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Predictors of dropout in university students participating in an 8-week e-mail-based cognitive-behavioral therapy for insomnia intervention

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Abstract

Purpose We conducted an exploratory study to identify risk factors of dropout in an 8-week e-mail-based cognitive-behavioral therapy for insomnia (REFRESH) to improve sleep among university students with insomnia symptoms.

Methods University and graduate students in Hong Kong and Korea who scored higher than 10 on the Insomnia Severity Index participated in REFRESH.

Results Of 158 participants from Hong Kong ($n = 43$) and Korea ($n = 115$), 90 (57%) did not complete all 7 sessions, while 52 of 90 (57.8%) dropped out prior to the fourth session. ROC analysis was conducted on the entire sample of 158 participants with intervention completion vs. dropout (non-completion) as the outcome variable. Predictors of dropout were wake time after sleep onset (WASO) < 7.1 min on the weekly sleep diary and expectations for sleep (a subscale of dysfunctional beliefs and attitudes about sleep; DBAS) < 18 at baseline.

Conclusions These findings indicate that shorter WASO and less expectations for sleep at baseline were associated with risk of dropout from e-mail delivered self-help CBT-I-based intervention. Our results highlight the importance of identifying and tailoring treatment formats to students based on their presenting sleep characteristics.

Keywords Insomnia · Cognitive-behavioral therapy · Treatment dropouts · Sleep

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Introduction

University students report having irregular sleep schedules, poor sleep hygiene, and poor sleep quality [1], in addition to a high prevalence of insomnia. In a systematic review, the prevalence of insomnia was 18.5% in university students, which is higher than that of reported in the general population (7.4%) [2]. Additionally, insomnia is associated with fatigue, irritability, depressed mood, and difficulty concentrating [3].

Cognitive-behavioral therapy for insomnia (CBT-I) is a multicomponent intervention including sleep hygiene education, sleep restriction, stimulus control, cognitive restructuring, and relaxation training [4]. CBT-I is usually delivered as a face-to-face intervention, either in an individual or group format. CBT-I is effective for insomnia and has shown better long-term treatment outcomes than pharmacological interventions [5]. However, there are still many challenges for CBT-I, including cost of treatment, a lack of trained clinicians, and inaccessibility to treatment, which are barriers for university students to receiving appropriate treatment for sleep difficulties [6].

Internet-based CBT-I is a promising and practical alternative to face-to-face CBT-I in that the patients can be treated at the time and location of their choosing, which may be advantageous for younger individuals who are familiar with internet-based environments [7]. Internet-based CBT-I has been shown to be effective in improving sleep and reducing the severity of insomnia [8]. There has also been evidence showing the efficacy of e-mail-based sleep interventions in improving sleep [9, 10]. Lancee et al. showed that internet and e-mail delivered CBT-I was effective in improving clinical sleep-related outcomes 4 weeks after treatment [11].

Despite internet-based CBT-I being effective, attrition and adherence remain a major challenge. Available estimates of dropout for traditional face-to-face CBT-I suggest that 14–40% of study participants drop out before the midpoint of treatment. In contrast, average treatment adherence is around 50% for digital CBT-I. Also, the percentage of treatment completers is higher in face-to-face CBT (84.7%) than in guided internet-based CBT (65.1%) [12, 13]. Thus, rates of attrition and adherence need to be improved in order for a digital approach to be considered as a viable option for treatment [13, 14].

Although dropout from online-based CBT-I is clinically relevant, there are few studies that have investigated factors predicting dropout. Previous studies investigating factors that predict dropout for CBT-I suggest that predictive factors may be different for face-to-face CBT-I compared to online-based interventions. Shorter total sleep time (TST) coupled with depressive symptoms were found to be associated with early dropout of group-based face-to-face CBT-I [15]. In contrast, less severe symptoms of sleep disturbance as measured by sleep quality [16] and insomnia severity, longer total sleep time, the presence of psychiatric disorders, and greater severity of depression were shown to be associated with non-completers for self-help internet-based CBT-I [17, 18].

