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The relationship between problematic mobile phone use and meaning in life among adolescents: a latent profile analyses

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Abstract

Purpose This study utilized Latent Profile Analysis to identify distinct profiles of meaning in life (MiL) among adolescents. Additionally, it aimed to investigate the relationships and specific impacts of sociodemographic variables and problematic mobile phone use on these identified profiles.

Methods A total of 989 adolescents participated in this study, completing the Meaning in Life Questionnaire, Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use, and sociodemographic questions. Latent Profile Analysis was used to differentiate between groups exhibiting distinct classes of meaning in life. Multinomial logistic regression analysis were employed to investigate the influence of various factors on these classes.

Results Latent profile analysis identified three distinct classes of meaning in life based on meaning in life questionnaire scores: low presence and search group (8.5%), high presence and search group (31.4%), and average presence and search group (60.1%). Multinomial logistic regression analysis revealed that problematic mobile phone use negatively affects latent classes of meaning in life among adolescents in the dimension of physical and psychological effects ($p < 0.05$). Furthermore, among sociodemographic variables, age, gender and left-behind experience and parents' marital relationship found to be influencing factors across the three latent classes ($p < 0.05$).

Discussion Our findings highlight significant heterogeneity in latent classes of meaning in life among adolescents. This underscores the need for tailored intervention plans based on their specific categorical characteristics. Addressing the influence of problematic mobile phone use and other relevant factors should be crucial considerations when promoting meaning in life development among adolescents.

Keywords Problematic mobile phone use, Meaning in life, Adolescents, Latent profile analysis

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Introduction

Meaning in Life (MiL) refers to a subjective experience encompassing an individual's self-perception, purpose, values, and understanding of life's significance. It is the individual's perception of life as having integrity, purpose, and significance [1]. It promotes enjoyment, satisfaction, and positive relationships, and is intimately tied to both physical and mental health [2]. Individuals with a higher sense of meaning in life generally experience greater happiness, health, and satisfaction and report stronger interpersonal relationships [3]. When facing challenges, meaning in life serves as a driving force, motivating individuals to overcome difficulties with positive emotions [4]. Research suggests that individuals with higher levels of meaning in life experience fewer stressors and negative thoughts [5]. The importance of finding meaning in life cannot be overstated, as it significantly impacts an individual's psychological well-being and acts as a protective factor against depression [6]. The presence of meaning in life can also assist individuals in enduring prolonged negative circumstances [7]. Therefore, examining the factors influencing meaning in life can deepen adolescents' understanding and provide scientific guidance for their experience and pursuit of meaning.

With the development of the internet and the rise of mobile phone, these devices have become an indispensable part of our lives, offering convenience through their diverse functionalities and serving as the primary communication medium in contemporary society [8]. However, while mobile phone bring convenience, they also bring potential risks that people will develop problematic mobile phone use through long-term overuse. Problematic mobile phone use, characterized by an inability to control phone usage despite negative consequences, is considered an impulse control disorder. It manifests as excessive and inappropriate phone use, leading to detrimental impacts on physical, psychological, and social well-being [9]. Studies have linked problematic mobile phone use to various health issues, including headaches, blurred vision, memory loss, hearing problems [10], psychological issues (anxiety and depression) [11], and sleep disturbances [12]. Problematic mobile phone use has become a major concern in recent years, with a large proportion of adolescents in China [13] and young people worldwide experiencing increasing rates of addiction [14–16].

Compared to adults, adolescents are more susceptible to developing problematic mobile phone use due to their ongoing physical and psychological development, which limits their ability to regulate emotions and manage behaviors effectively [17, 18]. Additionally, the pressure to prioritize academic performance often leads adolescents to voluntarily or involuntarily abandon extracurricular activities. Because of its simplicity and speed, the

mobile phone has become the main form of entertainment for teenagers in their odd break times. This not only coincides with a critical stage of rapid psychological and cognitive development, further increasing their vulnerability to problematic mobile phone use compared to other age groups [19]. Therefore, to ensure the healthy development of adolescents, it is crucial to conduct research on the physical and psychological effects of problematic mobile phone use in this population and raise awareness among them about the potential harms associated with problematic mobile phone use.

