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Significant Domains of Life Satisfaction That Affect Suicidal Behavior in Adolescents

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Objectives: Adolescent suicide is a serious national issue in Korea. Recently, life satisfaction has been recognized as a major factor related to this issue. The main purpose of this study was to identify the domains of life satisfaction that affect suicidal behavior in adolescence.
Methods: Data were collected from eight middle schools in Incheon, Korea. A total of 1297 students answered questions regarding their demographic characteristics, happiness, self-related life satisfaction domains (appearance, leisure time, physical health, and mental health), depressive symptoms, and suicidal behavior.
Results: In the Spearman correlation analysis, female sex, perceived socioeconomic status (SES), happiness, and all four self-related satisfaction scores showed significant correlations with depression and suicidality. Multivariate regression analysis suggested that suicidality was significantly affected by perceived SES, satisfaction with appearance, mental health satisfaction, and depression. Finally, depression was identified as a partial mediator of the association between mental health satisfaction and suicidality, and a complete mediator of the association between female sex and suicidality.
Conclusion: Perceived SES, satisfaction with appearance, and mental health satisfaction significantly affected students' suicidality, with or without the effect of depression. Health authorities, educators, and family members must be aware of this to identify adolescents at suicide risk earlier.

Key Words: Suicide; Satisfaction; Physical appearance; Mental health; Depression; Adolescent.

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INTRODUCTION

Suicide awareness is a critical social issue in Korea. Korea's suicide rate was the fourth highest worldwide and the highest among the members of the Organization for Economic Co-operation and Development (OECD) in 2019 [1,2]. Although the suicide rate in Korea steadily declined from 31.0 to 24.3 per 100000 people from 2009 to 2017, this rate rose again by 2.3 per 100000 people in 2018 and by 0.3 per 100000 people in 2019. According to age-specific trends during this period, this increase was the highest among individuals in their teens and twenties. In teenagers, the suicide rate has not fallen significantly over the past decade [3]. This may indicate that interventions to prevent adolescent suicides have not been well established.

Given that adolescents are intrinsically immature and vulnerable to external stimuli, the psychological structures that lead to adolescent suicidality must be viewed differently from those of adults. Previous studies on adolescent suicides have included several suicidal risk factors. These include internal factors (e.g., depression, hopelessness, stress, self-esteem, and attitudes toward suicide) [4-6], interpersonal factors (e.g., school and family life) [7], and psychiatric factors (e.g., mood disorders and substance abuse) [8,9].

Research regarding life satisfaction has been ongoing since the late 20th century. More recently, research into the life satisfaction of adolescents has been considered important. Life satisfaction is a cognitive and subjective judgment of life, where both global satisfaction and domain life satisfaction must be considered [10]. Global life satisfaction refers to a comprehensive judgment of one's life. On the other hand, domain satisfaction refers to satisfaction with specific areas of one's life. These may vary but are commonly divided into income, work,

relationships, and self [11,12]. There has been a continuous effort to link global satisfaction and domain satisfaction with suicidal behavior. A significant association was reported between global life satisfaction, poor mental and physical health, and suicidal behavior [13]. In a Japanese study, life satisfaction was divided into home life, work, income, leisure, relationships, and residence to study the connection between the domain satisfaction of residence and adult suicide deaths [14]. A cross-sectional adolescent study in China included satisfaction with oneself, which was not significantly associated with suicidal ideation [15]. Another study conducted in Korea revealed that self-satisfaction significantly affected suicidal ideation among middle school students [6].

The primary goal of our study was to identify domain satisfaction specific to the "self" that significantly affected suicidal behavior. Additionally, we examined the mediation effect of depression on the association between these factors and suicidality. To our knowledge, this is the first adolescent study to investigate the significant domains of life satisfaction, especially those focused on the "self," that affect suicidal ideation, plan, or attempts.

METHODS

Participants

This study was a secondary analysis of an adolescent suicide survey that examined the mental health of adolescents, which included depression, life satisfaction, and suicidality, and their attitudes toward suicidal behavior. The original study sample included 1385 eighth-grade students from eight middle schools located in Jung-gu, Incheon [16]. Excluding 88 respondents, 1297 valid respondents were included in the analysis.

Procedure

The survey was conducted in September 2018. Homeroom teachers explained the details of the study to the students, who then completed a questionnaire distributed to them.

