and emotions are influenced by comparisons with others [39]. Relevant studies have also confirmed that upward social media appearance comparison can result in lower self-esteem, increased anxiety, lower self-appearance evaluations, and dissatisfaction with appearance among female youth [36, 40, 41]. Based on these findings, the following research hypothesis is proposed:

Hypothesis 3 Upward social media appearance comparisons play a mediating role between short-video social media exposure and appearance anxiety among female youth.

Currently, social media videos promote the idea that popular celebrities, models, and internet celebrities effortlessly attain wealth and social status by having features such as double eyelids, large eyes, a pointed chin, a high nose bridge, an S figure, and being excessively thin [9, 28]. When women frequently consume these videos and content, they are led to believe that models, internet

celebrities, and stars who succeed on social media do so by relying on their beautiful appearance and physique to increase their popularity and fame, hence easily attaining wealth and social status [27–30]. This further encourages women to believe that a woman's physical appearance and attractiveness are crucial capital for achieving success [28].

Cognitive behavioral theory suggests that cognition directly influences an individual's actions [42]. Therefore, women with a high level of sexual attractiveness capital tend to hold themselves to higher physical appearance standards and are less willing to accept the risk of not meeting societal beauty standards [9, 43]. They tend to view being less attractive as a sign of failure, resulting in a constant need for social media appearance comparisons and a greater difficulty in tolerating the lack of information on online platforms and social media [43, 44]. In other words, due to the high standards female youth set for their appearance, female youth with a higher degree of capitalization of sexual attractiveness have a greater need for upward social media appearance comparison [45]. After engaging in upward social media appearance comparisons, female youth will show the appearance dissatisfaction and willingness to undergo cosmetic surgery [28, 46]. The higher frequency of exposure to short social media videos leads to a greater likelihood of capitalization on sexual attractiveness, which will result in a greater number of upward appearance comparisons [36, 44]. This will activate their negative self-perceptions for their appearance [36, 44]. Based on these findings, the following research hypothesis is proposed:

Hypothesis 4 The capitalization of sexual attractiveness and upward social media appearance comparisons play a serial mediation role between short-video social media exposure and appearance anxiety.

Materials and methods

Procedures and participants

The study employed snowball sampling to conduct a survey among young females aged 18 to 40 in China. In order to ensure data authenticity and facilitate participants' completion of scales, the scales were filled out anonymously online, and participants can withdraw from the survey at any time. Informed consent was obtained from all participants in this study. The survey was conducted in Yunnan Province, China, from July 2023 to August 2023. Four individuals distributed and collected questionnaires in Yunnan Province and were trained before the distribution of the questionnaires. The questionnaire was distributed online, with four individuals sharing the online questionnaire link with female youth they could reach. After completing the questionnaire,

these female youths then shared the online questionnaire link with other young women they could connect with.

Before distributing the survey questionnaire, we must confirm that the participants are willing to participate in the survey. We will provide the link to the online survey only if participants agree to complete the questionnaire. Moreover, the online survey has been configured to require a response to each question, thereby guaranteeing that the collected survey data does not contain any missing values. There were a total of 600 questionnaires distributed, and 600 returned, with 585 deemed valid and a 97.50% validity rate. Regarding the age distribution of the study participants, it was observed that the mean age was 23.14 with a standard deviation of 5.00.

Measures

Short-video social media exposure

This study revised the Media Exposure Scale of Appearance Social-cultural Attitude Questionnaire [47], and measured the short-video social media exposure among female youth (see supplementary file for scale). The scale consisted of 5 items (e.g., “I often follow beauty-related content on short video social media” and “Short video social media platforms are a great source of information for me about fashion and physical attractiveness”). The items were scored on a Likert scale from one (strongly disagree) to five (strongly agree). Higher scores indicated a higher short-video social media exposure among female youth. In the present study, Cronbach’s alpha coefficient was 0.92. The confirmatory factor analysis results shown that $\chi^2/df=3.17$, $RMSEA=0.06$, $RMR=0.02$, $GFI=0.99$, $AGFI=0.97$.