According to self-determination theory, an individual's psychological well-being is intricately linked to the fulfillment of their basic psychological needs: autonomy, competence, and belonging [20]. Factors such as problematic mobile phone use can undermine an individual's sense of meaning in life by eroding their autonomy (i.e., over-reliance on external stimuli and instant gratification), decreasing competence (reducing real-life fulfillment), and diminishing a sense of belonging (preventing face-to-face interpersonal interactions). Previous studies have linked problematic mobile phone use with a lack of meaning in life, suggesting that people with higher rates of problematic mobile phone use may have a lower meaning in life [21–23]. Of the two dimensions of meaning in life, the search for meaning dimension was found to be negatively correlated with problematic mobile phone use [24]. However, most of the above studies have focused on the adult population, and have not focused on the relationship between the meaning of life and problematic mobile phone use in the adolescent population. Compared to adults, adolescents are more susceptible to negative influences because of their immaturity, and such negative influences are more damaging to adolescents than to adults in terms of time duration and degree of destruction [25]. The search for meaning and presence of meaning dimensions can help us to better explore the specific manifestations of meaning in an individual's life. Focusing on problematic mobile phone use in adolescents may offer a new perspective for understanding the underlying factors affecting their meaning in life. Adolescents, compared to adults, are at a stage of development where they are highly susceptible to the impact of digital environments on their self-concept and life purpose. Excessive mobile phone use can interfere with important developmental tasks such as forming self-identity, establishing meaningful relationships, and engaging in purposeful activities. This disruption may contribute to a diminished sense of meaning in life. By examining the relationship between mobile phone use and meaning in life, we can better understand how excessive screen time affects adolescents' ability to find purpose and significance in their lives. Furthermore, this focus can provide insights into potential intervention strategies, such

as promoting balanced digital consumption, fostering offline social connections, and encouraging activities that enhance self-reflection and personal growth. These strategies can help adolescents reclaim a sense of meaning in life, which is crucial for their psychological well-being.

In addition, the level of meaning in life is also influenced by factors such as the family environment, and factors such as experiences, values and expectations in an individual's family of family of origin all play an important role in the process of forming an individual's sense of meaning in life [26]. A good parental relationship not only helps children form a positive self-identity, but also stimulates their passion for life and desire to explore [27]. The left-behind experience is a factor that requires additional attention when exploring the impact of relevant factors such as family environment on the meaning in life. Since the 1880s, China has undergone rapid industrialization and urbanization. Changes in the pattern of resource distribution and redistribution in the process of urbanization have created new opportunities and challenges for individuals, leading to large-scale rural-urban migration and migration from the central and western parts of the country to the eastern part of the country, as well as large-scale migratory flows [28]. The left-behind experience was defined as a parent-child separation for at least 6 months [29]. There are two types of left-behind experiences. One is when a child lives with one parent (usually the mother) and the other parent goes to work in the field (one parent leaves). The other is when the child lives with grandparents or other relatives and both parents go to the field (both parents leave) [30]. Many children face prolonged periods without one or both parents due to labor migration, during which they are often cared for by relatives or placed in residential schools. This situation frequently forces these children to cope with life and academic challenges largely on their own, which poses a significant hardship for young individuals still in the process of physical and psychological development. The prolonged absence of parental figures can potentially lead to a lack of guidance and support, potentially contributing to negative outcomes such as depression and suicidal ideation [31, 32]. The importance of exploring the impact of factors such as the family environment on the meaning of life cannot be overlooked. These factors have the potential to collectively influence the meaning of an individual's life, and an in-depth understanding of how these factors shape an individual's sense of purpose and fulfillment in life is critical to fostering mental resilience, promoting psychological well-being, and ensuring that everyone has the opportunity to live life to the fullest. By recognizing the importance of the family environment and other relevant factors, we can develop more targeted interventions and policies that deepen our understanding of the factors that shape an individual's meaning in life.

Prior research has employed meaning-in-life questionnaires to categorize individuals into distinct groups based on their total score, resulting in high-, medium-, and low-scoring categories. This approach, which adopts a variable-centered perspective, overlooks the unique differences between individuals within each group [33]. Latent Profile Analysis (LPA) overcomes this limitation by employing an individual-centered approach. LPA utilizes data and probability models to identify potential classifications for each individual, and subsequently groups them into distinct latent classes [34]. This method effectively captures the heterogeneity within the population, offering a more nuanced understanding of the meaning in life. Furthermore, LPA employs specific fitting indicators and standards that differentiate it from traditional classification methods, ultimately yielding more accurate and objective results [35].

