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Treating eating disorders in the real world — MaiStep: A skill-based universal prevention for schools

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ABSTRACT

Eating disorders are difficult to treat and often associated with morbidity and mortality. Universal prevention approaches are increasingly focusing on enhancing skills, but few eating disorder programs are available for under-15-year-olds. This study aimed to develop and examine a school-based universal prevention program ('MaiStep') for adolescent boys and girls.

A three-arm randomized controlled trial with baseline, post-intervention and 12-month follow-up was conducted with 1654 adolescents (M = 13.35, SD 0.76). 'MaiStep' was delivered by psychologists in the first intervention group (IG1) and teachers in the second intervention group (IG2), and compared to an active control group (ACG). Primary outcomes were eating disorder-related risk factors measured with scales of the Eating Disorder Inventory-2 (e.g. 'drive for thinness', 'interoceptive awareness'), cognitions and affect related to the body (Body Shape Questionnaire, BSQ-8), and behaviors (Body Image Avoidance Questionnaire, BIAQ). The total sample (N1) was divided into a healthy subsample (N2) and a sample fulfilling DSM-5 criteria for a subthreshold eating disorder (N3) measured with the self-report Structured Inventory for Anorexic and Bulimic Syndromes (SIAB-S).

Significant improvements in 'interoceptive awareness' (EDI-2) and lower BIAQ scores emerged in N1 at post-intervention and at 12-month follow-up ($F(4; 3038) = 3.068$, $p = .016$, $\eta_{part}^2 = 0.004$ and $F(4; 2900) = 2.993$, $p = .018$, $\eta_{part}^2 = 0.004$) and in N2 at post-intervention and at 12-month follow-up ($F(4; 2812) = 3.147$, $p = .014$, $\eta_{part}^2 = 0.004$ and $F(4; 2684) = 3.674$, $p = .005$, $\eta_{part}^2 = 0.005$). The healthy subsample N2 additionally showed significantly lower scores on 'drive for thinness' (EDI-2) and on the BSQ-8c at post-intervention ($F(2; 1446) = 3.091$, $p = .046$, $\eta_{part}^2 = 0.004$ and $F(2; 1453) = 3.505$, $p = .030$, $\eta_{part}^2 = 0.005$) but not at 12-month follow-up. No significant results emerged for N3.

The positive findings of improved 'interoceptive awareness' (EDI-2) and reduced body image avoidance (BIAQ) indicate that broad disseminated universal prevention under the age of 15 is possible.

Trial registration MaiStep is registered at the German Clinical Trials Register (DRKS00005050).

1. Introduction

Eating disorders such as anorexia nervosa (AN) and bulimia nervosa (BN) are difficult to treat and have a tendency to become chronic. They are often associated with serious physical complications as well as high rates of morbidity and mortality, and can negatively influence socioeconomic achievement (Arcelus et al., 2011; Smink et al., 2012; Tabler and Utz, 2015). Both AN (with a prevalence of 0.3%) and BN (prevalence of 0.4%) as well as Binge Eating Disorder (BED; prevalence of 0.5%) are substantially more frequent in girls under the age of 15, with sex ratios of 5:0 (AN), 5:1 (BN) and 5:3 (BED) (Hammerle et al., 2016). Body dissatisfaction, negative affect, media use and reduced self-

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esteem concerning body and shape are some of the key predictors for the development of eating disorder-related behaviors (Jacobi et al., 2011; Stice et al., 2011). Risk factors of eating disorders have increased in young children and pre-adolescents (Smink et al., 2013; Steinhausen and Jensen, 2015), and according to German studies, at least 20% of this age group are adversely affected by eating disorder behaviors (Hammerle et al., 2016). Even with respect to risk factors and eating disorder-related behaviors, girls are significantly more affected than boys, with one third of girls and 15% of boys reporting disordered eating behaviors and attitudes (Herpertz-Dahlmann et al., 2008). Consequently, there has been an increase in reported incidences of pre- and early-adolescents suffering from partial-syndrome and full-syndrome eating disorders (Smink et al., 2013; Swanson et al., 2011). Thus, there is an urgent need to develop prevention programs prior to the age when adolescents begin to show dangerous weight control behaviors (e.g. restrictive eating, vomiting).

