Participant adherence to the Internet-based prevention program StudentBodies™ for eating disorders – A review

Ina Beintner a,*, Corinna Jacobi a, C. Barr Taylor b

a Technische Universität Dresden, Institute for Clinical Psychology and Psychotherapy, Germany
b Stanford University School of Medicine, United States

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A B S T R A C T
Study and treatment dropout and adherence represent particular challenges in studies on Internet-based interventions. However, systematic investigations of the relationship between study, intervention and patient characteristics, participation, and intervention outcomes in online-prevention are scarce. A review of participation in trials investigating a cognitive-behavioral, Internet-based, 8-week prevention program (StudentBodies™) for eating disorders, moderators of participation, and the impact of participation on the relationship of outcome moderators and outcomes was performed. Seven US and three German studies with a total of N = 1059 female participants were included. Two of the U.S. and one of the German trials explicitly addressed high risk samples in a selective prevention approach. Across studies, dropout rates ranged from 3% to 26%. The women who participated in the trials accessed on average between 49% and 83% of the assigned intervention content. None of the study characteristics (universal vs. selective prevention, incentives, country, participants’ age) predicted adherence or study dropout. After adjusting for adherence, intervention outcomes (EDI Drive for Thinness and EDI Bulimia) were only moderately by participant’s age, with smaller effects in one sample of adolescent girls. Adherence to StudentBodies™ proved to be high across a number of trials, settings and countries. These findings are promising, but it is likely that adherence will be distinctly lower in the general public than in research settings, and intervention effects will turn out smaller. However, the intervention is readily available at minimal cost per participant, and the public health impact may still be notable.

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1. Introduction
Disordered eating is a common problem among young women. While only 1–3% of young women meet full diagnostic criteria for anorexia nervosa, bulimia nervosa or binge eating disorder (Hoek and van Hoeken, 2003; Hudson et al., 2007), up to 25% report partial syndromes or symptoms that meet criteria for subthreshold eating disorders (Leon et al., 1997; Shisslak et al., 1995).

In recent years, a number of risk factors for eating disorders have been identified in longitudinal studies, including frequent dieting and restrictive eating as well as an extreme preoccupation with weight and body shape (Jacobi et al., 2004). Structured and/or manualized psychoeducational programs have shown to reduce the impact of these risk factors (Stice et al., 2007) as well as, in some high-risk groups, the onset of full-syndrome eating disorders (Stice et al., 2008; Taylor et al., 2006). Such programs, particularly when they are available electronically, have the potential for wide-spread dissemination at low cost per participant.

StudentBodies™ is an Internet-based program for the prevention of eating disorders (Winzelberg et al., 2000; Winzelberg and Taylor, 1998). It is a structured, cognitive-behavioral program with 8 sessions over 8 weeks for adolescent girls and women that addresses factors presumed to lead to or alleviate eating pathology, including high weight and shape concerns. Universal as well as selective prevention approaches have employed StudentBodies™. In universal prevention approaches, every girl or woman interested in participating in the intervention was eligible for participation. In selective prevention approaches, participation was limited to women with elevated weight and shape concerns and/or initial eating disorder symptoms. Almost 1000 adolescent girls and young women in both the USA and Germany took part in ten randomized controlled trials evaluating the program. Across all trials, the intervention was associated with moderate improvements in eating disorder related attitudes, especially reductions of negative body image and the desire to be thin (Beintner et al., 2012).

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* Corresponding author at: TU Dresden, Institut für Klinische Psychologie und Psychotherapie, Chemnitzer Straße 46, 01187 Dresden, Germany. Tel.: +49 351 463 37460; fax: +49 351 463 37208.
E-mail address: Ina.Beintner@tu-dresden.de (I. Beintner).

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Apart from efficacy, adherence is a key factor in prevention programs. Poor adherence can preclude a positive impact of prevention programs that have the potential to be effective. This is especially important from a public health point of view: an intervention that has been proven efficacious in circumscribed lab conditions but is not adopted and accepted in more generalized settings will have little impact on public health (Glasgow et al., 1999).