The process of creating meaning in life can be interpreted as a relationship between the perception of a life full of meaning (the presence of meaning) and the perception of an active search for a sense of meaning (the search for meaning) [2]. The measurement of these two dimensions facilitates a comprehensive evaluation of an individual's sense of meaning in life. Notably, the quest for meaning is particularly pronounced during the early stages of development. The search may be a natural part of the development of identity and worldview in adolescents and young adults [36]. One study found a significant negative correlation between searching for meaning and depression [37, 38]. In the person-centered research approach to meaning in life, by differentiating between individuals in terms of the presence of meaning and the search for meaning dimensions, this study identified individuals with different traits. In LPA, the person-centered approach not only emphasizes the centrality of the individual in the exploration of meaning in life, but also demonstrates its unique strengths in examining how the two dimensions of meaning in life, which often include a sense of purpose and belonging, among others, intersect and are embodied within the individual. This approach allows the researcher to explore deeply within the individual to understand and reveal the diversity and complexity of meaning in life. Through careful analysis, the researcher is able to gain insight into the most common and the rarest configurational patterns of meaning in life within the study group. These configurations not only reflect the unique paths taken by different individuals in their quest for meaning in life, but also reveal how social, cultural, and personal experiences work together in this process. It can not only accurately portray the quantitative differences between individuals, but also summarize the multi-dimensional qualitative differences between individuals, which helps to explore the characteristics and heterogeneity of different categories of people, and

achieve accurate identification of key populations [39]. An overview of the construction of meaning in life in a person-centered context can be summarized in different profiles [40]. For example, In previous studies, they referred to people who exhibited high presence and low search as *presence style*, *foreclosure profile* and *fulfilled profile* [41–43]. Groups characterized by low presence and high search are known as *moratorium* and *searchers* [42, 43]. Clusters that balance the two dimensions are called *presence and search style*, *high presence* and *search and achievement* [41, 42, 44].

Adolescence is a critical period for young people to develop self-awareness and establish positive behaviors. This study employed latent profile analysis, a person-centered approach, to investigate variations in latent classes of meaning in life among adolescents and their corresponding characteristics, providing new perspectives for a deeper understanding of the diversity and complexity of meaning in life. Based on the accumulation of previous studies, this study aims to further explore the diversity of life meaning through latent profile analysis (LPA). We expect to be able to identify at least three categories of meaning in life groups that exhibit different combinatorial patterns on the two key dimensions of presence of meaning and search for meaning, thus providing us with a more nuanced perspective on the categorization of meaning in life. At the same time, we hypothesize that these meaning in life categories will be influenced by multiple factors, particularly factors such as problematic mobile phone use and family environment, which may shape, to varying degrees, the unique paths and heterogeneity of individuals in the process of seeking meaning in life.

Methods

Participants and procedure

Between June and July 2023, 1,063 adolescents from Shandong Province, China, were recruited as participants using a convenience cluster sampling method. Include middle school students as adolescent participants who do not have mobile phone restrictions. (Students in residential schools are usually far away from home, and parents choose to let their children carry mobile phones to keep in touch with them so that they can easily know the status of their children. At the same time, mobile phones provide a wealth of learning resources and tools, such as online dictionaries and learning apps, which can help student study online). Participants who completed the questionnaire in less than 2 min or responded inaccurately (an exclusion item “Do not select this option” was used to screen out random questionnaires) to an instructed item were excluded. After removing invalid responses, the final sample comprised 989 adolescents (353 males, 35.7%; 636 females, 64.3%) aged 14–18 years (Mean = 16.1, SD = 0.8). See Table 1 for further details. The effective response rate was 93%. The online survey was administered through “Questionnaire Star” (www.wjx.cn), a popular data collection platform in China. QR codes and online questionnaire links were distributed via the social media platform WeChat.

Sociodemographic variables

The questionnaire collected sociodemographic information through seven questions: gender, only child status, residence type (urban/rural), family economic status.

The left-behind experience

The left-behind experience was defined as a parent-child separation for minimum duration of six months [29].

Table 1 Sociodemographic Information of the participants (N = 989)

| Characteristics | | σ/n(%) |
|---|--------------------------------------|------------|
| Age | | 16.1 ± 0.8 |
| Sex | Male | 353(35.7%) |
| | Female | 636(64.3%) |
| Only-child status | Yes | 83(8.4%) |
| | No | 906(91.6%) |
| Residential area | Rural | 719(72.7%) |
| | Urban | 270(27.3%) |
| Left-behind experience | Left-behind experience | 166(16.8%) |
| | No left-behind experience | 823(83.2%) |
| Perceived family income | High | 14(1.4%) |
| | Medium | 899(90.9%) |
| | Low | 76(7.7%) |
| Relationship with parents | Discordant parent-child relationship | 58(5.9%) |
| | Harmonious parent-child relationship | 931(94.1%) |
| The marital relationship of the parents | Discordant parental relationship | 12(1.2.3%) |
| | Harmonious parental relationship | 867(87.7%) |

Participants were asked to indicate whether they had encountered any of the following scenarios: (1) One or both parents were absent for more than six months, or (2) My parents were consistently present, and if they were away, it was for less than six months.