Since the results of prior studies have been mixed and limited, we aimed to identify the characteristics of university students who dropped out of an 8-week e-mail delivered self-help CBT-I intervention. We explored a set of potential predictors including demographic characteristics, insomnia symptoms, depression, stress, sleep behaviors, and insomnia-related cognitive factors to identify predictors of dropout from an 8-week e-mail-based CBT-I.

Methods

Participants

University students (both undergraduate and graduate students) aged 18 to 30 were selected to participate in the study. Individuals who scored 10 or higher on the Insomnia Severity Index (ISI) were considered. Participants were recruited using online (social media and school-based mass mailing) and offline advertisements (posters/flyers) within the university in both South Korea (Sungshin University) and Hong Kong (University of Hong Kong, The Chinese University of Hong Kong) and a nearby university district.

The data collection in Hong Kong was conducted as part of another clinical trial [19]. Exclusion criteria were individuals who (1) had been diagnosed with bipolar disorder or had a family member with bipolar disorder, (2) had a trouble staying awake while driving or performing other activities in which drowsiness may have fatal consequences, and (3) were planning on travelling overseas in the near future. These exclusion criteria were implemented because the REFRESH program used in this study uses sleep restriction as a key element of sleep intervention, and those who experience excessive daytime sleepiness or bipolar disorder were excluded from the study because of safety issues [10]. The study was approved by the Institutional Review Board (IRB) at Sungshin University (SSWUIRB 2017–009, approval date: 13/03/2017), University of Hong Kong (EA1710023, approval date: 31/10/2017), and the Chinese University of Hong Kong (2017.618-T, approval date: 08/03/2018).

Procedures

The intervention program was an e-mail-based sleep health improvement program (REFRESH) adapted CBT-I methods to the special circumstances of university students developed at Stanford University, with the purpose of improving sleep in students regardless of their insomnia status. Efficacy and content of the intervention can be found elsewhere [10, 19, 20]. The original e-mail-based intervention material was translated and back-translated into both Korean and Chinese and was edited and checked to ensure content fidelity of the original intervention by an independent researcher.

The intervention was delivered in 8 weekly sessions, sent via weekly e-mail messages with an attached PDF file. The contents were based on CBT-I and included education about sleep, sleep restriction, relaxation training, mindfulness meditation, sleep hygiene, stimulus control, cognitive restructuring, and relapse prevention. Specifically, in the theme of sleep restriction, it is more important to improve the quality of sleep than to increase the amount of sleep, and participants could directly implement sleep restriction according to their sleep schedules, and in the next session, they could check and revise their progress. It also introduced breathing, progressive muscle relaxation, and mindfulness mediation, encouraging the participants to engage

in practice in their own daily lives. In the session dealing with cognitive therapy, detailed examples and methods to reduce anxiety were presented, and cognitive restructuring could be practiced through thought records traditionally used in cognitive therapy. The program encouraged all participants to keep sleep diaries throughout the intervention and implement strategies for improved sleep health. At the end of a total of 8 weeks of the program, participants were asked to complete a battery of self-report measures as the post-intervention assessment.

People completed the online questionnaire corresponding to the first online screening through links presented in the advertisements and they were checked to see if they met inclusion criteria and met the exclusion criteria. After that, participants reaffirmed the criteria for participation by phone call (Korea) or face-to-face (Hong Kong), obtained informed consent to participate in the study, and structured the program through introduction of REFRESH (Fig. 1). Eligible participants took part in the 8-week REFRESH program.