Adherence has been defined as ‘the extent to which the patient’s behavior matches agreed recommendations from the prescriber’ (Haynes et al., 1979). While medication adherence has been given much attention (e.g., Andrade et al., 2006; Cramer et al., 2008; Farmer, 1999; Haynes et al., 2001) and some research on adherence to psychotherapy (e.g., Edlund et al., 2002; Ogrodniczuk et al., 2006; Olsson et al., 2009; Scheel et al., 2004), and Internet-based self-help (e.g., Christensen et al., 2009; Eysenbach, 2005; Wangberg et al., 2008) has been conducted, comparatively little is known about adherence to prevention programs.

However, previous research on self-directed interventions reveals that initial risk status (e.g., Linke et al., 2007) and participants’ age (e.g., Buller et al., 2008; Christensen et al., 2009; Donker et al., 2013; Stopponi et al., 2009) may affect adherence and dropout. Incentives have been shown to increase response rates in surveys (Edwards et al., 2009; Simmons and Wilmot, 2004; Singer et al., 1999), and may also reduce study dropout from trials on Internet-based interventions (Alexander et al., 2008; Khashayar et al., 2011).

Knowing which moderators impact both adherence and outcomes can facilitate clinical decision making by (1) ensuring that Internet-based prevention programs are not offered to participants who are unlikely to benefit from them in the first place and (2) ensuring that participants who would benefit, but need extra encouragement to use the program, receive the appropriate additional support.

In contrast to non-online preventive interventions, Internet-based preventive interventions have an inherent potential to obtain objective measures of adherence utilizing participants log-on data. These data have been reported for most of the StudentBodies™ trials. Adherence to the program seems to rise with increased structure of the program (Celio et al., 2002). In one of the individual studies, predictors of adherence, as well as adherence effects on outcomes, were investigated: Higher adherence was linked to more pronounced eating disorder related attitudes at baseline (Taylor et al., 2006) and—in the same sample—higher adherence predicted a greater reduction in EDI Drive for Thinness, but no other outcomes (Manwaring et al., 2008). The study is noteworthy because it includes analyses on the relationship of adherence to specific program components and outcomes and thus attempts to determine the most meaningful adherence measure. The main finding was that the duration of program use, the amount of content read and the number of postings in self-monitoring journal program use were associated with post-intervention outcomes while participation in online discussions did not predict outcomes.

With this review, we aim to expand past investigations on adherence to StudentBodies™ (Celio et al., 2002; Manwaring et al., 2008) and our previous meta-analysis (Beintrae et al., 2012) to further examine adherence across trials. We will 1) integrate adherence data reported in individual studies on StudentBodies™, 2) investigate the impact of potential moderators (universal vs. selective prevention approach, country where the study was conducted in, the mean age of participants, incentive) of adherence and 3) analyze whether and to what degree differences in adherence contribute to the moderation of intervention outcomes. In order to do that, we need to identify moderators of adherence, moderators of intervention outcomes, and examine if and how associations between these moderators and intervention outcomes change when adherence is taken into account.

2. Method

2.1. Study selection

All studies employing StudentBodies™ in RCTs, completed by August 2013 were included (Beintrae et al., 2012).

2.2. Measures of adherence

The degree of adherence to the intervention was defined as the mean number of pages (i.e. online screens) opened in the online program by the intervention group of each trial. Study dropout rates were also included in the analyses as a proxy for adherence. We chose to do this because there is great variation in how adherence to self-directed interventions is reported, and study dropout is a measure reported for most studies. Also, it has been postulated that study dropout (i.e., the failure to provide post-intervention data; also termed dropout attrition) and premature termination of treatment (i.e., the failure to engage in a preset minimum amount of the intervention; also termed non-usage attrition) are closely related in Internet-based interventions (Eysenbach, 2005).