Measurement

We used a questionnaire that included questions related to demographic characteristics, happiness, life satisfaction, symptoms of depression, and suicidal behavior. Demographic characteristics included sex, number of family members, religious affiliation, perceived socioeconomic status (SES), and exercise.

Happiness and life satisfaction

Happiness was rated on a four-point Likert scale, from 1 (very happy) to 4 (not at all happy), in response to "How happy/unhappy do you think you are now?." Life satisfaction included four self-related domains (appearance, leisure time, physical health, and mental health): "How satisfied/or dissatisfied you are with your appearance?"; "Do you think you have/do not have enough leisure time?"; "How good/bad is your physical health?"; and "How good/bad is your mental health?." Appearance satisfaction and leisure time satisfaction were rated on a four-point Likert scale, from 1 (very satisfied) to 4 (not at all satisfied). Physical and mental health satisfaction were rated on a five-point Likert scale ranging from 1 (very good) to 5 (not at all good).

Center for Epidemiologic Studies Depression Scale-Revised (CESD-R)

The Center for Epidemiologic Studies Depression Scale (CESD), first developed by Radloff [17] and revised by Eaton et al. [18], was used to assess the severity of depression. Lee et al. [19] translated and standardized this scale into a Korean version. According to the optimal cut-off value suggested in the study, we classified those who scored less than 13 points as low risk and those who scored more than 13 points as high risk, while using depression as a binary variable [19].

Suicidal behavior

Questions related to suicidal behavior or suicidality were selected from the Korean version of the Composite International Diagnostic Interview (K-CIDI). CIDI, an international diagnostic tool for mental disorders, was standardized to a Korean version by Cho et al. [20]. Suicidality was defined as responding "yes" to the questions: "Have you ever seriously thought about committing suicide?"; "Have you ever made a plan to commit suicide?"; and "Have you ever attempted suicide?."

Statistical analysis

"Non-response/no idea" was converted to N/A and was automatically excluded from the analysis. Histogram and Shapiro-Wilk normality tests confirmed that the data did not have a normal distribution. All analyses were conducted using R Studio version 1.3.1073 (Delaware Public Benefit Corporation, Boston, MA, USA).

We used the Spearman correlation analysis to explore how and in what direction depression and suicidality are correlated with other characteristics of adolescents. Multivariate logistic regression analyses were conducted to determine the independent association of each variable with suicidal ideation, suicidal plans, and suicide attempts. The fit of the model was confirmed using the Chi-square test and maximum likelihood test. Since all variance inflation factor (VIF) values were below 2.5, multicollinearity among variables was ruled out. According to Belsley et al. [21], a VIF above 10 suggests multicollinearity.

Additionally, using the Baron and Kenny method [22], we

examined the mediation effect of depression on the associations found in the multivariate analyses. The Sobel test verified the significance of the mediation effect.

Ethical statement

The Institutional Review Board of Inha University Hospital (registration number: 2018-06-032) approved the study protocol and waiving of informed consent.

RESULTS

Characteristics of the study population

As presented in Table 1, 653 of the respondents (50.3%) were male and 598 (46.1%) were female. More than half (52.8%) the respondents lived with four family members including themselves, more than half (58%) had no religious affiliation, and most of them (78.3%) exercised regularly or irregularly. In the perceived SES domain, "middle" or "upper-middle" accounted for the largest percentage (65.3%) of respondents.

Among the respondents, 189 (14.6%) responded that they were unhappy, and 351 (26.9%) and 388 (29.9%) were not satisfied with their appearance or leisure time, respectively. In terms of physical and mental health satisfaction, 127 (9.8%) and 119 (9.2%) said that they were not satisfied. The mean score of Korean version of CESD-R (K-CESD-R), including all students, was 9.61 [standard deviation (SD) 14.11], and 337 (26%) were at high risk for depression, with a mean score of 28.63 (SD 12.63). Regarding suicidality, 353 (27.2%), 122 (9.4%), and 97 (7.5%) had suicidal ideation, suicidal plans, and suicidal attempts, respectively.

Correlation between the variables, depression, and suicidality

Regarding all the characteristics included in Table 1, a Spearman correlation analysis was performed to determine how the various factors correlated with depression and suicidality (Table 2). Female sex, less exercise, lower perceived SES, unhappiness, or lower satisfaction with oneself tended to expose adolescents to depression and suicidality. Depression and suicidality also had positive correlations with each other. The correlation between exercise and suicidality did not exist for suicidal plans or attempts. The number of family members or religious affiliations showed no significant correlation with suicidality.

