

Article

Predicting Effects of ADHD Symptoms and Mindfulness on Smartphone Overuse in Athletes: A Basic Psychological Needs Perspective

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Abstract: Informed by basic psychological need theory, this study was undertaken to examine the relationship between self-reported symptoms of attention deficit hyperactivity disorder (ADHD), mindfulness, basic psychological need satisfaction/frustration, and smartphone overuse among athletes. Athletes ($n = 360$, $M_{age} = 20.27$, male = 72.5%) completed a survey that measured the outcomes of interest. Path analysis indicated that greater ADHD symptoms were both directly related to higher smartphone overuse scores and indirectly related to greater smartphone overuse scores via need frustration. Higher mindfulness scores were associated with lower levels of need frustration and greater levels of need satisfaction. Mindfulness moderated the positive association between ADHD symptoms and need frustration. Specifically, the positive association between ADHD symptoms and need frustration was attenuated in the presence of higher levels of mindfulness among participants with a lower risk of ADHD. Surprisingly, the same association was heightened among participants with a higher risk of ADHD. These findings highlight the significant role of need frustration in explaining the underlying process from ADHD symptoms to smartphone overuse.

Keywords: mental health; awareness; attention deficit; basic psychological needs; phone addiction; sports



Citation: Li, C.; Kee, Y.H.; Zhang, C.-Q.; Fan, R. Predicting Effects of ADHD Symptoms and Mindfulness on Smartphone Overuse in Athletes: A Basic Psychological Needs Perspective. *Sustainability* **2021**, *13*, 6027. <https://doi.org/10.3390/su13116027>

Academic Editors: Sidonio Serpa and Jürgen Beckmann

Received: 30 April 2021

Accepted: 18 May 2021

Published: 27 May 2021

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1. Introduction

Growing research attention has been paid to understand athletes' mental health [1,2]. Mental health disorders such as anxiety, depression, and substance use are not uncommon among athletes [3]. For example, 23.7% of university athletes were found to have depressive symptoms, and 19% of elite athletes were diagnosed with alcohol misuse [2,3]. To address these issues, numerous studies have been conducted to identify risk and protective factors of mental health in athletes [4]. For example, many risk and protective factors of mental health such as symptoms of attention deficit hyperactivity disorder (ADHD), feelings of autonomy, and sports injuries have been identified [1,3,4]. Compared with other mental health disorders such as gambling disorders and exercise addiction, little attention has been paid to understand smartphone addiction or overuse in athletes [1,5].

It is worthy to note that smartphone overuse may have similar presentations as an addiction, but may not be considered an addiction. Further, there is no formal diagnosis for smartphone addiction [6]. Thus, the term smartphone overuse is used in the present study. A recent review showed that about one-quarter of children and young people were excessive smartphone users [7]. Smartphone overuse has been found to associate with several correlates such as anxiety, depression, and sleep in nonathletic populations [8,9]. As the predictors of smartphone overuse among athletes are still unknown, our study aimed to

understand the psychological predictors of smartphone overuse in athletes. Specifically, we purposefully selected several potential and theoretically relevant predictors of smartphone overuse (i.e., ADHD symptoms, basic psychological need satisfaction/frustration, and mindfulness). We examined the relationships among these variables through the lens of self-determination theory [10].

1.1. Basic Psychological Needs and Smartphone Overuse

According to basic psychological need theory (BPNT), a mini-theory of self-determination theory, human beings have three universal basic psychological needs [10]. These three basic psychological needs are autonomy (the need to experience volition and independence), competence (the need to feel confident in completing optimally challenging tasks), and relatedness (the need to experience warmth and connections to significant others). BPNT also postulates that satisfaction of the three basic psychological needs is essential for individuals' well-being and thriving, while frustration from these needs will result in ill-being. This tenet has been well-supported by meta-analytic findings in health and sport contexts [11,12]. More recently, findings of a scoping review indicated that need satisfaction was a protective factor of mental health, while need frustration was a risk factor in elite athletes [4]. As such, it is highly possible that need satisfaction/frustration could predict mental health outcomes such as smartphone overuse. However, direct empirical evidence is needed to support this assertion.