Measures

Dysfunctional Beliefs and Attitudes about Sleep 16, (DBAS-16)

The DBAS was originally developed as a 30-item scale by Morin and colleagues [21]. This study used the abbreviated 16-item version (DBAS-16), validated by Yu and colleagues [22]. The DBAS-16 consists of four subscales computed separately as follows: (1) perceived consequences of insomnia ("After a poor night's sleep, I know that it will interfere with

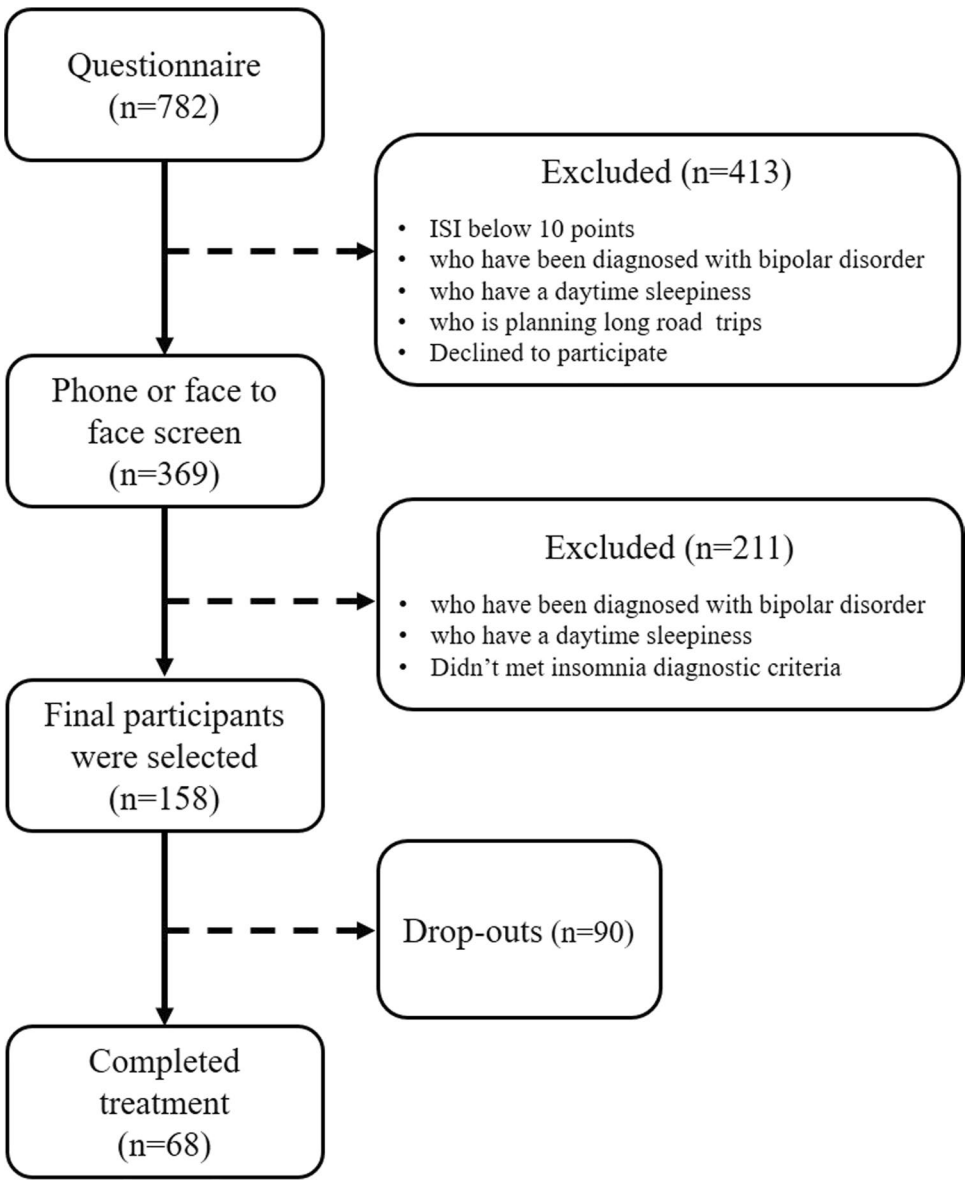

Fig. 1 Flowchart of study

my daily activities on the next day"); (2) worry/helplessness about insomnia ("I am concerned that chronic insomnia may have serious consequences on my physical health"); (3) expectations for sleep ("If don't get the proper amount of sleep on a given night, I need to catch up on it the next day by napping or on the next night by sleeping longer"; and (4) medication ("In order to be alert and function well during the day, I believe I would be better off taking a sleeping pill rather than having a poor night's sleep"). The DBAS-16 is rated on an 11-point Likert scale from 0 to 10 (0 = strongly disagree, 10 = strongly agree), with high scores indicating greater dysfunctional beliefs and attitudes about sleep. Cronbach's alpha for the DBAS was 0.77 in Morin et al. [21] and 0.82 in this sample.