Relationship with parents

Participants were asked to respond to a single item, “How do I feel about the time I spend with my parents?” This item was used to assess adolescents’ perceptions of their relationships with their parents [45]. Adolescents selected their responses based on their actual feelings, with options indicating: (1) a discordant relationship with parents, or (2) a harmonious relationship with parents.

Parents’ marital relationship

One study assessed the marital relationship of respondents’ parents by asking, “I am satisfied with my marriage” [46]. In our study, adolescents evaluated their parents’ marital relationship using the item: “In my opinion, my parents’ marital relationship is: 1) discordant, 2) harmonious.”

Meaning in life

Steger designed the Meaning in Life Questionnaire (MLQ) to assess participants’ sense of meaning in life [2]. The Chinese version of the Meaning in Life Questionnaire, which was translated and produced by Wang, was used in this study [47]. This 10-item scale includes a reverse-scored item: “I do not have a clear goal in life” (The statistics were positively processed accordingly). The MLQ measures two dimensions: the presence of meaning and the search for meaning. McDonald’s omega for the presence of meaning dimension and the search for meaning dimension were 0.843 and 0.934, respectively. The presence of meaning reflects an individual’s perception of their life having meaning, while the search for meaning focuses on their motivation to actively pursue meaning. Participants rated their agreement with each statement on a 7-point Likert scale (1 = completely disagree, 7 = completely agree), with higher scores indicating a greater sense of meaning in life.

Problematic mobile phone use

The Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use (SQAPMPU) is a valuable tool for assessing problematic mobile phone use among students [48]. The questionnaire measures three core dimensions: withdrawal symptoms, craving, and physical and psychological effects. The McDonald’s omega in the three dimensions were 0.901, 0.749 and 0.863. Withdrawal symptoms and craving capture the fundamental psychological changes associated with problematic mobile phone use, while physical and psychological

effects highlight the consequences of addiction on overall well-being. Higher scores indicate a greater impact, with responses rated on a 5-point Likert scale (1 = never, 5 = always). Scores closer to the higher end signify a greater likelihood of problematic mobile phone use.

Statistical analysis

To identify latent classes of meaning in life among adolescents, we selected the presence of meaning dimension and the search for meaning dimension scores in the Meaning in Life Questionnaire as indicators of Latent Profile Analyses. Mplus 8.3 software was used to analyze the data. We began with a one-class model and progressively increased the number of classes. Model fit was evaluated using various indicators: Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted BIC (aBIC), entropy, Lo-Mendell-Rubin likelihood ratio test (LMR), and Bootstrap likelihood ratio test (BLRT). Lower AIC, BIC, and aBIC values indicate better model fit. Entropy ranges from 0 to 1 [49], when the entropy value is greater than 0.8 it means that the classification results have good accuracy [50]. LMR and BLRT serve as comparison tests between the two models. A significant p-value indicates that the K-class model has a better fit than the K-1 class model [51]. By integrating these indicators alongside model interpretability and simplicity, the optimal classification model was established.

Given the nature of our sampling procedure, where participants were recruited using a cluster sampling approach, we accounted for the potential design effect by using complex sample analysis in Mplus.

Following the identification of latent classes, statistical analysis was performed using Mplus. Therefore, we used latent class of meaning in life as the dependent variable in a multinomial logistic regression model to explore the effects of problematic mobile phone use and other factors on potential class membership of meaning in life among adolescents.