1.2. ADHD and Basic Psychological Needs

In line with the tenets of BPNT [10], social contexts or environmental factors are determinants of need satisfaction/frustration. Accordingly, a wealth of literature has shown that environmental factors such as parental support and peer relationships are significant predictors of need satisfaction and frustration [11,13]. In addition to environmental factors, personal factors have also been found to predict the three basic psychological needs [14,15]. To illustrate, perfectionistic strivings, one of the personality traits, were found to positively predict need satisfaction and negatively predict need frustration among youth athletes [16]. Besides perfectionism, one personal factor that received little attention was ADHD, despite a review study found that about 7% to 8% of athletes may have had ADHD based on self-reported measures and clinical diagnoses [17].

ADHD is a developmental disorder that includes inattentive, hyperactive, and/or impulsive symptoms [18]. ADHD symptoms can cause dysfunctions across settings such as academic performance and interpersonal relationships [19]. In the sports setting, while ADHD symptoms may enhance sports performance, they may also impair athletic performance [17]. Athletes with inattention will have difficulty in sustaining their attention in a training task, and that can affect their skill acquisition or refinement. As such, ADHD symptoms are potentially detrimental to their fulfillment of competence need satisfaction. In addition, athletes displaying hyperactive behaviors tend to have impaired social functioning, which may negatively affect their connections with significant others such as coaches and teammates (i.e., the experience of relatedness need frustration). Thus, ADHD symptoms are likely to affect athletes' experiences of need satisfaction and frustration. However, direct evidence to support this line of reasoning is lacking.

1.3. ADHD, Mindfulness, and Basic Psychological Needs

One psychological construct that has received increasing attention in the literature is mindfulness [20–22]. Mindfulness is defined as a trait and a state ability of being aware of the present-moment experience in a nonjudgmental way [23]. Mindfulness appears to facilitate the fulfillment of the three basic psychological needs [13]. The awareness of the present moment that characterizes mindfulness can help individuals to function in a way that is congruent with their own interests and values (autonomy need satisfaction). Moreover, acceptance of the experience characterized by mindfulness is believed to decrease ego-defensive behaviors and promote healthy relationships (competence and relatedness

need satisfaction) [24]. Growing evidence has shown that mindfulness can be a positive predictor of need satisfaction and a negative predictor of need frustration across athletes, employees, and pre-service teachers [25–27].

Other than acting as a predictor of need satisfaction and frustration, mindfulness may also play a protective role, especially within a need-frustrating context [14]. For example, while mindfulness was not a moderator in the positive relationship between managerial behaviors and need satisfaction, it was found to attenuate the negative association between managerial behaviors and need frustration among employees [24]. Similarly, mindfulness has been found to moderate the positive effects of nomophobia and boredom proneness on smartphone overuse in university students [28]. Preliminary evidence has also shown that mindfulness-based interventions could be an effective option for decreasing ADHD symptoms among youth and adults [29,30]. Thus, given the alleviating role of mindfulness on ADHD symptoms, coupled with the documented relationship between mindfulness and the three basic psychological needs, mindfulness may attenuate the negative effects of ADHD symptoms on need frustration. Yet, there is a literature gap on whether mindfulness can attenuate that negative effect.

1.4. Aim and Hypotheses

In summary, this study was undertaken to examine the relationship between ADHD symptoms, mindfulness, basic psychological need satisfaction/frustration, and smartphone overuse among athletes. Specifically, the model depicted in Figure 1 was formulated and examined. Based on the above literature review and reasoning, it was hypothesized that ADHD symptoms would negatively predict need satisfaction and positively predict need frustration (H1 and H2) [14,15]. Mindfulness would positively predict need satisfaction and negatively predict need frustration (H3 and H4) [25,26]. Mindfulness would attenuate the positive effect of ADHD symptoms on need frustration (H5) [24]. Finally, need satisfaction would be a negative predictor of smartphone overuse while need frustration would be a positive one (H6 and H7) [4,12].