Insomnia Severity Index

The ISI, developed by Bastien, Vallières, and Morin [23], was used to evaluate sleep problems according to the diagnostic criteria for insomnia in the DSM-5 during the two previous weeks. The Korean and Chinese version of the ISI was used and validated by Cho, Song, and Morin [24] and Chung, Kan, and Yeung [25]. The ISI consists of 7 items that were rated on a 5-point Likert scale from 0 to 4. Total scores range from 0 to 28, with higher scores indicating greater insomnia severity. Participants who scored above 10 were classified as having insomnia [26]. Cronbach's alpha for the ISI was 0.74 in Bastien et al. [23] and 0.63 in this sample.

Depression Anxiety Stress Scale 21 (DASS-21)

Depression, anxiety, and stress were measured by the DASS-21 [27]. The DASS-21 consists of three subscale measures: depression (DASS-D), anxiety (DASS-A), and stress (DASS-S). Each subscale consists of 7 items, with a score total of 21. Higher scores reflect higher levels of depression, anxiety, and stress. We used the validated version by Cha and colleagues [28]. Cronbach's alpha of the questionnaire was 0.93 in Henry and Crawford [29] and 0.90 in this sample.

Sleep Hygiene Practice Scale (SHPS)

The SHPS, developed by Yang et al. [30] and translated by Jeong and Gu [31], was used to assess sleep interfering behaviors. The SHPS consists of 30 items rated on a 6-point Likert scale; the total scores on all items provide a global measure of sleep hygiene practice. In addition, scores for four sleep hygiene domains can be obtained: (1) SHPS_S: sleep schedule; (2) SHPS_A: arousal-related behaviors; (3) SHPS_ED: poor eating/drinking habits prior to sleep; and (4) SHPS_E: poor sleep environment. A higher score indicates higher frequency of maladaptive sleep hygiene practices. Cronbach's alpha of this questionnaire was 0.88 in Jeong and Gu [31] and 0.81 in this sample.

Sleep diary

Participants were asked to keep a daily sleep diary for 7 weeks to closely examine their sleep patterns during the intervention. Sleep diary indices included sleep onset latency (SOL), wake after sleep onset (WASO), TST, and sleep efficiency (SE; ratio of TST to TIB multiplied by 100%).

Data analysis

All of data including the mean, standard deviation of continuous variables, frequency, and percentage of categorical variables were summarized. Cronbach's alpha was calculated to examine the internal consistency of the questionnaire. Independent two sample *t*-test was used to compare baseline indices of dropouts and completers. Data were analyzed using SPSS version 26.0 (IBM Corp. Armonk, NY).

ROC analysis was conducted to address our aim using the ROC5.07 program (found at https://web.stanford.edu/~yesavage/ROC.html). ROC is derived from signal detection technique, and the optimal cutoff point of the predictors can be calculated by maximizing the balance between sensitivity and specificity. ROC is recently employed to identify subgroups of a population at differential risk for specific outcome (i.e., treatment response and dropouts). We conducted the ROC analysis as a predictor of baseline variables to find out the factors predicting completion vs. non-completion of treatment. When the best predictor and cutoff value are confirmed, the group with the success criterion is tested by a stopping rule (statistically significant at $p < 0.05$). If the group fails to pass the stopping rule, it ends, but if the rule is met, the group is divided into two subgroups by the cutoff point of the variables determined to be optimal. The ROC has no limited assumptions such as normality and can identify all predictors and their cut-points and complex interactions by simultaneously evaluating various predictors. Therefore, it is possible to provide clinically relevant information based on the optimal predictor and its level. ROC analyses have been used in other studies by authors of this paper to predict clinical outcomes [32].