The first steps of eating disorder prevention research revealed a discouraging state of the field. In a review of 20 empirical intervention studies, Austin (2000) found that four studies reported a significant worsening of eating disorder-related behaviors and the vast majority of the programs achieved no effect at all. Seven years later, however, reviews by Stice and Shaw (2004) and Stice et al. (2007) found that 51% of the included prevention programs led to a significant reduction of at least one eating disorder risk factor and 29% were able to reduce eating disorder-related behaviors in the participants. The meta-analytic review suggested that larger intervention effects tended to occur in selected (vs. universal) programs, interactive (vs. didactic especially with a psychoeducational content) programs, and multisession (vs. single-session) programs in high-risk female participants older than 15 years. In detail, there are 85 published randomized controlled trials (RCTs) for eating disorder prevention delivered to high-risk female samples above the age of 15, compared to only 13 published RCTs for universal prevention (targeting the general population including mixed-gender samples under the age of 15) (Watson et al., 2016). This ratio is surprising given that epidemiological data have shown a peak of subclinical conspicuous eating behaviors and incidence of AN at the age of 15 (Hammerle et al., 2016; Milos et al., 2004). Although effective eating disorder prevention programs do exist, only a limited amount of research has addressed participants of both sexes under the age of 15 years, keeping in mind that a universal prevention approach should start before a disorder develops (Caplan, 1964).

Recent programs for children and adolescents (e.g. 'Life Smart' (Wilksch et al., 2015), 'MABIC-Project' (Sanchez-Carracedo et al., 2016), 'Happy Being Me' (Richardson and Paxton, 2010)) are attempting to fill this gap. These programs use interactive program content to induce behavior that protects children and adolescents from developing risk factors such as body dissatisfaction or binge eating. Such protective behaviors can be labeled as skills. The World Health Organization (WHO) (1997) emphasized the importance of life skills education in preventing health problems, and the meta-analytic reviews by Stice et al. (2004, 2007) confirmed this assumption. Thus, the existing programs for this age group demonstrate that the life skills approach is both useful and helpful.

Another important dimension lies in the relevance of broad dissemination, especially in the field of universal prevention (Wilksch, 2017). One main reason for dissemination is to develop universal prevention programs that are practicable in 'real-world settings' and compatible with existing systems such as schools rather than 'stand-alone' scientific programs. Examples of broad dissemination in school settings under the age of 15 are scarce (Sanchez-Carracedo et al., 2016). To the best of our knowledge, only three universal prevention programs exist, whose effectiveness have been evaluated with the respective intervention being delivered by trained teachers. The German program 'Primary prevention of anorexia nervosa in preadolescent girls' (PriMa) showed positive changes in knowledge and body self-esteem at follow-up (Wick et al., 2011). An evaluation of the German POtsdam Prevention at Schools (POPS) program of Warschburger et al. (2011) is still underway. Evaluation of the third program, the Spanish MABIC project, reported reductions in beauty ideal internalization, disordered eating attitudes and weight-related teasing (Sanchez-Carracedo et al., 2016). One major limitation might be that both MABIC and PriMa only included girls. Following the principle of broad dissemination, it is important to develop and evaluate skills-based universal prevention for participants of both sexes under the age of 15.

The main aim of the present study was therefore to develop and assess a universal prevention program for eating disorders for adolescents of both sexes. Further aims were to investigate broad dissemination aspects as well as realization by professionals (psychologists) and trained teachers compared to an active control group, and the investigation of subgroups of healthy participants and participants fulfilling criteria for an eating disorder according to the DSM-5 (Falkai, 2015). We therefore formulated the following a priori hypotheses: MaiStep will significantly reduce: a) the risk factors 'Drive for thinness', 'Bulimia' 'Body dissatisfaction', 'Ineffectiveness', 'Perfectionism', 'Interoceptive Awareness' (measured with the Eating Disorder Inventory-2), b) eating disorder-related cognitions and affect related to the body (measured with the Body Shape Questionnaire), and c) associated eating disorder-related behaviors such as 'Body Image Avoidance' (measured with the Body Image Avoidance Questionnaire) in the intervention groups versus the active control group.

2. Methods

2.1. Procedure and study design

The study was approved by the local independent ethics committee and the local commissioner for data protection prior to commencement. Schools in the German Federal state of Rhineland-Palatinate were randomly selected in cooperation with the State Department of Education. They were initially approached by telephone and e-mail and asked for general interest in participation. Of thirteen contacted schools, nine agreed to participate.