2.3. Effect size calculation for intervention outcomes

Effect sizes were calculated as the difference in mean outcomes between pre- and post-assessment in the intervention group and the control group divided by the pooled standard deviation of intervention and control conditions at baseline (\(d = (\text{MWCGpost} - \text{MWCGpre}) / \text{SDpooled}\)). An adjustment for sample size was conducted (Hedges and Olkin, 1985). To account for small sample sizes in some of the trials, we then calculated Hedges’ g (Hedges, 1981; Hedges and Olkin, 1985). Due to the lack of ITT data in the majority of original publications, we calculated effect sizes for the study completer samples. We included outcome measures if they were available for at least eight trials.

2.4. Coding

Each study was coded by IB according to the characteristics listed below. Information from all sections of a research study was included.

Study dropout rate

Rate of participants not attending post-intervention assessments (based on the intent-to-treat sample size of the intervention group). Some authors did not consider participants as dropouts when they had been allocated to the intervention but never started it. In this case, we added the proportion of patients who had not started intervention to the reported dropout rate.

Adherence

Mean number of pages opened by participants in the intervention group in each trial.

Intervention outcomes

Effect sizes for the Eating disorder Inventory (EDI) Drive for Thinness and EDI Bulimia subscales (Garner, 1991) calculated as specified above.

Type of preventive intervention

Universal vs. selective prevention. Selective prevention was coded if inclusion criteria encompassed a minimum amount of weight and shape concern (i.e. a minimum score of 42 on the Weight Concerns Scale (Grund, 2003) in German samples or a minimum score of 50 on the Weight Concerns Scale (Killen et al., 1994) or 110 on the Body Shape Questionnaire (Cooper et al., 1987) in US samples) and/or symptoms of disordered eating.
effects model analyses. The random variance component was estimated analyses (Hedges and Olkin, 1985). To facilitate the interpretation of™et al., 2011). However, to date only 10 trials employed StudentBodies to be independent of adherence, we repeated all analyses by adjusting for adherence. Here, selective preventive approaches yield a larger

tial moderators for both participation and outcomes in the analyses.

2.6. Moderator analysis

In the original metaanalysis (Beintner et al., 2012), moderator analyses were only conducted if there was evidence for heterogeneity between effect sizes from individual studies. In the current review, we chose a different approach. We pragmatically selected potential moderators based on a sufficient number of studies that reported these variables and conducted exploratory analyses regardless of overall heterogeneity. We included 1) the type of prevention (universal vs. selective), 2) the country the study was conducted in, 3) the mean age of participants and 4) whether an incentive was given or not as potential moderators for both participation and outcomes in the analyses. To ensure a minimum of power to detect moderator effects, it has been suggested to include data from at least 10 trials (Borenstein et al., 2011). However, to date only 10 trials employed StudentBodies. We, therefore, pragmatically decided to perform moderator analyses if data from at least 8 out of these 10 trials were available.

To determine potential moderators, we performed metaregression analyses (Hedges and Olkin, 1985). To facilitate the interpretation of findings, all independent variables were centered around their median (Kraemer and Blasey, 2004). Due to the small number of trials and the fact that the same intervention was examined in all trials, primary analyses were based on the fixed effects model (Borenstein et al., 2011). In addition, secondary analyses based on the random effects model were performed.

Moderator analyses of intervention effects were first performed unadjusted as described above. Because intervention effects are unlikely to be independent of adherence, we repeated all analyses by adjusting for the mean number of pages opened in the intervention group and the interaction between potential moderators and the mean number of pages opened in the intervention group. When analyses are not adjusted, differences in treatment outcomes that are solely due to differences in adherence could be mistaken for true differences in treatment efficacy. Conversely, true differences that are masked by differences in adherence might be missed in unadjusted analyses.