Capitalization of sexual attractiveness

This study measured the capitalization of sexual attractiveness among female youth using the Capitalization of Sexual Attractiveness Scale developed by Tengfei [29]. The scale consisted of 5 items (e.g., “I believe that if a girl has a beautiful appearance and a perfect body, it can make it easier for them to gain benefits in various aspects” and “I believe that if a girl has a beautiful appearance and a perfect body, their outstanding appearance can be seen as a form of capital”). The items were scored on a Likert scale from one (strongly disagree) to five (strongly agree). Higher scores indicated a higher capitalization of sexual attractiveness among female youth. In the present study, the Cronbach’s alpha coefficient was 0.91. The confirmatory factor analysis results show that $\chi^2/df=1.36$, $RMSEA=0.03$, $RMR=0.01$, $GFI=0.99$, $AGFI=0.98$.

Upward social media appearance comparison

The study measured upward social media appearance comparison among female youth using the revised

Upward Physical Appearance Comparison Scale developed by Liao et al. [48]. The scale consisted of 7 items (e.g., “I find myself comparing my appearance to people who are more attractive than me” and “During parties or other social activities, I compare my appearance to that of highly attractive individuals”). The items were scored on a Likert scale from one (strongly disagree) to five (strongly agree). Higher scores indicated a higher frequency of upward social media appearance comparison among female youth. In the present study, the Cronbach’s alpha coefficient was 0.90. The confirmatory factor analysis results show that $\chi^2/df=4.16$, $RMSEA=0.07$, $RMR=0.02$, $GFI=0.99$, $AGFI=0.94$.

Appearance anxiety

This study measured appearance anxiety among female youth using the Appearance Anxiety Scale revised by Sun Qingqing et al. [49]. The scale consisted of 14 items (e.g., “I feel nervous and uneasy about my appearance” and “I am dissatisfied with my appearance”). The items were scored on a Likert scale from one (never) to five (always). Higher scores indicated a higher level of appearance anxiety among female youth. In the present study, the Cronbach’s alpha coefficient was 0.97. The confirmatory factor analysis results show that $\chi^2/df=4.13$, $RMSEA=0.07$, $RMR=0.03$, $GFI=0.96$, $AGFI=0.90$.

Data analysis

The age is analyzed using the mean and standard deviation. The reliability and validity of the scale were verified using Cronbach’s alpha coefficient and confirmatory factor analysis, respectively. The Pearson correlation coefficient analysis was employed to determine the relationship between short-video social media exposure and capitalization of sexual attractiveness, upward social media appearance comparison, and appearance anxiety. Using model 6 in SPSS PROCESS 4.0, the serial mediation of capitalization of sexual attractiveness and upward social media appearance comparisons between short-video social media exposure and appearance anxiety was estimated through bias-corrected percentile bootstrapping analysis with 5,000 repeated samples.

Results

Variable descriptive and correlation analysis

As the Table 1 shown, it can be observed that female youth universally experienced short-video social media exposure, capitalization of sexual attractiveness, and upward social media appearance comparisons. Additionally, female youth who participated in the survey displayed a tendency towards appearance anxiety.

The Table 2 indicated significant correlations between short-video social media exposure and capitalization of sexual attractiveness, upward social media appearance

Table 1 Variable descriptive analysis

Variables	N	Min	Max	M ± SD
Short-video Social Media Exposure	585	5.00	25.00	15.98 ± 5.01
Capitalization of Sexual Attractiveness	585	5.00	25.00	16.31 ± 4.60
Upward Social Media Appearance Comparisons	585	7.00	35.00	22.00 ± 6.05
Appearance Anxiety	585	18.00	70.00	45.93 ± 12.37

Table 2 Correlations between study variables

	1	2	3	4
1.Short-video Social Media Exposure	1			
2.Capitalization of Sexual Attractiveness	0.45**	1		
3.Upward Social Media Appearance Comparisons	0.53**	0.63**	1	
4.Appearance Anxiety	0.70**	0.51**	0.60**	1

Note. ** $p < .01$

comparisons, and appearance anxiety. Significant correlations were also found between capitalization of sexual attractiveness and upward social media appearance comparisons and appearance anxiety. Appearance anxiety is significantly associated with upward social media appearance comparisons.