For a better measurement of broad dissemination, a three-group design with two intervention groups and one active control group, measuring baseline, post-intervention and 12-month follow-up, was implemented. For practical reasons and according to the requirements of the State Department of Education, school-wise randomization was chosen, and stratified by type of school, each of the nine schools was randomly allocated to one of the three groups. Randomization was carried out using MS Excel by an independent member of the institute not involved in the project (Fig. 1).

In intervention group 1 (IG 1), the primary prevention 'Mainz School Training of Eating Disorder Prevention' (MaiStep), which is further described in the Interventions section below, was carried out by psychologists of the Department of Child and Adolescent Psychiatry and Psychotherapy, University Medical Centre of the Johannes Gutenberg University Mainz. To ensure adherence to the program, the eight coaches attended a two-day workshop prior to the start of the study and received a specially developed accompanying manual. The workshop included information about eating disorders and instructions on teaching the program. Adherence meetings were scheduled after three units and at the end of the intervention. Adherence was checked via individual discussion, whereupon changes were implemented if necessary.

In intervention group 2 (IG 2), the MaiStep program was carried out by trained teachers. To ensure adherence to the program, teachers likewise attended a two-day workshop (the same workshop as in IG 1) prior to the start of the study and received a specially developed accompanying manual (same as IG 1). Adherence was checked analogously to IG 1.

In the active control group (ACG), teachers carried out a universal prevention program for stress prevention, which was recommended by