3. Results

3.1. Sample of studies

We included six US and four German studies with a total of N = 990 female participants. Nine trials were conducted in college populations; participants were 20 years old on average. One trial was conducted in a prep school setting in Germany with 15–17 year old girls. Two of the U.S. and two of the German trials explicitly targeted high-risk samples in a selective prevention approach. Detailed descriptions of the included studies have been provided elsewhere (Beintner et al., 2012). In five studies, incentives were given for completing post-intervention and follow-up assessments, but not for participating in the intervention. In one study, the intervention was part of a college class and participation was required to receive a pass grade. In the remaining four studies, no incentives were given.

3.2. Participation

Adherence indicators reported in the individual trials are summarized in Table 1. Between 9% and 26% (mean: 13%) of participants dropped out from the studies (i.e., they did not complete post-intervention assessments). In eight trials, the mean number of online pages opened by participants of the intervention group was reported. Participants opened between 49% and 81% (mean: 74%) of assigned online pages. Adherence was lowest in one study recruiting high school students in Germany.

3.3. Moderators of participation

None of the potential moderators (type of prevention, country, incentives, participants’ age) significantly predict study dropout rates and adherence (see Table 2).

3.4. Impact of participation on the moderation of intervention outcomes

Adherence significantly predicts effect sizes of the EDI Drive for Thinness subscale in both the fixed (b = 0.01, p = .01) and random effects model (b = .01, p = .04); a 10% increase in the proportion of assigned pages opened by the average participant of a trial increases the effect size by d = 0.10. Adherence does not predict effects on the EDI Bulimia subscale.

Analyses of treatment effect moderators were first performed unadjusted. In a second step, we repeated all analyses by adjusting for adherence and the statistical interaction between potential moderators and adherence. Detailed results of the analyses are summarized in Table 3. The type of prevention significantly predicts effect sizes of the EDI Drive for Thinness subscale in both the unadjusted fixed and random effects models, but not in the fixed and random effects models adjusted for adherence. Here, selective preventive approaches yield a larger effect than universal approaches. Type of prevention does not predict effect sizes on the EDI Bulimia subscale.

The country where the trial was conducted in does not predict effect sizes of the EDI Drive for Thinness and Bulimia subscales.

Incentives significantly predict effect sizes of the EDI Drive for Thinness subscale in the unadjusted fixed effects model, but not in any other model. Effect sizes were lower if participants were given an incentive for completing post-intervention assessments.

Participants’ age significantly predicts effect sizes of the EDI Drive for Thinness subscale in the unadjusted fixed effects model and both the fixed and random effects models adjusted for adherence. A higher age is associated with larger intervention effects, and the influence of participants’ age is even larger when adjusting for adherence. Participants’ age also significantly predicts effect sizes on the EDI Bulimia subscale in both the unadjusted fixed and random effects models, but not in the fixed and random effects models adjusted for adherence. Here, a higher age is associated with a smaller effect size. However, age does not significantly predict intervention outcomes in any of the models if the only study on adolescents (Fritsche and Schlenkrich, 2005) is excluded from the analyses.
4. Discussion

The objectives of this review were to assess adherence across all randomized controlled trials employing StudentBodies™ by meta-analytic techniques, and to analyze if and how adherence affects main outcomes of these studies. The mean number of pages opened in the online program was used as a measure for adherence. Additionally, study dropout rates were included in the analyses as a proxy for adherence (Eysenbach, 2005) to facilitate comparisons with other trials.

Overall, adherence to StudentBodies™ was high, regardless of whether the program was utilized in universal or selective prevention approaches, whether the program was used in the US or Germany, whether incentives were given or not, and regardless of participants’ age. On average, participants opened almost three quarters of the assigned pages. This is in line with findings from another trial on an Internet-based eating disorder prevention program (Stice et al., 2012), but makes StudentBodies™ stand out compared with an Internet-based combined targeted prevention and early intervention program (Bauer et al., 2009; Lindenberg et al., 2011), Internet-based self-help interventions for eating disorder patients (Beintner et al., 2014) and online interventions for the prevention and treatment of other mental disorders and/or behavioral problems (Christensen et al., 2009; Eysenbach, 2005; Melville et al., 2010) where attrition usually is a major issue. Study dropout rates, on the other hand, were moderate and comparable to other trials on Internet-based interventions for patients with eating disorders (Beintner et al., 2014) as well as other RCTs on prevention (e.g., Carli et al., 2013; Hansen et al., 1990). Adherence predicted intervention effects on the EDI Drive for Thinness subscale, but not on the EDI Bulimia subscale.