Results

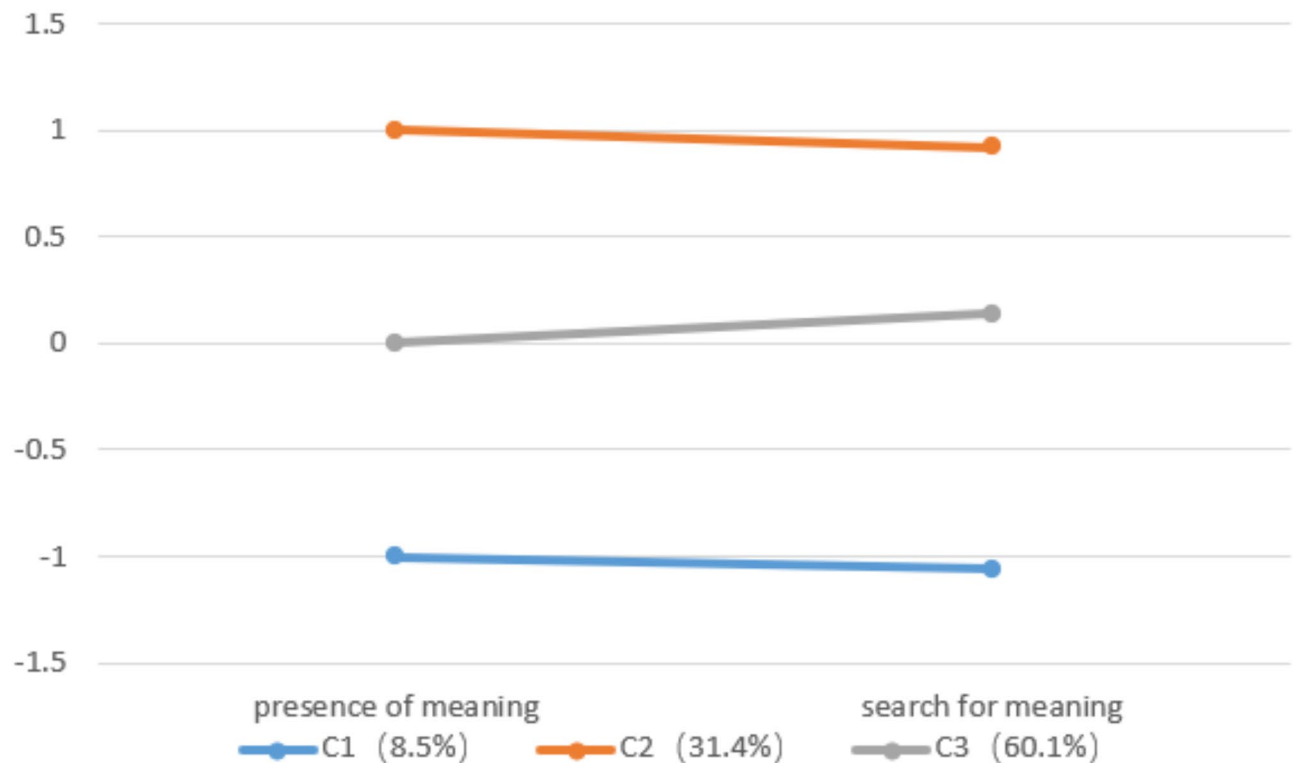
LPA results of meaning in life among adolescents

Latent profile analysis was conducted to explore latent classes of meaning in life among adolescents. Scores from the two dimensions of the meaning in life scale served as indicators, and models with 1 to 5 latent classes were fitted sequentially. Model fit indices are presented in Table 2.

Results showed that AIC, BIC, and aBIC values generally decreased across models with increasing class numbers (1 to 5). LMRT and BLRT indicated statistically significant improvements in model fit for all models compared to the previous model with fewer classes. Additionally, this downward trend leveled off in the 3-class.

Table 2 Indicators of fit for the Latent Profile Analysis

| | AIC | BIC | aBIC | Entropy | LMRT(<i>p</i>) | BLRT(<i>p</i>) | Class Probability |
|---|----------|----------|----------|---------|------------------|------------------|-------------------------------|
| 1 | 6726.411 | 6745.997 | 6733.293 | | | | 1 |
| 2 | 6292.896 | 6327.173 | 6304.94 | 0.702 | < 0.001 | < 0.001 | 0.595/0.405 |
| 3 | 5741.405 | 5790.372 | 5758.611 | 0.879 | < 0.001 | < 0.001 | 0.085/0.314/0.601 |
| 4 | 5673.94 | 5737.597 | 5696.309 | 0.912 | < 0.001 | < 0.001 | 0.59/0.087/0.012/0.311 |
| 5 | 5577.91 | 5656.257 | 5605.44 | 0.826 | < 0.001 | < 0.001 | 0.079/0.417/0.273/0.014/0.218 |

**Fig. 1** The participants' scores in each item of meaning in life. **Note:** Class 1 = low presence and search group; Class 2 = high presence and search group; Class 3 = average presence and search group

Extremely low sample sizes in individual categories occur in the 4- and 5-classes. Considering the balance between accuracy, simplicity, and interpretability, the 3-class model was selected as the optimal solution.