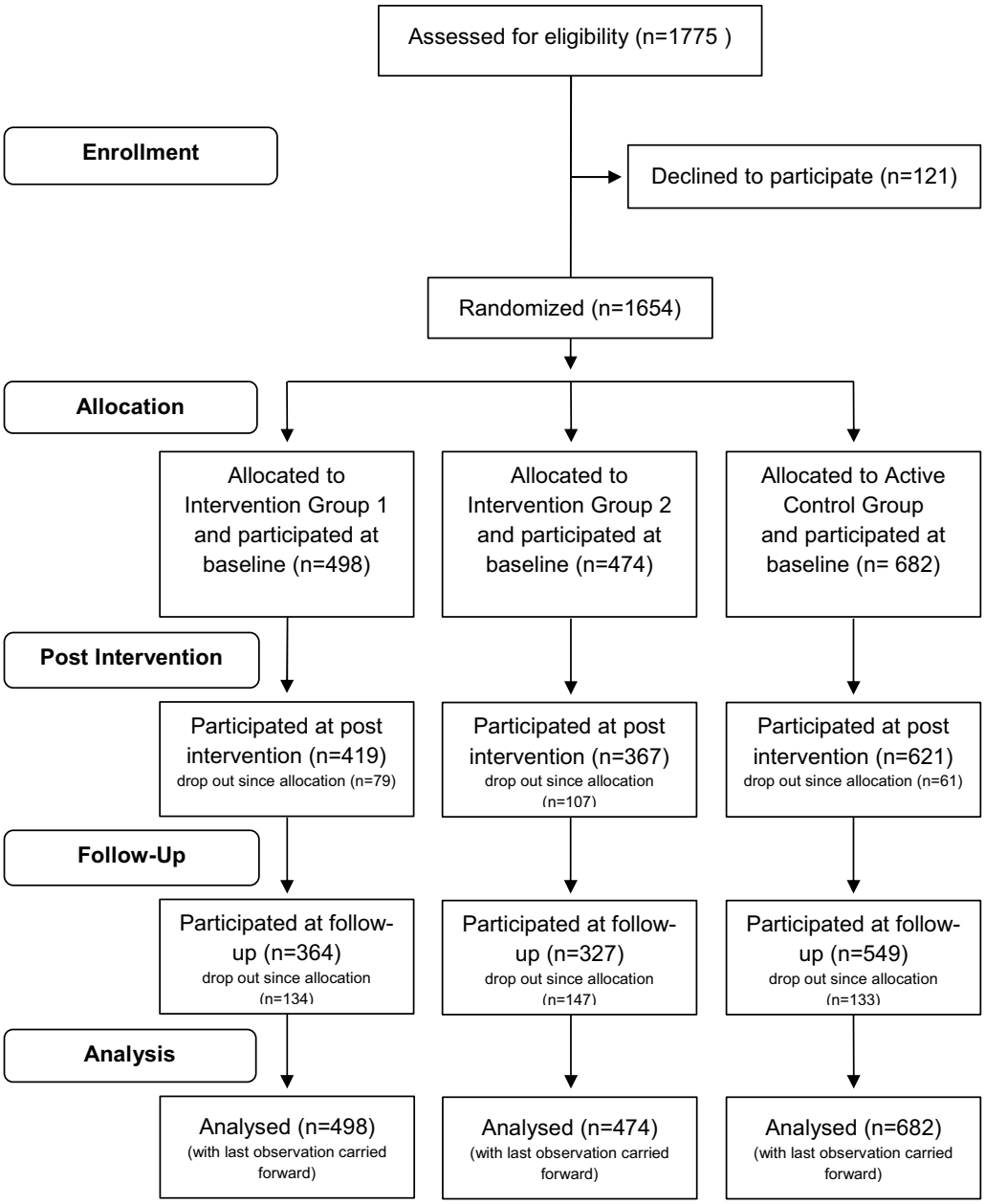

Fig. 1. Study flow diagram.
Note. No significant differences in dropout rates ($\chi^2(4) = 4.70$, $p = .35$).

the Federal Center of Health Education. The intervention comprised five units with the major aim of reducing experiences of stress and thus preventing the occurrence of stress-related psychological disorders and improving quality of life. Psychoeducational contents about stress and how to learn relaxation techniques were taught in the first and second units. Subsequently, in units three and four, the role of stress in groups, including the phenomenon of bullying, was explained and the enhancement of cohesiveness in the classes was trained through role-plays and group exercises. The final unit dealt with the experience of stress related to school examinations. This active control group design was chosen to ensure that unspecific effects of undergoing a prevention program were not solely responsible for potential changes in eating disorder behaviors.

2.2. Participants

We included participants into the study between October 2009 and February 2011. Written informed consent of both parents and adolescents was obtained before study inclusion. Adolescents of both sexes aged between 12 and 15 years were eligible to participate in the study. During the entire study period, participants were given the opportunity to make an appointment with the clinical psychologists of the study team. Additionally, an evening parent meeting was offered in every participating school, which included information about eating disorders in general and the aims of the study in particular.

The required sample size was calculated using G-Power 3.0 (Faul et al., 2007). To detect a small effect ($\eta_{part}^2 = 0.01$) according to Cohen's (1988) criteria, with a power of 95% and an alpha error of 5%, in a three-group design, correcting for clustering with an intraclass coefficient (ICC) of 0.05 (Hedges and Hedberg, 2007) and the inflation formula (Eldridge et al., 2006), a total sample of 1242 participants was calculated.

We approached 1775 students to take part in the study and 1654 students and their parents gave written informed consent. Data from

these adolescents were collected at baseline, post-intervention and 12-month follow-up. Of these 1654 participants, 247 (14.9% of the total group) dropped out after the post-intervention and a further 167 (25.1% of the total group) dropped out after 12 months. Due to our anonymization procedure in accordance with the ethics committee and commissioner for data protection, it was not possible to ask participants about reasons for dropout. There were no significant differences between participants who completed the study and those who dropped out with regard to age, weight, BMI and BMI percentile, and intervention group.

Baseline data were collected from 498 participants of IG 1, 474 participants of IG 2 and 682 participants of the ACG. The mean age of the 1654 participants was 13.35 years (SD = 0.76). 55.9% were in the seventh grade and 44.1% the eighth grade. The average body weight was 53.22 kg (SD = 11.69) and the average height was 1.62 m (SD = 0.08). The average body mass index (BMI = kg/m^2) was 20 (SD = 3.46), which corresponds to a BMI percentile of 55.25 according to the data of Kromeyer-Hauschild et al. (2001). Of all participants, 7.2% were considered to be underweight (BMI percentile < 10) and 15.2% were considered to be overweight (BMI percentile > 90). A total of 122 participants fulfilled criteria for an eating disorder according to DSM-5. Five girls met criteria for anorexia nervosa, five girls and one boy met criteria for bulimia nervosa, five girls and three boys met criteria for binge eating disorder and 103 participants met criteria for OSFED. Please refer to Ernst et al. (2017) and Hammerle et al. (2016) for further information. Sample characteristics are reported in Table 1.