In the present study, the dichotomous dependent variable was dropouts coded as 1 to find out the predictors of treatment non-completion. We included variables providing relevant information on demographic characteristics, sleep parameters, sleep-related cognition and behavior, insomnia symptoms and depression, and anxiety symptom: baseline age, sex, DBAS, ISI, DASS, SHPS, subscales of DBAS, DASS, SHPS, and sleep diary variables (SOL, TST, WASO, SE). For the sleep diary, the first week was analyzed and the

criteria for significant sleep diary data to be included for analysis were 3 days.

Results

Dropouts vs. completers

A total of 782 people completed the online questionnaire corresponding with the first online screening and 369 reaffirmed the criteria to participate by phone call (Korea) or face to face (Hong Kong). An additional 211 people were excluded (see Fig. 1), leaving 158 participating students (30% men) from South Korea ($n = 115$) and Hong Kong ($n = 43$), ranging in age from 18 to 30 years. Table 1 presents the baseline indices of completers and dropouts. Among the participants, 68 out of 158 participants completed all sessions (completion rate: 43%). Dropouts reported lower worry/helplessness about insomnia ($p < 0.05$) than completers. WASO was shorter in dropouts than in completers ($p < 0.05$). Of the dropouts, 52 (57.8%) terminated between the first session and third session. Please see Table 2 for a summary of the data on dropouts by session.

Table 1 Baseline characteristics of the sample ($N = 158$)

	Completers ($n = 68$) *N* (%) or M (SD)	Dropouts ($n = 90$)	*p*
Gender			
Male	17 (25%)	31 (34.4%)	.201
Female	51 (75%)	59 (65.6%)	
Age (year)	22.3 (±2.8)	22.1 (±2.6)	.623
DBAS	105.5 (±22.4)	100.2 (±22.7)	.144
DBAS_C	46.3 (±11.2)	44.5 (±10.5)	.305
DBAS_W	36.2 (±8.5)	33.4 (±8.9)	**.046***
DBAS_E	15.2 (±4.5)	14.2 (±4.2)	.173
DBAS_M	7.8 (±6.2)	8.0 (±5.7)	.813
ISI	17.4 (±4.1)	16.7 (±3.8)	.301
DASS-D	6.7 (±4.6)	6.6 (±4.5)	.813
DASS-A	5.9 (±3.8)	5.4 (±3.9)	.465
DASS-S	10.4 (±4.7)	9.6 (±4.4)	.278
SHPS	91.7 (±17.13)	94.16 (±17.79)	.389
SOL	52.64 (±36.3)	56.4 (±49.4)	.606
TST	388.5 (±68.7)	403.1 (±106.6)	.341
WASO	18.8 (±26.9)	9.1 (±14.9)	**.010***
SE	78.5 (±10.0)	79.8 (±11.1)	.473

*$p < .05$

DBAS, Dysfunctional Beliefs and Attitudes about Sleep; *DBAS_C*, perceived consequences of insomnia; *DBAS_W*, worry/helplessness about insomnia; *DBAS_E*, expectations for sleep; *DBAS_M*, medication; *ISI*, Insomnia Severity Index; *DASS-D*, Depression Anxiety Stress Scale-Depression; *DASS-A*, DASS-Anxiety; *DASS-S*, DASS-Stress; *SHPS*, Sleep Hygiene Practice Scale; *SOL*, sleep onset; *TST*, total sleep time; *WASO*, wake time after sleep onset; *SE*, sleep efficiency

Predictors of dropout

Results from the ROC analysis identified two significant predictors of dropout in REFRESH program (see Fig. 2). At the first level, the best predictor was sleep diary-derived WASO with an optimal cut-point of 7.1 (sensitivity 70.8%, specificity 54.4%, $\chi^2 = 9.185$, $p < 0.01$). Participants with WASO ≥ 7.1, the chance of non-completion was 36.2% ($n = 21$), while those with WASO < 7.1, the chance was 62.2% ($n = 51$). The second-level predictor was expectations for sleep (the subscale of dysfunctional beliefs and attitudes about sleep) with a cut-point of 18 (sensitivity 80.0%, specificity 41.9%, $\chi^2 = 4.529$, $p < 0.05$). Among participants with baseline WASO < 7.1, expectations for sleep ≥ 18 was associated with 43.5% ($n = 10$) treatment non-completion and expectations for sleep score < 18 was correlated with treatment non-completion at 69% ($n = 40$). None of the other variables was significant in the ROC analysis, including age, gender, mood, and sleep parameters. A ROC curve was obtained by the decision tree analysis that is presented in Fig. 3.