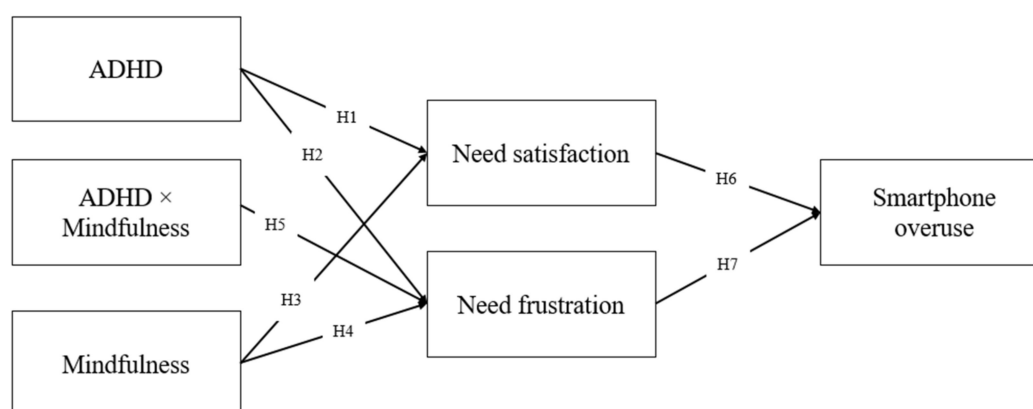


Figure 1. Proposed model and hypotheses. ADHD × mindfulness: interaction term between ADHD and mindfulness.

2. Materials and Methods

2.1. Study Design

A cross-sectional survey design was used in the present study.

2.2. Participants

To be eligible for the present study, participants must be university athletes studying in a public university in China. A convenience sample of 360 athletes (male = 261, female = 99) was recruited from five public universities in China. Participants had a mean age of 20.27 years (SD = 1.58). They specialized in one of 16 sports such as basketball, soccer, and table tennis (individual sport = 245, team sport = 108, and seven chose not to indicate their

sport). On average, participants had been involved in their sport for 7.6 years ($SD = 3.41$) and trained 10.69 h per week ($SD = 6.28$). All of them were grade 2 (sub-elite) or above athletes. Athletes are ranked from highest to lowest based on their sports performance in China: international master sportsman, national master sportsman, grade 1, grade 2, grade 3, and no grade.

2.3. Measures

Four standardized measures were used to measure one outcome (i.e., smartphone overuse) and four predictors including ADHD symptoms, mindfulness, need satisfaction, and need frustration. Potential confounders included the aforementioned demographic variables.

2.3.1. ADHD Symptoms

The Chinese-translated screening version of the Adult ADHD Self-Report Scale Version 1.1 was used to measure ADHD symptoms [31]. The scale consists of six items (e.g., “How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?”). Participants were asked to report how often they had experienced these symptoms over the last six months. A 5-point scale ranging from 1 (never) to 5 (very often) was used for responses. Participants were considered to have symptoms highly consistent with ADHD if they scored four or more checkmarks (i.e., 1 checkmark = scored 3 or above in one of the first three items or scored 4/5 in one of the last three items). Accordingly, 86 participants (23.9%) were classified into a group with a higher possibility of having ADHD (0 = lower risk group; 1 = higher risk group). The scale demonstrated good internal reliability in our sample ($\alpha = 0.81$).

2.3.2. Mindfulness

Participants reported their mindfulness levels using the Chinese version of the Athlete Mindfulness Questionnaire [32]. The scale comprises 16 items (e.g., “I can maintain my attention on my training”). The scale measures three facets of mindfulness in sports: present-moment attention, awareness, and acceptance. A 5-point scale that ranged from 1 (never true) to 5 (always true) was used for responses. A total mean scale score was computed for subsequent analyses, and a higher total score indicated a greater level of mindfulness. In the present sample, the scale showed good internal reliability ($\alpha = 0.89$).