Mediating analysis of capitalization of sexual attractiveness and upward social media appearance comparisons

The Fig. 1; Table 3 shown that short-video social media exposure positively predicts capitalization of sexual attractiveness ($\beta = 0.45$, $P < .001$); Short-video social media

exposure positively predicts upward social media appearance comparison ($\beta = 0.30$, $P < .001$); Capitalization of sexual attractiveness positively predicts upward social media appearance comparison ($\beta = 0.49$, $P < .001$); Short-video social media exposure positively predicts appearance anxiety ($\beta = 0.51$, $P < .001$); Capitalization of sexual attractiveness positively predicts appearance anxiety ($\beta = 0.12$, $P < .001$); Upward social media appearance comparisons positively predict appearance anxiety ($\beta = 0.26$, $P < .001$).

As shown in Table 4, capitalization of sexual attractiveness plays a mediating role between short-video social media exposure and appearance anxiety, with an effect value of 0.05, 95% CI [0.02, 0.09]. Upward social media appearance comparisons play a mediating role between short-video social media exposure and appearance anxiety, with an effect value of 0.08, 95% CI [0.04, 0.12]. Furthermore, capitalization of sexual attractiveness and upward social media appearance comparison have a serial mediation effect between short-video social media exposure and appearance anxiety, with an effect value of 0.06, 95% CI [0.04, 0.08].

Discussion

This study explored the relationship between short-video social media exposure and appearance anxiety among female youth and its underlying psychological mechanisms. The study results revealed that short-video social media exposure positively predicted appearance anxiety among female youth, supporting hypothesis 1. This finding is consistent with previous research, indicating that higher short-video social media exposure is associated

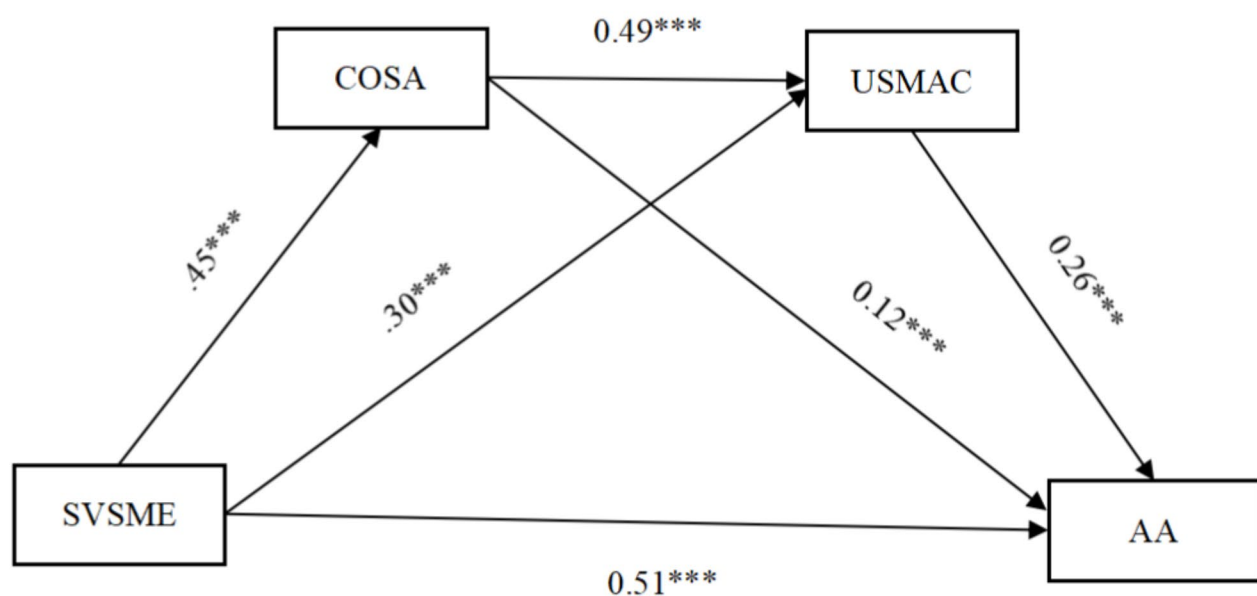
**Fig. 1** Mediating analysis of capitalization of sexual attractiveness and social media appearance comparisons