In particular, the correlation between suicidal ideation and happiness, mental health satisfaction, and depression approached a moderate level. For suicidal plans or attempts, the strength of the correlation was found to be weaker than that of suicidal ideation.

Independent effect of variables on suicidality

Multivariate logistic regression analyses helped identify the significant factors that have a consistent effect on suicidal ideation, suicidal plans, and suicidal attempts (Table 3). Before the multivariate adjustment, most variables were significant, except for the number of family members and religious affiliation, which showed no correlation with suicidality.

However, after the multivariate adjustment, satisfaction with appearance, mental health satisfaction, and depression were independently significant for suicidal ideation and demonstrated similar results for suicidal plans or attempts. That is, low satisfaction with appearance [suicidal ideation: odds ratio (OR)=1.54, p<0.001; suicidal attempts: OR=1.46, p=0.047], low mental health satisfaction (suicidal ideation: OR=1.69, p<0.001; suicidal plans: OR=1.91, p<0.001; suicidal attempts: OR=1.59, p=0.005), or a high risk of depression (suicidal ideation: OR=2.79, p<0.001; suicidal plans: OR=2.80, p<0.001; suicidal attempts: OR=4.00 p<0.001) increased the risk of suicidality. Perceived SES was significant only for suicidal plans. Many of the factors that were significant before adjustment were no longer significant. Sex did not affect suicidality, and neither did happiness, satisfaction with leisure time, or physical health.

Mediation analyses

Each step of the mediation analyses for depression between the variables and suicidality is shown in Supplementary Table 1 (in the online-only Data Supplement). This implies that the mediation effect of depression existed only between sex or mental health satisfaction and suicidality (except between sex and suicidal plans). This was confirmed by the Sobel test (Supplementary Table 2 in the online-only Data Supplement).

Fig. 1 shows a summary of the mediation effect of depression on suicidality, as discussed above. The only factors mediated by depression were sex and mental health satisfaction. Sex was significant for depression (β_{Aa}=0.721, p<0.001), indicating that females were more likely to be depressed. Its effect on suicidal ideation (β_{Ac}=0.427, p<0.05) and suicide attempts (β_{Bc}=0.577, p<0.05) disappeared when depression was introduced into the model (suicidal ideation: $\beta_{Ac'}$=0.319, p=0.065; suicidal attempts: $\beta_{Bc'}$=0.398, p=0.163). Therefore, depression was a complete mediator of the effect of females on suicidal ideation or attempts. Mental health satisfaction was also a significant factor for depression (β_{Ca}=0.741, p<0.001). Its effect on suicidal ideation (β_{Cc}=0.639, p<0.001), suicidal plans (β_{Dc}=0.762, p<0.001), and suicidal attempts (β_{Ec}=0.607, p<0.001) decreased when depression was introduced into the model (suicidal ideation: $\beta_{Cc'}$=0.522, p<0.001; suicidal plans: $\beta_{Dc'}$=0.649, p<0.001; suicide attempts: $\beta_{Ec'}$=0.463, p<0.001). Accordingly, depression was a partial mediator of the effect of mental health satisfac-

Table 1. Characteristics of study population

Characteristics	Values
Sex	
Male	653 (50.3)
Female	598 (46.1)
Number of family members	
≤3	231 (17.8)
4	685 (52.8)
≥5	378 (29.1)
Religious affiliation	
No	752 (58.0)
Yes	535 (41.3)
Exercise	
Regular	367 (28.3)
Irregular	649 (50.0)
Never	280 (21.6)
Perceived socioeconomic status	
Upper	143 (11)
Upper-middle	351 (27.1)
Middle	496 (38.2)
Lower-middle	120 (9.3)
Lower	31 (2.4)
Happiness	
Very happy	427 (32.9)
Somewhat happy	637 (49.1)
Not very happy	161 (12.4)
Not at all happy	28 (2.2)
Appearance satisfaction	
Very satisfied	214 (16.5)
Somewhat satisfied	643 (49.6)
Not very satisfied	282 (21.7)
Not at all satisfied	69 (5.2)
Leisure time satisfaction	
Very satisfied	314 (24.2)
Somewhat satisfied	560 (43.2)
Not very satisfied	314 (24.2)
Not at all satisfied	74 (5.7)
Physical health satisfaction	
Very good	310 (23.9)
Somewhat good	492 (37.9)
Neutral	368 (28.4)
Not very good	113 (8.7)
Not at all good	14 (1.1)
Mental health satisfaction	
Very good	450 (34.7)
Somewhat good	437 (33.7)
Neutral	290 (22.4)
Not very good	92 (7.1)
Not at all good	27 (2.1)
Depression (K-CESD-R)	
Low risk (total score<13)	960 (74)
Mean (SD)	2.93 (3.45)
High risk (total score≥13)	337 (26)
Mean (SD)	28.63 (12.63)
Total mean (SD)	9.61 (14.11)
History of suicidal ideation	
No	912 (70.3)
Yes	353 (27.2)
History of suicidal plan	
No	1133 (87.4)
Yes	122 (9.4)
History of suicidal attempt	
No	1148 (88.5)
Yes	97 (7.5)