2.3. Interventions

The development of the prevention program was preceded by a systematic review of 63 scientific articles addressing eating disorder prevention in childhood and adolescence (Bürger, 2015). Effective and ineffective programs were analyzed and guidelines were created including theoretical foundations, program content, didactic methods and further measurements, which also led to the three-group design (Bürger, 2015). Prospective studies for potential risk and protective factors were analyzed and hypothesized associations were combined into a model for the development of eating disorder symptoms, in accordance with Haines and Neumark-Sztainer (2006) in particular and with other study groups (Ouwens et al., 2009; Stice, 2001; Striegel-Moore and Bulik, 2006). In summary, MaiStep was developed based on the information compiled from prevention programs and risk factor studies.

MaiStep includes five 90-minute units conducted at weekly intervals. The didactic methods consist of skills coaching, including interactive methods (experience-based approaches, group discussions and role plays) to achieve a better anchoring of the content. Homework has to be completed after every lesson in order to integrate the content into the daily routine. In the present study, a tandem of a male and a female coach conducted certain units (e.g. body-related issues) separately for boys and girls. For an overview of the program content, please refer to Table 2. The participants attended a mean of 4.51 (SD 0.82) units.

2.4. Measures

The set of questionnaires encompassed demographic information (school, age) and different self-report questionnaires assessing eating disorder pathology, body dissatisfaction, eating disorder risk factors such as internalization of thin ideals, general psychopathology and general health. As primary outcomes, we focus on instruments regarding eating disorder pathology and body dissatisfaction. Body weight and height were measured with audited scales and stadiometers. At all measurement points, the questionnaires were administered within two school lessons in the different classrooms. Every participant had his/her own table, and body weight and height were measured in a separate room. At least one person from the study team was present to answer questions at all times. Every participant sat alone at a table when completing the questionnaires in order to reduce the risk of pee-desirability bias. At baseline, five participants (three girls and two boys) withdrew their informed consent because they did not wish to be weighed.

Self-report version of the Structured Interview for Anorexic and Bulimic Syndromes (SIAB-S)

Eating disorder symptoms were assessed with the SIAB-S (Fichter and Quadflieg, 1999). The SIAB-S has demonstrated reliable and valid

Table 1
Sample characteristics at baseline.

	IG 1 (n = 498)	IG 2 (n = 474)	ACG (n = 682)	Total sample (N = 1654)
Age in years, M(SD)[a]	13.20 (0.81)	13.37 (0.70)	13.44 (0.75)	13.35 (0.76)
Grade, n(%)[b]				
7	344 (69.1)	235 (49.6)	341 (50.0)	920 (55.6)
8	154 (30.9)	239 (50.4)	341 (50.0)	734 (44.4)
Gender, n(%)				
Female	260 (52.2)	234 (49.4)	379 (55.6)	873 (52.8)
Male	238 (47.8)	240 (50.6)	303 (44.4)	781 (47.2)
BMI percentile, M(SD)[c]	51.90 (29.26)	58.04 (28.24)	55.75 (29.66)	55.25 (29.19)
Weight groups, n(%)				
Underweight (< 10th percentile)	39 (8.6)	21 (4.7)	42 (7.7)	102 (7.2)
Normal weight (≥10th and ≤90th percentile)	355 (78.5)	355 (79.6)	414 (75.7)	1124 (68.0)
Overweight (> 90th percentile)	58 (12.8)	70 (15.7)	91 (16.6)	219 (15.2)
Type of school, n(%)[d]				
Gymnasium[e]	173 (34.7)	127 (26.8)	303 (44.4)	603 (36.46)
Realschule[f]	64 (12.9)	162 (34.2)	173 (25.4)	399 (24.12)
Gesamtschule[g]	261 (52.4)	185 (39.0)	206 (30.2)	652 (39.42)

Note. IG = Intervention Group; ACG = Active Control Group.
[a] $F(2,1554) = 14.21$, $p = .00$, part. $\eta^2 = 0.02$; IG1 < IG2 ($p = .00$); IG < ACG ($p = .00$).
[b] $\chi^2(2) = 52.27$, $p = .00$.
[c] $F(2,1442) = 5.13$, $p = .01$, part. $\eta^2 = 0.01$; IG1 < IG2 ($p = .01$).
[d] $\chi^2(4) = 106.98$, $p = .00$.
[e] 9-Year secondary school program, qualifying for university.
[f] 6-Year secondary school program.
[g] Comprehensive school.

Table 2
Overview of MaiStep goals and content.