2.3.3. Psychological Need Satisfaction and Frustration

We used the Chinese version of the Basic Psychological Needs Satisfaction and Frustration Scale to assess participants' basic psychological need satisfaction in life [33]. The scale contains six, 4-item subscales tapping into autonomy, competence, and relatedness satisfaction and frustration (e.g., “I feel a sense of choice and freedom in the things I undertake”). Participants were asked to give responses on a 5-point scale, ranging from 1 (not true at all) to 5 (completely true). A total mean need satisfaction score, as well as a total mean need frustration score, were used for further analyses. In our sample, good internal reliability was found for both total need satisfaction and frustration scores ($\alpha = 0.84/0.91$).

2.3.4. Smartphone Addiction

The Chinese version of the 10-item Smartphone Addiction Inventory was employed to measure participants' smartphone overuse [34]. A sample item is “I try to spend less time on smartphone, but the efforts were in vain”. Participants rated the scale items on a 4-point scale that ranged from 1 (strongly disagree) to 4 (strongly agree). As a clinical cutoff value for athletic populations was not available, a total scale score was computed for subsequent analyses. A higher total score indicated a higher risk of smartphone overuse. The scale had good internal reliability with the current sample ($\alpha = 0.89$).

2.4. Procedure

The study protocol was approved by the Human Research Ethics Committee of the China University of Geosciences (Wuhan). Upon receiving the ethical approval, head coaches of sports teams from five public universities in central and southeastern China were approached to invite their athletes to participate in this study. Informed consent forms together with multi-section survey forms were administered to participants by a research assistant in a quiet meeting room or lecture hall. Participants were assured that their participation was voluntary and anonymous. They were also encouraged to provide honest responses. The data collection was conducted from October to November 2019 (in-season training and competition). Initially, 426 athletes were invited, and 360 of them responded to the survey (response rate = 84.5%). No incentives were given for completing the survey. All of the respondents ($n = 360$) were included in our data analysis.

2.5. Data Analysis

Means, standard deviations, and zero-order correlations of study variables were computed using IBM SPSS 25 (IBM, Armonk, NY, USA). To test the proposed model and hypotheses (H1 to H7), a series of path analysis with a maximum likelihood estimation was conducted in AMOS 25 (IBM, Armonk, NY, USA). Multiple fit indices including the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean residual (SRMR) were employed to assess model fit [35]. Specifically, a CFI/TLI value higher than 0.90 and an RMSEA/SRMR value smaller than 0.08 indicated an adequate model fit [35,36]. Additional analyses using the bootstrapping approach (5000 replications) were employed to examine the indirect effects of need satisfaction/frustration in the model. The generated confidence intervals (CIs) of path estimates that did not include zero suggested an indirect effect [37]. According to Kline [35], our sample size ($n = 360$) was generally adequate for path analysis.

3. Results

3.1. Descriptive Findings

Table 1 presents descriptive statistics and zero-order associations of study variables. Greater ADHD symptoms were associated with lower mindfulness scores as well as higher levels of need frustration and smartphone overuse. Higher mindfulness scores were associated with greater levels of need satisfaction and lower levels of need frustration and smartphone overuse. However, the association between ADHD symptoms and need satisfaction as well as the relationship between need satisfaction and smartphone overuse were not significant. Of note, need frustration was negatively related to three demographic variables, including gender, year of participation, and training hours/week. Therefore, these demographic variables were entered as covariates in the path analyses.

Table 1. Descriptive statistics and zero-order correlations of study variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Gender	—									
2. Age	−0.10 *	—								
3. Sport	−0.21 **	−0.11 *	—							
4. Year of participation	0.12 *	0.15 **	−0.19 **	—						
5. Training hours/week	0.04	0.11 *	−0.14 *	0.19 **	—					
6. ADHD symptoms	−0.04	0.04	0.05	0.05	0.04	—				
7. Mindfulness	−0.04	−0.08	−0.05	−0.04	0.001	−0.20 **	—			
8. Need satisfaction	−0.02	−0.05	−0.02	−0.01	−0.05	−0.07	0.39 **	—		
9. Need frustration	−0.12 *	0.07	0.06	−0.15 **	−0.16 **	0.32 **	−0.22 **	−0.22 **	—	
10. Smartphone overuse	−0.07	0.08	0.08	−0.09	−0.04	0.32 **	−0.16 **	−0.06	0.47 **	—
M	—	20.27	—	7.60	10.69	—	3.89	3.99	2.96	25.70
SD	—	1.58	—	3.41	6.28	—	0.55	0.53	0.86	6.62

Note: ** $p < 0.01$, * $p < 0.05$.