Values are presented as n (%) unless otherwise indicated. Students with "non-response/no idea" were not counted. K-CESD-R: Korean version of Center for Epidemiologic Studies Depression Scale-Revised (CESD-R), SD: standard deviation

Table 2. Spearman correlation analysis between variables and depression and suicidality

	DEP	SI	SP	SA
Sex	0.208‡	0.166‡	0.097†	0.101‡
FAM	-0.057	-0.061	0.003	-0.001
RELI	-0.070†	-0.013	-0.051	-0.032
EXE	0.125‡	0.098†	0.029	0.035
SES	0.215‡	0.169‡	0.154‡	0.098‡
HAP	0.393‡	0.313‡	0.215‡	0.181‡
AS	0.281‡	0.287‡	0.156‡	0.164‡
LTS	0.225‡	0.195‡	0.093*	0.044*
PHS	0.273‡	0.216‡	0.136‡	0.135‡
MHS	0.443‡	0.382‡	0.275‡	0.223‡
DEP	1.000	0.383‡	0.291‡	0.286‡

*p<0.05, †p<0.01, ‡p<0.001. AS: appearance satisfaction, DEP: depression, EXE: exercise, FAM: number of family members, HAP: happiness, LTS: leisure time satisfaction, MHS: mental health satisfaction, PHS: physical health satisfaction, RELI: religious affiliation, SA: suicidal attempt, SES: perceived socioeconomic status, SI: suicidal ideation, SP: suicidal plan

tion on suicidality.

DISCUSSION

According to this study, in addition to depression, various factors that constitute quality of life, such as happiness, perceived SES, and life satisfaction in the domains of appearance, leisure time, and physical and mental health, were significantly correlated with suicidal behavior. It is also worth noting that these are subjective indicators. Among these, perceived SES,

satisfaction with appearance, mental health satisfaction, and depression independently revealed significant effects on suicidal behavior in the multivariate regression analysis. In other words, a negatively perceived SES or a lower domain satisfaction serve as important risk factors for suicidality separately, even after considering the effect of depression, which is a well-

Table 3. Multivariate logistic regression assessing the effects of variables on suicidal ideation, suicidal plan, and suicidal attempt