Table 3 Path analysis result

Dependent Variable:	β	se	t	P
Capitalization of sexual attractiveness				
Short-video social media exposure	0.45	0.03	12.10	< 0.001
Age	0.02	0.03	0.65	0.52
$R^2 = 0.21$				
$F = 75.09$				
Dependent Variable:	β	se	t	P
Upward social media appearance comparisons				
Short-video social media exposure	0.30	0.04	8.82	< 0.001
Capitalization of sexual attractiveness	0.49	0.04	14.44	< 0.001
Age	0.07	0.04	2.21	0.03
$R^2 = 0.47$				
$F = 173.76$				
Dependent Variable:	β	se	t	P
Appearance anxiety				
Short-video social media exposure	0.51	0.08	15.76	< 0.001
Capitalization of sexual attractiveness	0.12	0.10	3.37	< 0.001
Upward social media appearance comparisons	0.26	0.08	6.85	< 0.001
Age	-0.05	0.07	-1.69	0.09
$R^2 = 0.57$				
$F = 192.70$				

Table 4 Bootstrapped mediating effects analysis

Path	Mediating value	95% CI [LL, UL]	
Short-video Social Media Exposure → Capitalization of Sexual Attractiveness → Appearance Anxiety	0.05	0.02	0.09
Short-video Social Media Exposure → Upward Social Media Appearance Comparisons → Appearance Anxiety	0.08	0.04	0.12
Short-video Social Media Exposure → Capitalization of Sexual Attractiveness → Upward Social Media Appearance Comparisons → Appearance Anxiety	0.06	0.04	0.08

with greater appearance anxiety [18]. In the current era of digital information and self-media, the content of short-video social media emphasizes the importance of female figure and appearance, leading female youth to passively internalize the alienated aesthetic forms conveyed through various marketing strategies on short-video social media [9]. This heightened focus on appearance and the pursuit of unrealistic “ideal appearances” contribute to appearance anxiety [50]. Moreover, female youth frequently immerse themselves in these media messages; they are susceptible to feeling pressure to alter their appearances, which also appears appearance anxiety when comparing themselves to short-video social media standards [9, 39]. To alleviate this anxiety, some female youth even aspire to enhance their attractiveness through the purchase of expensive cosmetics, designer clothing, cosmetic surgeries, and weight loss products.

This study also found that short-video social media exposure can indirectly predict appearance anxiety among female youth through the mediating effects of capitalization of sexual attractiveness and upward social media appearance comparison. This finding extends previous research [3, 10]. On the one hand, short-video social media promotes film stars and network anchors

who have double eyelids, pointed chins, high nose bridges, an S-shaped curve, and an extremely thin body, emphasizing that these film stars and network anchor achieved popularity, fame, wealth, and social status effortlessly solely because of their attractive appearance [29, 30, 49]. This media propaganda leads female youth to believe that perfect body shape and attractive appearance are important capital for success, fostering the female youth’s desire to become “online celebrity beauties” [49]. Female youth associate their appearance with future success and wealth, becoming a significant source of risk for appearance anxiety among female youth [10].

On the other hand, female youth often immerse themselves in short video social media content, which features a large number of virtual beauties, internet celebrities, stars, and models to showcase appearance and body images [9]. This automatically appears upward social comparisons among female youth [35]. When female youth compare themselves to the virtual beauties, internet celebrities, stars, and models on short video social media and find themselves falling short in comparison, they experience appearance-related anxiety [35, 39].