While none of the analyzed variables predicted adherence, we cannot rule out that other moderators, which could not be analyzed due to a lack of sufficient data from individual studies, could be influential. In self-help interventions for eating disorders, initial symptom severity can affect adherence (Beintner et al., 2014). Similarly, in eating disorder prevention, the degree of participants’ weight and shape concerns or other eating disorder signs and symptoms at baseline may affect their engagement in a prevention program. Unfortunately, sufficient data from the original studies were not available for examining this possible interaction in more detail, as comparable measures from at least 8 of the trials would have been needed. Nonetheless, data from a pilot study employing StudentBodies™ in a sample of women with an elevated risk for or first signs of anorexia nervosa (Ohlmer et al., 2013) encouragingly suggest that an equally high adherence can be achieved in a sample with restrictive eating and high weight and shape concerns as in unselected samples or samples with elevated weight and shape concerns only.

In the original metaanalysis (Beintner et al., 2012), moderator analyses for intervention outcomes were only conducted if there was evidence for heterogeneity between effect sizes from individual studies. In the current review, we exploratively analyzed potential moderators based on a sufficient number of studies that reported these variables. Thus, when analyzing moderators of the intervention outcomes, we detected an effect that has not been detected in the first metaanalysis: selective intervention yielded larger effects on participants’ drive for thinness than universal interventions. However, this effect was not robust to adjusting for adherence. Also, contrary to the original metaanalysis, we also analyzed participants’ age as a potential moderator. We detected a robust positive connection between participants’ age and the reduction of their drive for thinness, but not with attitudes related...
et al., in preparation) show a somewhat contradictory effect: intervention effects on binge eating were considerably smaller in women past their mid-twenties, whose eating disorder related attitudes and behaviors may have persisted over a longer period of time. Thus, combining the evidence from the metaanalyses and the individual study, the relationship of participants’ age and intervention outcomes may not be linear, but instead follow an inverted U-shaped curve, with the intervention’s highest potential impact on women in their late teens and early twenties, who also have the highest risk for eating disorder onset (Hudson et al., 2007; Micali et al., 2013).

The country where the study was conducted in did not affect the intervention outcomes analyzed in this review. This is consistent with our previous analysis (Beintner et al., 2012) and suggests that on-line interventions with similar content and structure perform equally well in Germany and the U.S.

A major limitation of this review (as well most studies on adherence to Internet-based interventions in general) is rooted in measuring adherence utilizing participants’ log-on histories. While these data can be considered highly objective as such, it remains unclear how engaged participants actually were with the intervention contents after the intervention page had been opened on their computer. While we generally simply assume that they read each page they opened thoroughly, one must be aware that the focus of their attention could actually have been elsewhere (online or offline). However, the specific intervention investigated in this review contains numerous separate pages in each session, including links to additional reading. The additional reading may be optional and reading is based on the user’s interest. Nevertheless, participants in StudentBodies™ on average accessed 74% of the program pages. It seems unlikely that participants would take the trouble to navigate through large parts of the program if they are not interested in reading the program contents.

In future research, this problem could be solved by tracking how much time was spent on each page and checking for plausibility (i.e., defining a minimum amount of time that has to be spent on each page before it is registered as “read”), or automatically logging out participants who have been inactive for a set amount of time.