	Suicidal ideation		Suicidal plan		Suicidal attempt	
	Crude	Adjusted	Crude	Adjusted	Crude	Adjusted
Sex	2.15‡ (1.61, 2.88)	1.38 (0.98, 1.93)	1.92† (1.22, 3.01)	1.26 (0.76, 2.09)	2.20† (1.33, 3.63)	1.49 (0.85, 2.61)
FAM	0.88 (0.76, 1.02)	0.93 (0.79, 1.09)	1.01 (0.81, 1.26)	1.10 (0.88, 1.38)	1.02 (0.80, 1.29)	1.13 (0.89, 1.43)
RELI	0.97 (0.73, 1.30)	1.12 (0.80, 1.55)	0.73 (0.47, 1.13)	0.74 (0.46, 1.19)	0.79 (0.49, 1.27)	0.87 (0.52, 1.46)
EXE	1.38‡ (1.12, 1.69)	0.94 (0.73, 1.21)	1.14 (0.84, 1.56)	0.81 (0.56, 1.17)	1.20 (0.85, 1.69)	0.80 (0.54, 1.19)
SES	1.56‡ (1.33, 1.84)	1.05 (0.87, 1.28)	1.89‡ (1.48, 2.41)	1.40* (1.07, 1.84)	1.62‡ (1.25, 2.11)	1.11 (0.83, 1.49)
HAP	2.91‡ (2.33, 3.64)	1.15 (0.86, 1.55)	2.64‡ (1.98, 3.54)	1.11 (0.73, 1.67)	2.54‡ (1.85, 3.47)	1.08 (0.69, 1.68)
AS	2.53‡ (2.06, 3.12)	1.54‡ (1.20, 1.98)	1.96‡ (1.48, 2.61)	1.15 (0.81, 1.62)	2.30‡ (1.69, 3.14)	1.46* (1.00, 2.12)
LTS	1.67‡ (1.41, 1.99)	1.12 (0.91, 1.39)	1.36* (1.05, 1.75)	0.83 (0.60, 1.14)	1.24 (0.93, 1.64)	0.71 (0.50, 1.01)
PHS	1.73‡ (1.48, 2.02)	0.98 (0.80, 1.22)	1.54‡ (1.23, 1.93)	0.85 (0.62, 1.15)	1.70‡ (1.33, 2.17)	1.01 (0.73, 1.39)
MHS	2.55‡ (2.17, 3.01)	1.69‡ (1.36, 2.09)	2.43‡ (1.97, 3.00)	1.91‡ (1.41, 2.59)	2.31‡ (1.84, 2.90)	1.59† (1.15, 2.20)
DEP	6.27‡ (4.55, 8.63)	2.79‡ (1.90, 4.08)	6.12‡ (3.87, 9.68)	2.80‡ (1.60, 4.93)	7.59‡ (4.54, 12.69)	4.00‡ (2.16, 7.40)
DF	959		948		943	
AIC	937.49		513.15		448.64	

Values are presented as odds ratio (95% confidence interval) unless otherwise indicated. *p<0.05, †p<0.01, ‡p<0.001. AIC: Akaike information criterion, AS: appearance satisfaction, DEP: depression, DF: degree of freedom, EXE: exercise, FAM: number of family members, HAP: happiness, LTS: leisure time satisfaction, MHS: mental health satisfaction, PHS: physical health satisfaction, RELI: religious affiliation, SES: perceived socioeconomic status