The serial mediation of capitalization of sexual attractiveness and upward social media appearance

comparison is also supported. As the capitalization of sexual attractiveness increases, female youth pay more attention to their appearance [10]. This may be because female youth with a higher level of sexual attractiveness capitalization, driven by the idea that appearance leads to wealth, are more inclined to engage in self-monitoring and compare themselves with others in appearance [29, 49]. After female youth compare with the beauty standards of social media, they will have appearance anxiety if their appearance and physique do not meet the beauty standards promoted on short video social media [9, 25, 33]. In other words, female youth are often in the short-video social media environment that declares capitalization of sexual attractiveness and will be affected by the sexual attraction capitalization, having unrealistic appearance expectations and upward social media appearance comparison [9, 28, 49]. After upward social media appearance comparison, when the comparison results fail to meet the self-expectation, it is inevitably appearing in appearance anxiety [33, 39].

Implications

Firstly, previous research has explored the relationship between social media and body image based on the tripartite influence model. This study further demonstrates the positive predictive effect of short video social media exposure on appearance anxiety. Secondly, the sexual attractiveness capitalization in this study represents an internalization of cognition (internalization of the ideal beauty standard), which further enriches and expands the mediating mechanism variables proposed by the tripartite influence model of body image. Moreover, this study found that the serial mediation of capitalization of sexual attractiveness and upward social media appearance comparisons further enriches the serial mediation mechanism variables proposed by the tripartite model.

Thirdly, this study provides support for Lazarus's theory of emotion appraisal. It was found in this study that sexual attractiveness capitalization serves as a mediator between exposure to short video social media and appearance anxiety, validating the theory's proposition that emotions arise from individual cognitive appraisals of environmental stimuli. In other words, young women who frequently engage with social media environments evaluate the content within these environments in response to the stimuli they receive, triggering corresponding emotions. Finally, this study can also offer theoretical support for psychological interventions targeting appearance anxiety in young women. Psychological interventions for appearance anxiety in young women can be designed to consider aspects such as exposure to short video social media, sexual attractiveness capitalization, and upward appearance comparison.

Conclusion

This result revealed that short-video social media exposure not only directly predicts appearance anxiety in female youth, but also through the mediating roles of capitalization of sexual attractiveness and upward social media appearance comparison, as well as a serial mediation effect. This provides a theoretical foundation and practical guidance for preventing and intervening appearance anxiety among female youth and excessive short-video social media use. Moreover, the findings regarding capitalization of sexual attractiveness offer reference to understand the self-worth transformation of female youth and social values of female youth.

Limitations and future directions

All hypotheses of this study are supported. This study also has limitations. Firstly, the variables were measured using scales; this can't explore of longitudinal changes in the relationship between short-video social media exposure and capitalization of sexual attractiveness, upward social media appearance comparison, and appearance anxiety. Future research could employ an experimental method or longitudinal tracking method to investigate the relationship between short-video social media exposure and capitalization of sexual attractiveness, upward social media appearance comparison, and appearance anxiety among female youth from a longitudinal perspective. Secondly, this study focused on the group of female youth and did not consider females of other age groups. Future research could conduct comparative studies on appearance anxiety and social psychological mechanisms among females of different ages to yield more valuable conclusions. Thirdly, this study verifies the serial mediation of capitalization of sexual attractiveness and upward social media appearance comparison. However, value-driven mechanisms may also play a role in this mechanism. Future studies may consider incorporating value-driven mechanisms to further explore this model. Finally, this study measured exposure to short video social media using scales; however, future research could also employ experimental designs that present short videos to participants in order to assess their exposure to short video social media.

Abbreviations

AA	Appearance anxiety
COSA	Capitalization of sexual attractiveness
SVSME	Short-video social media exposure
USMAC	Upward social media appearance comparisons

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40359-025-02601-7>.

Supplementary Material 1

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Author contributions

Contributed to conception, design, acquisition of data and writing the article: Yu Tingrong. Contributed to conception, design, analysis and interpretation of data and writing the article: Zhang Gen. Approved the submitted version for publication: Yu Tingrong and Zhang Gen.

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Data availability

The data that support the findings of this study are available on request from the corresponding author.

Declarations

Ethics approval and consent to participate

The study was approved by the Life Science Ethics Committee of Yunnan Agricultural University (Number: APYNAU202403097). This study adhered to the ethical principles of the Life Science Ethics Committee of Yunnan Agricultural University, as well as the ethical principles of the Helsinki Declaration. Informed consent was obtained from all participants in this study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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