To better understand the characteristics of the three latent classes, we plotted the z-scores of the two dimensions (see Fig. 1). C1 had the lowest mean score of around 10 in both dimensions and showed a low level of MIL, naming it low presence and search group, accounting for 8.5% of the total. C2 has the highest mean score in both dimensions and shows a high level of MIL, which is named as high presence and search group. C3 has a medium mean score in both dimensions and is named as average presence and search group.

Analysis of influencing factors related to meaning in life among adolescents

To investigate the potential interaction between problematic mobile phone use and latent classes of meaning in

life, multinomial logistic regression model was employed. The model included the SQAPMPU dimensions and sociodemographic variables as predictors, the three latent classes (low presence and search group high presence and search group, and average presence and search group) as outcome variables, with high presence and search group serving as the reference group. After adjusting for the cluster sampling design effect, the results of the multinomial logistic regression analysis are presented in Table 3. The table reports the estimated coefficients, odds ratios (OR), and 95% confidence intervals (CI) for the associations between the independent variables and the three categories of the dependent variable.

In the comparison between low presence and search group and high presence and search group, the probability of belonging to the low presence and search group increased with higher scores on the physical and psychological effects dimension ($OR=1.240$). Similarly, for average presence and search group compared to high

Table 3 Multinomial logistic regressions for exploring the influences of three profile latent classes

| | | | Class 1 VS Class 2 | | | Class 3 VS Class 2 | | |
|--|---|--|--------------------|---------|-------------|--------------------|---------|-------------|
| | | | β | OR | 95%CI | β | OR | 95%CI |
| Physical and psychological effects dimension | | | 0.284 | 1.240** | 1.060–1.450 | 0.166 | 1.178* | 1.073–1.300 |
| Age | | | 0.171 | 1.718* | 1.259–2.343 | 0.175 | 1.1941* | 0.993–1.436 |
| Gender | Male | | 0.160 | 0.515** | 1.146–3.271 | -0.151 | 0.860 | 0.632–1.170 |
| | Female (refer) | | | | | | | |
| Left-behind experience | Left-behind experience | | 0.706 | 0.509* | 0.995–3.875 | 0.376 | 1.456 | 0.934–2.271 |
| | No left-behind experience (refer) | | | | | | | |
| Parents' marital relationship | Harmonious parental relationship | | 0.041 | 1.042 | 0.352–2.591 | -0.703 | 0.495* | 1.124–3.637 |
| | Discordant parental relationship(refer) | | | | | | | |

Note: * $p < 0.05$, ** $p < 0.001$

Abbreviations: β , Standardized regression coefficient, OR, Odds ratio; 95% CI, 95% Confidence Interval

presence and search group, the probability of belonging to the high presence and search group increased by 1.178 times for every one-unit increase in the score on the physical and psychological effects dimension ($OR = 1.178$). In the comparison between low presence and search group and high presence and search group, the likelihood of belonging to low presence and search group increased with age ($OR = 1.718$). Furthermore, male adolescents were 0.515 times more likely to in low presence and search group than females ($OR = 0.515$), and adolescents with left-behind experience were 0.509 times more likely to be in low presence and search group compared to those without such experience ($OR = 0.05$). In the comparison between high presence and search group and average presence and search group, the likelihood of belonging to high presence and search group increase with age ($OR = 1.194$). In addition, the probability of having a harmonious parental relationship attributed to average presence and search group is lower than high presence and search group ($OR = 0.495$).

Discussion

Latent classes of meaning in life among adolescents exhibit heterogeneity

This study employed latent profile analysis to identify three latent classes of meaning in life among adolescents based on questionnaire scores: low presence and search group, high presence and search group, and average presence and search group.

The high presence and search group, comprising 31.4% of the sample, demonstrated a strong sense of meaning in life. Some studies have named this grouping “meaning achievement” and “high presence and search” [42, 44]. Young people may have a certain understanding of their life but continue extending their understanding and work hard to reach their identified meaningful goals [52]. Research suggests that individuals with higher meaning in life tend to be more optimistic, experience greater happiness [53, 54], exhibit better psychological health [55]. They display stronger self-control, enabling them to avoid

inappropriate behavior [56], and cope with stress more effectively [57]. Encouragingly, this study found a substantial proportion of adolescents belonging to the high MiL group. While maintaining meaning-in-life education, it is crucial to further strengthen their life and world views, potentially fostering an even deeper sense of meaning in life. For this group, activities such as philosophical discussions and life-planning seminars are conducted to deepen their thinking about the meaning of life.