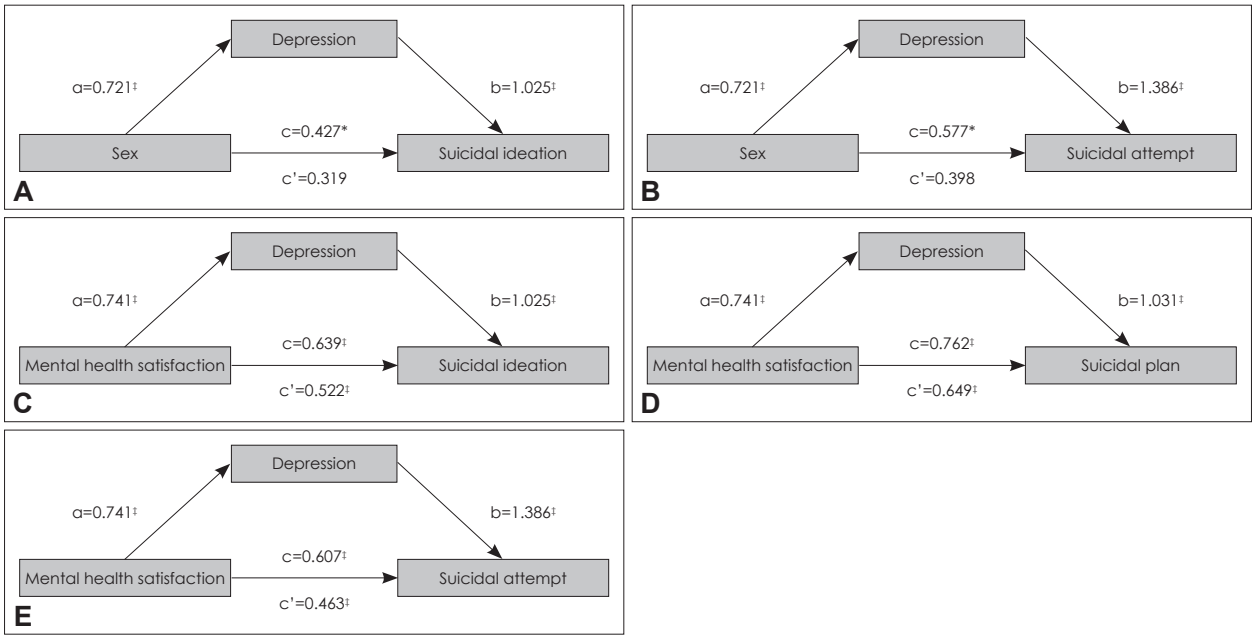

Fig. 1. Mediation model of independent variables, depression, and suicidal behavior. (A–E) Shows the significant results of mediation analysis of depression toward suicidal ideation, suicidal plan, and suicidal attempt. A: Depression mediates between sex and suicidal ideation. B: Depression mediates between sex and suicidal attempt. C: Depression mediates between mental health satisfaction and suicidal ideation. D: Depression mediates between mental health satisfaction and suicidal plan. E: Depression mediates between mental health satisfaction and suicidal attempt. Logistic regression coefficients are as follows: a=for the association of independent variable [which is shown significant both in step 1 and step 2 from Supplementary Table 1 (in the online-only Data Supplement)] with depression, b=for the association of depression with suicidality [from step 3 in Supplementary Table 1 (in the online-only Data Supplement)], c=for total effect [association of independent variable with suicidality, from step 2 in Supplementary Table 1 (in the online-only Data Supplement)], c'=for direct effect [association of independent variable with suicidality from step 3 in Supplementary Table 1 (in the online-only Data Supplement)]. Depression had no mediation effect between other independent variables and suicidality. *p<0.05, ‡p<0.001.

known critical risk factor for suicide [4,5,23,24]. On the other hand, there was a small difference in the regression results for suicidal plans. In adolescence, suicidal ideation or an attempt may not necessarily be accompanied by a suicidal plan because of their immature and impulsive nature.

In previous research, global life satisfaction scales, such as the Multidimensional Students' Life Satisfaction Scale [25] or the Satisfaction with Life Scale [10], were often used, rather than studying the effect of individual domain satisfaction. In contrast, this study investigated the effect of self-related domain satisfaction on suicidal behavior and the effect of depression as a mediator to help further clarify the internal and psychological structure of adolescents.

In terms of quality of life, a subjective assessment is more important than just objective figures related to economic conditions [26]. It is not uncommon for adults to attempt suicide out of pessimism regarding their SES. In this study, a negatively perceived SES also significantly affected adolescents' suicidal plans, which was not mediated by depression. This may be because they are under the emotional and cognitive influences of their parents.

A positive feeling regarding one's physical features or appearance establishes self-confidence and self-esteem in adolescence and enables a healthy mindset in adulthood. However, today's generation of adolescents is more likely to have a distorted perception of their appearance as they are exposed to media outlets that incite lookism. This experience makes them consciously and unconsciously evaluate their physical appearance against an unrealistic standard, which negatively affects their mental health. Dissatisfaction with one's appearance in adolescence can lead not only to depression, but also to suicidal ideation [23,27]. We confirmed that dissatisfaction with appearance contributed to suicidal ideation and suicide attempts, and this association was not mediated by depression.

Mental health satisfaction was the second most important factor affecting suicidal behavior. This effect was mediated by depression; however, it was also present without depression. The perception of mental health has previously been reported as a significant variable for suicidal ideation throughout adolescence. However, no analysis of suicidal plans or attempts has been made [5]. In comparison, physical health satisfaction was not a significant factor. In studies that did not distinguish between physical and mental health, results concerning the subjective assessment of overall health were inconsistent. Some studies have shown a significant effect on suicidal ideation or plans, but not on suicidal attempts [28], while others showed a significant effect on all suicidal behaviors [24].

Happiness has often been mentioned in relation to life satisfaction and mental health. It also showed a significant correlation with suicidal behavior in this study. Nevertheless, no significant impact was found on multivariate regression, and no mediating effects of depression were identified. This could mean that adolescents perceive happiness differently from mental health or that happiness interacts with various factors, including variables not investigated in this study. The ambiguity of happiness and the lack of standardized scales should also be considered.

Sex showed no significant results in the multivariate regression, unlike previous studies that reported female sex as a risk factor for suicidal behavior [6,15,23,24]. This was because depression completely mediated the association between sex and suicidal behavior. This means that female sex contributed to suicidal ideation and suicidal attempts only indirectly through depression.