3.2. Hypothesis Testing

The results of the path analysis indicated an adequate model fit to the hypothesized model: $\chi^2(10) = 19.31$, CFI = 0.977, TLI = 0.917, RMSEA = 0.051, 90%CI [0.012, 0.082], SRMR = 0.029. According to the value of the modification index (modification index = 9.66), the model fit would be improved by adding a direct path from ADHD to smartphone overuse. Empirically, greater ADHD symptoms may have been directly related to higher levels of smartphone overuse [38]. Taken together, we decided to re-specify the model by adding the direct path between ADHD symptoms and smartphone overuse. The re-specified model showed a good model fit: $\chi^2(9) = 4.90$, CFI = 1.000, TLI = 1.000, RMSEA = 0.000, 90%CI [0.000, 0.034], SRMR = 0.012. Figure 2 and Table 2 present the standardized path estimates of the re-specified model. All the hypothesized paths were significant except for the relationship between ADHD symptoms and need satisfaction ($\beta = 0.01$, $p = 0.88$; H1) as well as the path from need satisfaction to smartphone overuse ($\beta = 0.04$, $p = 0.45$; H6). Thus, only H1 and H6 were not supported. Overall, all the predictors explained 25.4% of the total variance in smartphone overuse.

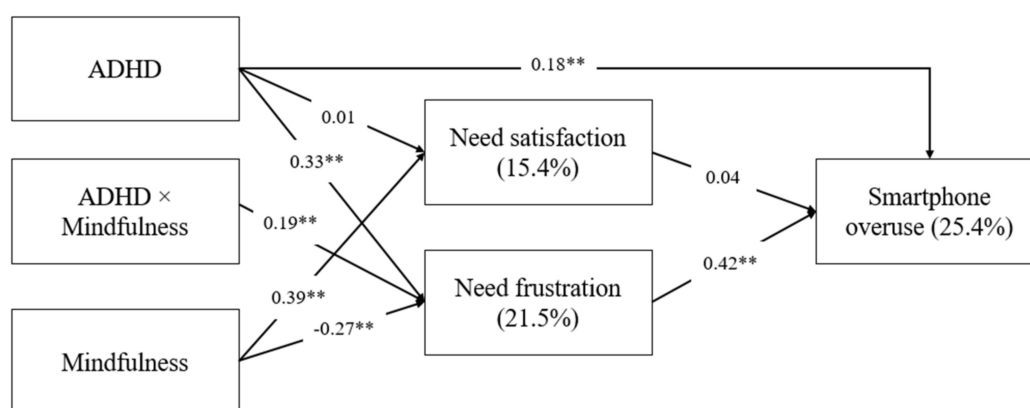


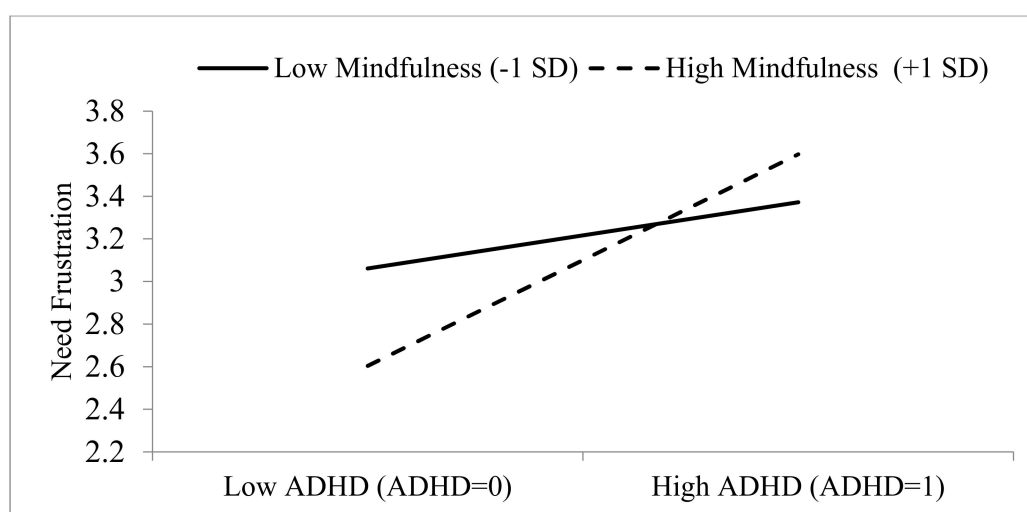
Figure 2. Standardized path estimates of the re-specified model. ADHD \times mindfulness: interaction term between ADHD and mindfulness. ADHD (0 = lower risk group, 1 = higher risk group). For clarity, controlling variables (i.e., gender, year of participation, and training hours/week) and correlates of error terms are omitted. ** $p < 0.01$.