The low presence and search group exhibited a low overall sense of meaning in life. Although this group represents the smallest proportion of the sample (8.5%), it deserves attention. Research suggests that meaning in life significantly impacts physical and mental health, acting as a protective factor against negative outcomes like depression and suicide [58, 59]. Therefore, it is crucial to provide this group with additional support through tailored interventions, such as narrative therapy, purpose-focused workshops, or peer support programs, to enhance their sense of meaning in life and promote their healthy development.

The average presence and search group (C3) constituted the largest portion of the sample (60.1%). Compared to the other two groups, this group exhibited a moderate and stable level of meaning in life. Guidance for this group needs to be given attention by adopting measures such as guiding their thinking about the meaning in life and strengthening their quest for meaning through mental health presentations and achievement sharing sessions.

In summary, our latent profile analysis identified three distinct classes of adolescents based on their meaning in life. These classes likely experienced varying degrees of challenges and required different levels of support. This finding holds valuable implications for informing interventions and programs aimed at improving adolescents' physical and mental well-being.

Problematic mobile phone use negatively association meaning in life among adolescents

This study confirmed a negative correlation between problematic mobile phone use and meaning in life, aligning with previous research [23, 60]. Notably, the study examined the influence of specific dimensions within the SQAPMPU scale and revealed that the physical and psychological effects dimension exhibited the strongest negative association with meaning in life. In other words, negative associations of the meaning of life from problematic mobile phone use were made through the pathway of physical and psychological impact dimensions, adolescents experiencing greater negative physical and psychological consequences from mobile phone use tend to report lower meaning in life.

Research has shown a significant negative correlation between meaning in life and negative emotions [61–63], while also demonstrating a positive correlation with individual psychological health [64]. Adolescents, navigating a critical stage in life, face various challenges, including academic and social pressures. Problematic mobile phone use shares characteristics with other behavioral addictions (e.g., Internet addiction, gambling addiction) and often serves as a way for individuals to escape from real-life challenges. According to Escapism Theory, individuals who are faced with emotional distress, stress, or uncertainty are more likely to engage in addictive behaviors as a form of avoidance [65]. This avoidance behavior may lead to a diminished meaning of life because the individual is not directly coping with and resolving real problems and thus lacks a deep connection to his or her life goals, values, and relationships. This often leaves them with limited free time for leisure activities. When they develop problematic mobile phone use, they lose control over their mobile phone use [66], leading to potential physical and psychological harm [67]. Furthermore, problematic mobile phone use is linked to increased negative emotions [68–70]. Consequently, this combination can significantly impact an individual's sense of purpose and fulfillment in life by disrupting the individual's emotional regulation, goal-setting processes, and self-concept. Specifically, adolescents engaging in problematic mobile phone use are often avoiding direct engagement with real-life challenges (such as academic pressures or social issues), leading to a reduced ability to cope with stress and emotional discomfort. As a result, they may experience a lack of emotional regulation and a diminished sense of control over their lives. This avoidance behavior, as suggested by Escapism Theory, prevents the development of a deeper connection to their life goals, values, and relationships, thereby weakening their sense of purpose. Additionally, excessive mobile phone use may contribute to disrupted sleep patterns, decreased physical activity, and social isolation, all of which further

exacerbate negative emotions and hinder the ability to engage in meaningful activities. These mechanisms together can contribute to a pervasive sense of emptiness and a lower overall sense of fulfillment in life. The findings of this study have important implications for understanding the relationship between adolescent problematic mobile phone use and meaning in life, firstly, it helps us to have a deeper understanding of the intrinsic connection between adolescent problematic mobile phone use and meaning in life. Second, this finding has implications for related research and policy. For example, unlike previous studies, this study explored the impact of the subordinate dimensions of problematic mobile phone use on meaning in life and found a significant negative correlation with meaning of life through the physical and mental health dimensions, based on which this study can provide ideas for strategies to enhance the meaning in life of adolescents as well as the mechanisms by which problematic mobile phone use affects the meaning of life.

Sociodemographic variables affecting meaning in life among adolescents

Age emerged as a significant factor associated with belonging to low presence and search group. This finding may be related to the specific age range of the study sample, as adolescents often face unique academic and social pressures compared to older adults and due to the immaturity of adolescents at the thinking, cognitive and emotional levels, they are unable to cope properly with setbacks, which in turn affects their level of meaning in life.