The study limitations should be noted. First, we did not use a validated life satisfaction scale. Further studies using a validated multidimensional measure, such as the Youth Happiness Index [29], which includes several self-related domains, are needed. Second, only the eighth graders of a particular region participated, which limits generalization. Nevertheless, our results were in line with those of previous studies, which showed that life satisfaction was a significant factor for suicidality [5,6,13,15]. Third, since the psychiatric histories of the participants were not known, it was difficult to determine whether mental illnesses other than depression affected the study results. Fourth, the results did not reflect the type of school or subregional differences, possibly underestimating the effect of confounding factors. Fifth, the ambiguity of happiness is another limitation. Happiness is often described as subjective well-being. According to the OECD, subjective well-being is a good mental state, including all the various evaluations that people make of their lives and the affective reactions to their experiences [30]. However, it is highly likely that eighth graders rated happiness only as their temporary emotion in response to the question "How happy do you think you are now?." The insignificant result of happiness in the multivariate regression analysis may also support this finding. In future studies, participants should be presented with specific definitions of happiness. Finally, the evaluation of suicidal behavior was oversimplified by including lifetime suicidal behaviors and not excluding non-suicidal self-harm behaviors. Therefore, the association of the variables with suicidality may have been overestimated. Given that previous suicide-related behaviors themselves are important risk factors for suicide [9], our results have significant implications for predicting and preventing suicide risk.

CONCLUSION

This study proposes that life satisfaction or the subjective

assessment of the quality of life, significantly affects suicidal ideation, planning, and attempts. Among them, self-satisfaction with appearance and mental health has a critical impact on adolescent suicidality. Additionally, depression not only partially mediates the association between mental health satisfaction and suicidality, but also completely mediates the association between female sex and suicidality. Therefore, female adolescents require adequate consideration of their emotional sensitivity and early encouragement to obtain professional help for depression. Above all, the subjective assessments of appearance, mental health, and depression will assist in screening for the risk of suicidal behavior. Health authorities, educators, and family members require instruction on how to appreciate and respect adolescents' interests in their appearance and mental health and improve negative self-perceptions.

Supplementary Materials

The online-only Data Supplement is available with this article at https://doi.org/10.5765/jkacap.210004.

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Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Ji Soo Kim, Won-Hyoung Kim, Hyeyoung Kim. Data curation: all authors. Investigation: all authors. Project administration: Sang-Eun Lee, Chai Won Lee, Hyeyoung Kim. Supervision: Hyeyoung Kim. Validation: Won-Hyoung Kim, Jae-Nam Bae, Jeong Seop Lee, Hyeyoung Kim. Writing—original draft: Ji Soo Kim. Writing—review & editing: Hyeyoung Kim.

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Supplementary Table 1. Mediation analysis of depression between independent variables of the study and suicidality