Discussion

The goal of this study was to explore characteristics of participants who were at risk for dropout in an 8-week e-mail-based cognitive-behavioral therapy for insomnia. The main findings of the study identified short WASO (< 7.14) and low expectations for sleep (< 18) as significant predictors of dropout for an e-mail-based CBT-I intervention.

Predictors of dropout for an e-mail-based intervention

Our study explored the risk factors of dropout from the REFRESH intervention. Individuals who had shorter wake

Table 2 Dropouts by session ($N = 90$)

	N	%	Cumulative %
Session 1	24	26.7	26.7
Session 2	17	18.9	45.6
Session 3	11	12.2	57.8
Session 4	12	13.3	71.1
Session 5	5	5.6	76.7
Session 6	2	2.2	78.9
Session 7	8	8.9	87.8
Session 8	11	12.1	100

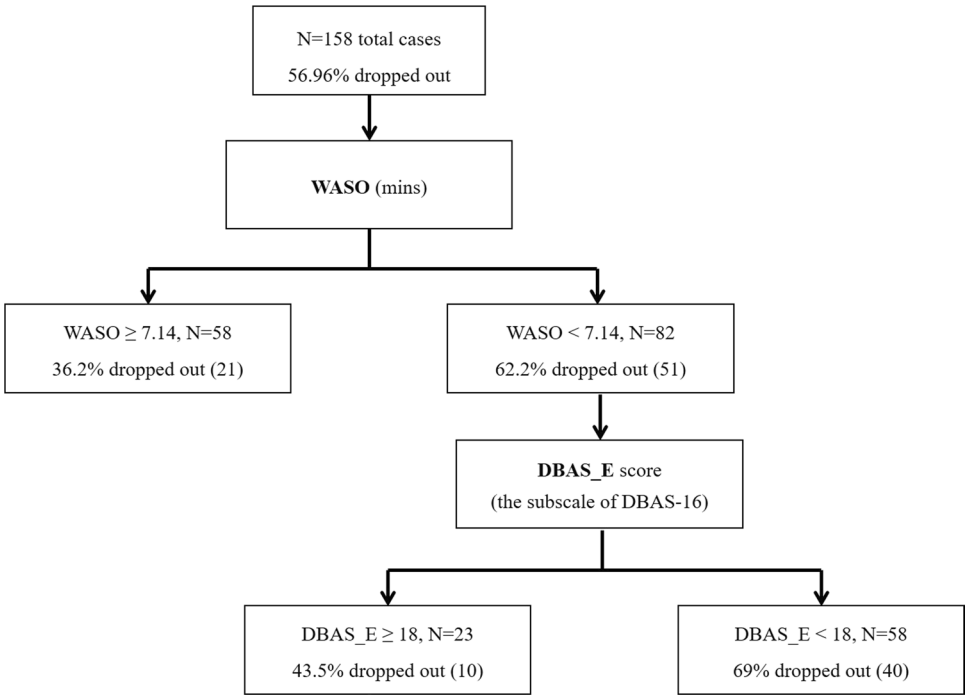

Fig. 2 ROC tree for dropout. WASO, wake after sleep onset; DBAS_E, Dysfunctional Beliefs and Attitudes about Sleep_Expectations for sleep. All factors significant at $p < .05$ level