In previous studies, the presence of low presence and search groups were found in male samples [44]. Interestingly, this study found that males were more likely to belong to low presence and search group compared to females. This also validates the findings in previous research suggests that women may experience higher levels of meaning in life [71]. However, it is important to acknowledge that the influence of gender on meaning in life remains inconclusive and warrants further investigation.

The left-behind experience emerged as a negative predictor of meaning in life within the latent class analysis. This finding aligns with the recognized challenges faced by left-behind children in China, where the issue is particularly prevalent [72]. As a special group in society, adolescents with left-behind experience are particularly important in exploring and constructing the meaning of their lives. We should pay attention to the physical and mental development of adolescents with left-behind experiences and give them the necessary care. It is especially important to strengthen communication between parents and adolescents at the family level. Through phone calls and videos and other forms of concern for

adolescents' lives, so that adolescents feel the warmth of the family. A care mechanism for left-behind adolescents should be set up in schools, including psychological counseling and life tutoring, to help them solve the difficulties they encounter in life and study. Society should strengthen its policy of care for left-behind adolescents and provide them with more assistance.

This study found a positive association between parental marital relationship and latent classes for meaning in life. Research has shown that parental marital relationships and adolescent relationships are interdependent and closely related to adolescent psychological functioning [73, 74]. Based on the family system, the marital relationship is the basis for the quality of family life and the psychological functioning of all family members [75]. However, destructive marital relationships, such as those marked by conflict and discord, may prevent parents from providing their adolescents with a warm and safe home environment in which to develop a sense of emotional security, which may increase their risk of psychological maladjustment [73], which in turn affects the adolescent's level of meaning in life.

The results should be interpreted in the context of Chinese culture, where family harmony and academic achievement are highly valued. These cultural priorities might amplify the negative perception of problematic mobile phone use and the protective effect of parental harmony on adolescents' meaning in life. Cross-cultural studies could further explore how different cultural norms and values moderate these relationships. The perception and pursuit of meaning in life are shaped by cultural factors. In collectivist cultures, meaning is often derived from interpersonal connections and fulfilling familial or societal roles, whereas in individualist cultures, personal goals and self-realization may take precedence. These cultural differences could influence how adolescents respond to challenges and seek meaning in life.

Limitations and future directions

This study has limitations that should be acknowledged. Firstly, our focus on adolescents warrants caution when generalizing the findings to other age groups. Future research should explore the MiL characteristics and potential harms of problematic mobile phone use across diverse populations. Secondly, this study used a cross-sectional design, which prevented us from making any cause-and-effect conclusions. Therefore, longitudinal studies should be designed to validate the findings. Finally, our findings were obtained from adolescents aged 14–18 in residential middle school, and whether the results are applicable to other populations require further testing. Future research should explore the MiL characteristics and potential harms of problematic mobile

phone use across diverse populations, particularly among those subject to mobile phone restrictions.

Conclusion

This study identified three distinct latent classes of meaning in life among adolescents as follows: low presence and search group (8.5%), high presence and search group (31.4%), and average presence and search group (60.1%). Using latent profile analysis, the study explored the characteristics of each class and identified factors influencing adolescents' meaning in life. These findings contribute to a deeper understanding of meaning in life among this population and provide valuable insights for educators, parents, and youth health professionals. The study revealed negative association of problematic mobile phone use on meaning in life, with adolescents struggling with addiction demonstrating lower levels of meaning. This finding adds to the growing body of evidence highlighting the detrimental impacts of problematic mobile phone use. When adolescents experience low meaning in life, interventions can be tailored to address potential problematic mobile phone use issues.

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Author contributions

Ny P: Conceptualization, Formal analysis, Methodology, Visualization, Writing– original draft, Writing– review & editing. QI S: Methodology, Investigation, Resources, Data curation. Zx L: Formal analysis, Validation. X X: Conceptualization, Methodology, Supervision, Project administration, Resources, Writing– review & editing. Ys L: Conceptualization, Formal analysis, Methodology, Visualization, Funding acquisition, Writing– original draft, Writing– review & editing.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the recommendations of the World Medical Association's Declaration of Helsinki and was approved by the Qingdao University Ethics Committee (QDU-HEC-2022216). Written informed consent was obtained from all participants and their guardians.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Supplementary information

None.

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