In addition, due to the comparatively small number of studies having employed StudentBodies™, there was insufficient data on other outcome measures, such as weight and shape concerns or initial symptoms of eating disorders to analyze potential moderator effects on these outcomes. Such analyses should be conducted once the number of trials

### Table 2

<table>
<thead>
<tr>
<th>Potential moderators</th>
<th>Measure Study dropout rate</th>
<th>Average percentage of assigned pages opened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of prevention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universal vs. selective</td>
<td>bselective = .2869** bselective = .073p = .40</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA vs. Germany</td>
<td>b = .01** p = .87</td>
<td>b = .013p = .89</td>
</tr>
<tr>
<td>Incentive yes vs. no</td>
<td>b = -.019p = .31</td>
<td>b = .032p = .15</td>
</tr>
<tr>
<td>Participants’ age</td>
<td>b = -.019p = .31</td>
<td>b = .032p = .15</td>
</tr>
</tbody>
</table>

FEM: fixed effects model; REM: random effects model; k: number of studies included.

### Table 3

<table>
<thead>
<tr>
<th>Potential moderator</th>
<th>Outcome measures</th>
<th>EDI Drive for Thinness</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention type universal vs. selective</td>
<td>bselective = .2869**</td>
<td>EDI Drive for Thinness</td>
<td>10</td>
</tr>
<tr>
<td>Country USA vs. Germany</td>
<td>b = .1184p = .10</td>
<td>b = .1245p = .88</td>
<td>10</td>
</tr>
<tr>
<td>Incentive yes vs. no</td>
<td>b = -.1763p = .01</td>
<td>b = .0093p = .95</td>
<td>10</td>
</tr>
<tr>
<td>Participants’ age</td>
<td>b = .042p = .04a</td>
<td>b = .043p = .12</td>
<td>9</td>
</tr>
</tbody>
</table>

FEM: fixed effects model; REM: random effects model; k: number of studies included; adj: adherence: metaanalysis adjusted mean number of pages opened in the intervention group; b: linear regression slope; regressions slopes that are significantly different from zero are indicated in bold font.

Participants’ age was centered around the median age across all trials. For categorical moderators, b is the difference between the two groups. The reference group is indicated in the subscript. Example: Selective prevention predicts effects on EDI Drive for Thinness in the fixed and random effects models. Effect sizes for EDI Drive for Thinness are increased by .29 in selective prevention compared with universal prevention (bselective = .2869** in the unadjusted fixed and random effects models.

For continuous moderators, b indicates the change in effect sizes if the value of the moderator is increased by one unit. Example: Participants’ age predicts effect sizes for EDI Drive for Thinness by .04 (b = .0425) in the unadjusted fixed effects model.

Age did not significantly predict outcome when the only trial on adolescents (Fritsche and Schlenkirch, 2005) was excluded from the analyses.
employing this intervention has grown further. Also, the comparatively small number of studies limits the statistical power of the metaanalysis to detect potential moderator effects. In order to address this problem, fixed effects analyses (which yield more power to detect differences) were chosen as primary analyses in this review (Hedges and Vevea, 1998).

Finally, the review is limited by the relatively small number of moderators available for analysis. Acceptance to StudentBodies™ may have been affected by intervention or participant characteristics other than prevention approach, incentives, and age that remain undetected. Acceptance of StudentBodies™ among its users—which is reflected by the degree they participate in the intervention and adhere to the intervention assignments—proved to be outstanding across a number of trials, settings and countries. These findings are promising, especially when comparing them to findings of other Internet-based interventions for eating disorders (Beintner et al., 2014) and other mental disorders (e.g., Christensen et al., 2009; Eysenbach, 2005; Wangberg et al., 2008). An important next question is whether or not adherence will remain sufficient to achieve the desired intervention outcomes when the intervention is taken from the research lab to “real-world” settings, and schools and communities. It has been suggested that adherence to treatment will be distinctly lower in primary care or the general public than in clinical trials, and intervention effects will thus turn out smaller (e.g., Miller and Hays, 2000; Prado and Mion, 2010). We have to expect similar effects in online prevention, but since the intervention is readily available at minimal cost per participant, the public health impact may still be notable.

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