As the interaction term was a significant predictor of need frustration, a simple-slope analysis was conducted to examine the moderation effect further [39]. The results indicated that mindfulness moderated the positive effect of ADHD symptoms on need frustration at both lower ($B = 0.31$, $SE = 0.13$, 95%CI (0.07, 0.56)) and higher levels ($B = 0.99$, $SE = 0.16$, 95%CI (0.68, 1.30)). Figure 3 presents the positive association between ADHD symptoms and need frustration at different levels of mindfulness. For participants with lower levels of ADHD symptoms, higher levels of mindfulness were associated with lower levels of need frustration. In other words, the positive association between ADHD symptoms and need frustration became weaker in the presence of higher levels of mindfulness among participants with a lower risk of ADHD. Counterintuitively, for participants with a higher risk of ADHD symptoms, higher levels of mindfulness were related to greater levels of need frustration. Namely, the positive association between ADHD and need frustration was heightened among participants with a higher level of mindfulness and a higher risk of ADHD.

Table 2. Standardized direct, indirect, and total effects of the re-specified model.

Effect (Hypothesis if Applicable)	β	95% CI	<i>p</i>
<i>Direct effects</i>			
ADHD \rightarrow Need satisfaction (H1)	0.01	[−0.09, 0.10]	0.88
ADHD \rightarrow Need frustration (H2)	0.33	[0.24, 0.41]	<0.001
Mindfulness \rightarrow Need satisfaction (H3)	0.39	[0.29, 0.48]	<0.001
Mindfulness \rightarrow Need frustration (H4)	−0.27	[−0.37, −0.16]	0.001
ADHD \times Mindfulness \rightarrow Need frustration (H5)	0.19	[0.08, 0.29]	0.002
Need satisfaction \rightarrow Smartphone overuse (H6)	0.04	[−0.07, 0.15]	0.45
Need frustration \rightarrow Smartphone overuse (H7)	0.42	[0.32, 0.53]	<0.001
ADHD \rightarrow Smartphone overuse	0.18	[0.09, 0.28]	<0.001
<i>Indirect effects</i>			
ADHD \rightarrow Need satisfaction/frustration \rightarrow Smartphone overuse	0.14	[0.09, 0.19]	<0.001
Mindfulness \rightarrow Need satisfaction/frustration \rightarrow Smartphone overuse	−0.10	[−0.16, −0.04]	0.001
ADHD \times Mindfulness \rightarrow Need frustration \rightarrow Smartphone overuse	0.08	[0.03, 0.14]	0.002
<i>Total effects</i>			
ADHD \rightarrow Smartphone overuse	0.32	[0.23, 0.41]	<0.001
Mindfulness \rightarrow Smartphone overuse	−0.10	[−0.16, −0.04]	0.001
ADHD \times Mindfulness \rightarrow Smartphone overuse	0.08	[0.03, 0.14]	0.002

Note: β : standardized parameter estimate; CI: confidence interval.