X → Y	Variable		B	SE	OR (Exp B)	p
	Y	X				
Step 1	DEP	Sex	0.721	0.185	2.06	<0.001
		FAM	-0.045	0.087	0.96	0.603
		RELI	-0.293	0.178	0.75	0.100
		EXE	-0.049	0.139	0.95	0.725
		SES	0.096	0.106	1.1	0.362
		HAP	0.817	0.164	2.26	<0.001
		AS	0.168	0.136	1.18	0.218
		LTS	0.103	0.118	1.11	0.380
		PHS	0.191	0.116	1.21	0.098
		MHS	0.741	0.114	2.1	<0.001
Step 2_{SI}	SI	Sex	0.427	0.168	1.53	0.011
		FAM	-0.085	0.082	0.92	0.299
		RELI	0.055	0.164	1.06	0.737
		EXE	-0.074	0.128	0.93	0.563
		SES	0.074	0.097	1.08	0.445
		HAP	0.286	0.146	1.33	0.050
		AS	0.437	0.126	1.55	<0.001
		LTS	0.125	0.107	1.13	0.241
		PHS	0.026	0.107	1.03	0.804
		MHS	0.639	0.105	1.9	<0.001
Step 2_{SP}	SP	Sex	0.371	0.252	1.45	0.142
		FAM	0.083	0.114	1.09	0.469
		RELI	-0.332	0.239	0.72	0.167
		EXE	-0.203	0.184	0.82	0.270
		SES	0.364	0.139	1.44	0.009
		HAP	0.273	0.205	1.31	0.183
		AS	0.141	0.178	1.15	0.428
		LTS	-0.164	0.159	0.85	0.303
		PHS	-0.119	0.153	0.89	0.436
		MHS	0.762	0.149	2.14	<0.001
Step 2_{SA}	SA	Sex	0.577	0.277	1.78	0.037
		FAM	0.108	0.121	1.11	0.376
		RELI	-0.200	0.259	0.82	0.440
		EXE	-0.204	0.198	0.82	0.303
		SES	0.139	0.149	1.15	0.352
		HAP	0.286	0.223	1.33	0.200
		AS	0.399	0.192	1.49	0.037
		LTS	-0.297	0.175	0.74	0.089
		PHS	0.078	0.160	1.08	0.626
		MHS	0.607	0.157	1.83	<0.001
Step 3_{SI}	SI	Sex	0.319	0.173	1.38	0.065
		FAM	-0.076	0.083	0.93	0.358
		RELI	0.109	0.168	1.12	0.518
		EXE	-0.063	0.131	0.94	0.629
		SES	0.051	0.098	1.05	0.602
		HAP	0.142	0.151	1.15	0.347
		AS	0.429	0.128	1.54	<0.001
		LTS	0.114	0.109	1.12	0.294
		PHS	-0.016	0.109	0.98	0.886
		MHS	0.522	0.109	1.69	<0.001
		DEP	1.025	0.194	2.79	<0.001
Step 3_{SP}	SP	Sex	0.231	0.259	1.26	0.372
		FAM	0.095	0.114	1.1	0.402
		RELI	-0.299	0.242	0.74	0.217
		EXE	-0.211	0.188	0.81	0.261
		SES	0.336	0.139	1.4	0.016
		HAP	0.102	0.21	1.11	0.628
		AS	0.137	0.176	1.15	0.434
		LTS	-0.187	0.162	0.83	0.247
		PHS	-0.168	0.155	0.85	0.278
		MHS	0.649	0.154	1.91	<0.001
		DEP	1.031	0.287	2.8	<0.001
Step 3_{SA}	SA	Sex	0.398	0.286	1.49	0.163
		FAM	0.121	0.121	1.13	0.317
		RELI	-0.138	0.264	0.87	0.601
		EXE	-0.221	0.203	0.8	0.278
		SES	0.108	0.149	1.11	0.471
		HAP	0.075	0.228	1.08	0.743
		AS	0.377	0.189	1.46	0.047
		LTS	-0.34	0.179	0.71	0.058
		PHS	0.008	0.164	1.01	0.960
		MHS	0.463	0.165	1.59	0.005
		DEP	1.386	0.315	4	<0.001

Step 1: logistic regression for the effect of independent variables on depression (mediator). Step 2: logistic regression for the effect of independent variables on suicidality. Step 3: logistic regression for the effect of independent variables and depression on suicidality. AS: appearance satisfaction, B: coefficient, DEP: depression, EXE: exercise, FAM: number of family numbers, HAP: happiness, LTS: leisure time satisfaction, MHS: mental health satisfaction, OR: odds ratio, PHS: physical health satisfaction, RELI: religious affiliation, SA: suicidal attempt, SE: standardized error, SES: perceived socioeconomic status, SI: suicidal ideation, SP: suicidal plan

Supplementary Table 2. Significance test of the mediation effect

Mediation effect	A	B	SE_A	SE_B	Z	p
Sex → DEP → SI	0.721	1.025	0.185	0.194	3.136	0.002
MHS → DEP → SI	0.741	1.025	0.114	0.194	4.099	<0.001
MHS → DEP → SP	0.741	1.031	0.114	0.287	3.144	0.002
Sex → DEP → SA	0.721	1.386	0.185	0.315	2.917	0.004
MHS → DEP → SA	0.741	1.386	0.114	0.315	3.644	<0.001

The Sobel test was performed on the dataset shown in Supplementary Table 1. A=coefficient for the relationship between the independent variable and the mediator; B=coefficient for the relationship between the mediator and the dependent variable; SE_A=standard error of the relationship between the independent variable and the mediator; SE_B=standard error of the relationship between the mediator and the dependent variable. DEP: depression, MHS: mental health satisfaction, SA: suicidal attempt, SI: suicidal ideation, SP: suicidal plan