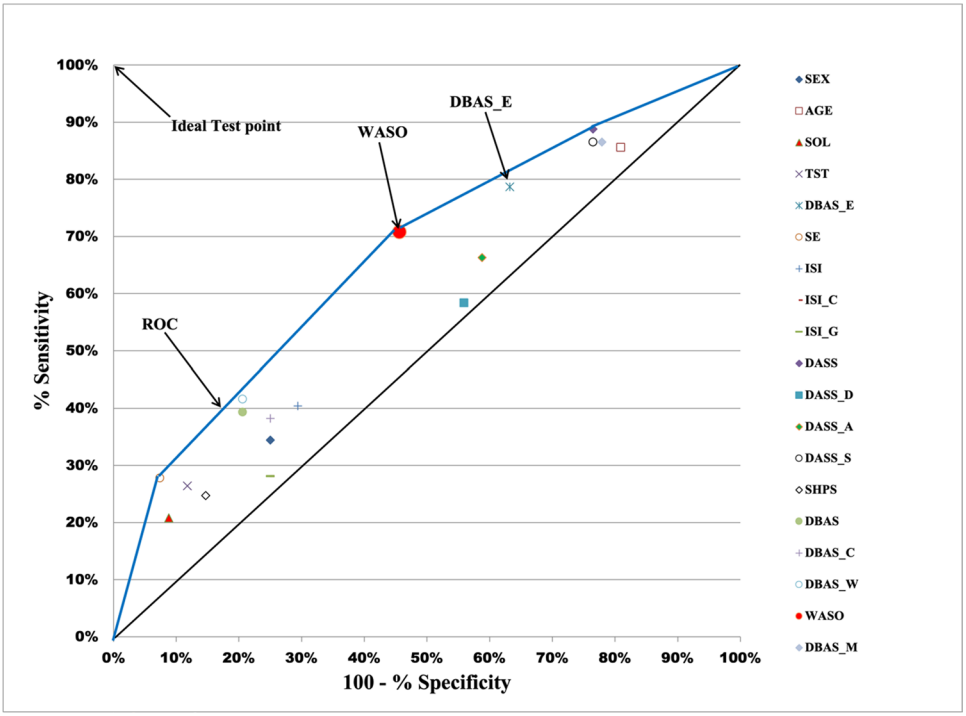

Fig. 3 ROC curve of the decision tree analysis. Figure 3 displays the receiver operating characteristic (ROC) curve. The optimal cutoff points for the WASO, DBAS_E, and other variables are located on the ROC plane. The best two predictors (here WASO < 7.1, DBAS_E < 18) are the ones nearest the Ideal Test Point

time after sleep onset (WASO < 7.14) and lower expectations for sleep (the subscale of dysfunctional beliefs and attitudes about sleep < 18) at baseline were at highest risk for dropout. Thus, having milder symptoms of insomnia, reflected in lower WASO, increased the risk of dropout in an e-mail-based CBT-I intervention.

Expectations for sleep, one of the subscales of DBAS-16, was the second factor to predict dropout. Specifically, among those with shorter than 7.1 min of WASO, those with less than a score of 18 on the DBAS-expectations for sleep subscale had a relatively higher risk of dropout compared to those with less than 7.1 of WASO and 18 or

more of sleep expectations score. Expectations for sleep consist of unrealistic sleep expectations about needing 8 h or more of sleep and need to catch up on sleep loss. These dysfunctional beliefs and attitudes about sleep are the common factors that cause and perpetuate insomnia. In addition, individuals who experience insomnia tend to have more dysfunctional beliefs and attitudes about sleep than those who do not [33]. Previous studies have shown that mild symptoms of insomnia as measured by ISI were associated with treatment non-completion in an internet-based self-help CBT-I [17]. Individuals with mild sleep problems and lower levels of dysfunctional beliefs and attitudes about sleep may experience less distress and impairment from their sleep problems, and thus may likely have lower levels of motivation and have doubts about need for treatment [17]. Additionally, individuals with lower scores on the DBAS-expectations for sleep may be more flexible in adjusting their expectations for sleep.