**Figure 3.** Plot of simple slopes. ADHD (0 = lower risk group, 1 = higher risk group).

3.3. Indirect Effects

Table 2 shows the results of mediation analyses. Need satisfaction/frustration was found to mediate the positive relationship between ADHD symptoms and smartphone overuse ($\beta = 0.14$, 95% CI (0.09, 0.19)). Furthermore, need satisfaction/frustration was also a mediator in the relationship between mindfulness and smartphone overuse ($\beta = -0.10$, 95% CI (−0.16, −0.04)).

4. Discussion

Guided by BPNT [10], this is the first study to examine the relationship between self-reported ADHD symptoms, mindfulness, basic psychological need satisfaction/frustration, and smartphone overuse in athletes. It was found that ADHD symptoms had a direct and positive association with smartphone overuse. ADHD symptoms also had an indirect effect on smartphone overuse via need frustration. Mindfulness positively predicted need

satisfaction and negatively predicted need frustration, which subsequently had a positive association with smartphone overuse. Moreover, mindfulness weakened the positive association between ADHD symptoms and need frustration in the participants with a lower risk of ADHD. In contrast, the positive association was heightened among the participants with a higher risk of ADHD.

4.1. ADHD and Basic Psychological Needs

Our study showed that 23.9% of the participants had a high risk of having ADHD based on the self-reported measure. This suggests the pressing need to examine ADHD symptoms in athlete groups. We did not find ADHD symptoms to negatively predict need satisfaction. This finding is not in line with H1 and the tenet of BPNT [10]. Instead, H2 was supported in that ADHD symptoms were found to positively predict need frustration. Athletes with inattentive ADHD usually have a limited attention span and can be easily distracted by external stimuli. As such, they have difficulty following task instructions and sustaining focus on skill training, which then frustrates their competence need satisfaction. Similarly, hyperactive and impulsive symptoms can impair athletes' relationships with significant others such as parents, coaches, and teammates, and subsequently frustrate their relatedness [19]. Therefore, ADHD symptoms seem to increase the sensitivity of psychological costs and contribute to need frustration in athletes. Overall, our findings fill out a literature gap and suggest that the presence of ADHD symptoms only interferes with athletes' need frustration rather than both need satisfaction and need frustration.

4.2. ADHD, Mindfulness, and Basic Psychological Needs

Another predictor that was studied in the present study is mindfulness. In accordance with H3 and H4, mindfulness had a positive association with need satisfaction as well as a negative association with need frustration. Our findings are similar to previous studies with athletic and non-athletic groups [24–26]. The link between mindfulness and the three basic psychological needs can be attributed to the characteristics of mindfulness. For example, being at the present moment helps athletes to function in a way that is congruent with their own interests and values (autonomy need). In addition, attending to the present moment with a nonjudgmental approach or an acceptance attitude can help athletes to decrease ego-defensive behaviors and promote healthy relationships (autonomy and relatedness needs) [24]. Therefore, the characteristics of mindfulness are expected to facilitate need satisfaction and prevent need frustration. Our findings add to the broad literature that interpersonal and intrapersonal factors are predictors of need satisfaction and frustration [14–16].

In addition to examining the predicting roles of ADHD symptoms and mindfulness, our study adds to the literature by examining whether mindfulness can attenuate the effect of ADHD symptoms on need frustration. In support of H5, the interactive term between ADHD and mindfulness was found to positively predict need frustration, suggesting these two factors could influence one's experience of need frustration in an interactive way [14]. Specifically, in the lower-risk group for ADHD, mindfulness attenuated the positive association between ADHD symptoms and need frustration in athletes. This finding is consistent with early research based on the working context, wherein mindfulness was found to attenuate the negative relationship between managerial behaviors and need frustration in employees [24]. Unexpectedly, our finding also showed that the association between ADHD and need frustration was heightened among the higher-risk group for ADHD. This means mindfulness may not always be a good thing for athletes with ADHD symptoms. Indeed, mindfulness-based intervention programs typically require participants to stabilize attention, which could be challenging for athletes with ADHD symptoms [40]. Stated differently, attempting to increase mindfulness levels or greater mindfulness scores could exacerbate the experience of need frustration. In contrast to the present finding, preliminary evidence has supported the efficacy of mindfulness-based training on alleviating ADHD

symptoms in non-athletic groups [29,30]. The inconsistent finding may be attributed to varying study designs and research groups and warrants future investigations.