Nevertheless, individuals with mild insomnia symptoms also experience more negative health problems than good sleepers [34], suggesting that it is important to participate in treatments to improve symptoms. They may also have lower expectations from benefiting from intervention. Murray et al. found that lower expectation of the usefulness of treatment influenced participation of a self-guided intervention [35]. Therefore, motivational factors may play an important role with mild symptoms of insomnia.

In addition, 57.8% of the dropouts in this study were found to have terminated early (before the 4th session) in the intervention, highlighting the importance of strategies for adherence improvement at the early stages of treatment. The reason for dropout remained unclear because such data was not collected in this study, but we speculate low treatment adherence and early dropout might be due to a lack of therapeutic alliance, lower expectations, and a lack of understanding of the intervention in the early stages of intervention. A prior study has shown that high conscientiousness results in high medication and treatment adherence [36]. Therefore, personality characteristics, while not investigated in this study, such as participants' conscientiousness may also have been associated with adherence. Some evidence suggests that participants may dropout because they find the treatment recommendations counterintuitive, experience significant daytime sleepiness early in treatment, complain of boredom and a lack of activities upon the advice to reduce time in bed, or are ambivalent about changing their sleep–wake habit [37]. Additionally, the trouble of writing a sleep diary for a total of 7 weeks every day could have been a barrier to completing the intervention. It is likely to minimize and prevent high early dropout rates if treatment motivation is enhanced by adding factors that allow the therapist to provide personalized support and help understand the treatment process at the beginning of the treatment, which may be more feasible in a face-to-face format. For example, in a study of internet CBT for anxiety and depressive disorders, clinician contact during the course was found to be associated with increased adherence [38].

Interestingly, demographic factors such as gender and age were not significant predictors of treatment dropout. In this study, the relative homogeneity of the age of this sample may have resulted in age as a non-significant factor. Future studies including samples with wider age ranges may be able to clarify this issue further. Additionally, mood symptoms were not found to be a predictor in our study. A previous study reported that severe depression levels in the face-to-face group CBT-I were predictors of early dropout [15], while in a study of an online treatment program for chronic insomnia, the diagnoses of depressive and anxiety disorders were associated with attrition [18]. In this study, it is possible that mood symptoms were not significant because the sample had minimal/low levels of mood symptoms, as the intervention was designed to help students regardless of their insomnia status. However, it does raise the possibility that participants in face-to-face and e-mail-based interventions may drop out for different reasons, and further studies are needed to investigate different factors that contribute to dropout of treatment in different formats.

Limitations

Despite the strengths in this study, there were several limitations. First, demographic factors other than age, gender and information about the reason for dropout were not collected in this study. Future study should consider interviewing participants who dropped out and collect the qualitative information about various demographic factors and reasons for dropout. Second, the number of men was less than women. In other words, since the sample had a larger proportion of women, the results should be interpreted with caution in regard to generalizing the results to both genders. Third, in the process of screening participants, the first screening was the same in both sites. However, in the case of the second screening, the content was the same, but the method was different in that it was conducted by phone call in Korea and face-to-face in Hong Kong. Ensuring the same screening protocols in addition to adding other national samples will be important for future studies. While this study did not investigate differences between countries, it is important to acknowledge that not all Asian countries are the same. Additionally, ROC analysis is an exploratory method for generating hypotheses rather than testing hypotheses and requires a minimum sample size of 200 [39]. Thus, the results of the analyses should be considered tentative and therefore must be tested in other samples with a larger sample size.

Conclusions

Despite these limitations, this exploratory study adds to important indications on the prediction of dropout from e-mail CBT-I. The results are promising in that this may provide important indicators to tailoring interventions that improve adherence to a CBT-I program based on presenting individual characteristics. Our study highlights the importance of being more attentive to individuals with milder symptoms of insomnia and lower expectations of sleep when implementing alternative form of CBT-I. While this was an exploratory study, future studies should investigate strategies for improving intervention completion and ultimately ensuring optimal delivery of CBT-I.

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Data availability The datasets supporting the findings of the current study are not openly available due to human data and are available from the corresponding author upon reasonable request.

Declarations

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Sungshin University, The University of Hong Kong and The Chinese University of Hong Kong) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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