4.3. Basic Psychological Needs and Smartphone Overuse

Our study found need frustration to positively predict smartphone overuse, while need satisfaction did not. Thus, H7, but not H6, was supported in the present study. This finding provided the first piece of evidence that need frustration was a risk factor of smartphone overuse, supporting the tenets of BPNT [10]. This finding is also parallel to previous research, where need frustration resulted in ill-being such as anxiety and burnout [4,11,12]. Early research also showed that need frustration was more likely to result in maladjustment and ill-being than need satisfaction [41,42], which might explain why need frustration had a stronger association with smartphone overuse than need satisfaction in our study.

We conducted additional analyses to examine the mechanisms underlying the relationship between ADHD/mindfulness and smartphone overuse. We found that need frustration mediated the relationship between ADHD symptoms and smartphone overuse as well as the relationship between mindfulness and smartphone overuse. These findings support the utility of BPNT in understanding mental health, and particularly in sports settings [12]. We also identified a direct path between ADHD symptoms and smartphone overuse. Early research has shown that adults with ADHD are inclined to engage in smartphone overuse [38]. Taken together, smartphone overuse may not be fully attributed to the maladjustment of need frustration. To this end, integrating BPNT with other theoretical frameworks such as incentive sensitization theory and the Interaction of Person-Affect-Cognition-Execution model [8,43] may better our understanding of smartphone overuse.

4.4. Practical Implications

From a practical perspective, there is a need to decrease ADHD symptoms and need frustration to prevent smartphone overuse. For management of ADHD symptoms, psychological interventions such as behavior therapy and mental skills training can be applied. If necessary, medication management for ADHD can also be used, especially for those athletes with moderate or severe ADHD symptoms [17]. For prevention of need frustration, social contexts can be manipulated. For example, coaches and parents can be educated to avoid the use of controlling coaching and parenting styles such as pressuring athletes to think and act in prescribed ways [41,42].

4.5. Limitations and Future Research Directions

The present study has several limitations. First, participants were athletes recruited from five public universities in China. Thus, our study findings may not be generalized to a larger group or other contexts. It would be beneficial for future research to examine whether the findings could be replicated in other groups such as fulltime athletes and school athletes. Second, a cross-sectional design was used, which means the directionality among the study variables should be interpreted with caution. A multi-wave survey design can be used to examine the dynamic interplay between these variables. Finally, we only used self-report measures to assess the outcomes of interest. Other measures such as a third-party report of need satisfaction or a clinical diagnosis of ADHD symptoms may be used in future research to increase the reliability of the present findings.

5. Conclusions

Our findings provide some insight into the relationship between ADHD symptoms, mindfulness, basic psychological need satisfaction/frustration, and smartphone overuse among athletes. The findings provide some initial evidence that greater ADHD symptoms are indirectly associated with higher smartphone overuse scores via need frustration. Meanwhile, higher mindfulness scores are indirectly related to higher smartphone overuse scores via need frustration. The findings also provide some preliminary evidence that

mindfulness may not be a protective factor in the development of need frustration among athletes with a higher risk of ADHD. These findings speak to the roles of mindfulness and need frustration in understanding smartphone overuse among athletes.

Author Contributions: Conceptualization, C.L. and R.F.; methodology, C.L., C.-Q.Z.; formal analysis, C.L.; investigation and data curation, R.F.; writing—original draft preparation, C.L., Y.H.K. and R.F.; writing—review and editing, Y.H.K. and C.-Q.Z. All authors have read and agreed to the published version of the manuscript.

Funding: Hubei Leisure Sports Development Research Center Open Funding. Funding number: 2020Y003.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Human Research Ethics Committee of the China University of Geosciences (Wuhan) on 18 September 2019.

Informed Consent Statement: Informed consent was obtained from all participants involved in this study.

Data Availability Statement: Data supporting reported results are available upon request to the corresponding author.

Acknowledgments: The authors would like to thank all the participants for their participation in this research.

Conflicts of Interest: The authors declare no conflict of interest.

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