MaiStep unit	Name of the unit	Goals of the unit	Content of MaiStep unit	Targeted risk factor
1	MaiStep - what's that?	Introduction and description of the three basic variables	Introductions and information regarding the goals and content of MaiStep	–
		Create solidarity in the class	Theory and benefits of class solidarity Group game and role play in which the students are required to stick together	Countering bullying to reduce beauty ideal internalization
		Improve mindfulness in daily life	Introduction to the core elements of mindfulness Practice of mindfulness	Reducing perfectionism and improving interoceptive awareness
		Recognize the importance of using skills in dealing with problems of daily life	Introduction and discussion of the pros and cons of using skills	Reducing fear of loss of control and improving self-efficacy
2	Ideal or real beauty!	Improve one's critical view of beauty ideals in the mass media	Discussion with pictures about real beauty and searching for the most attractive men and women Group discussion and film on how the media changes beauty ideals with make-up and retouching Group discussion of important friend characteristics	Reducing internalization of beauty ideals
3	My body and me!	Improve one's perception and awareness of the body	Film on how different body parts are stressed Discussion "what I like and don't like about my body!" Mindfulness exercises for body self-awareness	Reducing body image avoidance and improving body satisfaction
4	Rollercoaster of emotions!	Improve one's response to negative emotions	Interactive group play regarding emotions Interactive group work and discussion about which skills improve and help stabilize one's own mood	Reducing negative affect (ineffectiveness) and improving self-efficacy
5	Responding to interpersonal conflicts and conclusion	Improve one's handling of interpersonal conflicts	Group exercise and group discussion of interpersonal conflicts Training of interpersonal skills in role-play situations Conclusion of the contents of the program	Reducing fear of loss of control and improving self-efficacy

results similar to the structured interview, as well as good internal consistency, concurrent validity and criterion validity (Fichter and Quadflieg, 2000). The sensitivity and specificity for detecting partial and full-syndrome eating disorders is within an acceptable range (Fichter and Quadflieg, 2000). We recorded an excellent Cronbach's α of 0.91 in our sample. The SIAB-S was used to determine whether participants fulfilled criteria for DSM-5 eating disorders or 'Other Specified Feeding and Eating Disorders' (OSFED) (Falkai, 2015) in order to additionally analyze a healthy subgroup. For further information about the applied diagnostic criteria, please refer to Ernst et al. (2017) and Hammerle et al. (2016).

To assess eating disorder-related psychopathology, we used the following instruments:

Eating Disorder Inventory-2 (EDI-2) (Paul and Thiel, 2005)

The subscales of the EDI-2 are widely accepted in research on eating disorders and have shown good internal consistency and validity (Thiel et al., 1997). To ensure maximum test economy, in accordance with other studies (Kappel et al., 2012; Salbach-Andrae et al., 2010), we used the most valid subscales of the EDI-2 (Drive for Thinness, Bulimia, Body Dissatisfaction, Infectiveness, Perfectionism and Interoceptive Awareness). Cronbach's α ranged from 0.695 (Perfectionism) to 0.922 (Body Dissatisfaction) in our sample.

Body Shape Questionnaire - Short Version (BSQ-8c; (Pook et al., 2008; Tuschen-Caffer et al., 2005))

The BSQ-8c is a short version of the BSQ, which has shown both good factorial validity and treatment sensitivity. In particular, it is used to measure cognitive-affective aspects of body dissatisfaction with eight items (Pook et al., 2008). Cronbach's α amounted to 0.925 in our sample.

Body Image Avoidance Questionnaire - Short Version (BIAQ; (Legenbauer et al., 2007))

For economic reasons, we employed the 11-item German version of the BIAQ. The items measure body image disturbances, including the avoidance of situations in which body image is activated or in which one's body might be judged by others. The short version of the BIAQ has shown good internal consistency and validity, and was found to distinguish between healthy controls and individuals with eating disorders (Legenbauer et al., 2007). Cronbach's α was 0.730 in our sample.

2.5. Statistical analyses

Accuracy of the data was ensured by double entry of the questionnaires and subsequent comparison of the two datasets. Following a conservative approach, missing values were treated with the last-observation-carried-forward (LOCF) method, resulting in an intent-to-treat dataset (Tabachnik and Fidell, 2012). The Statistical Package for the Social Sciences (SPSS), Version 24 was used for all analyses. The threshold for statistical significance was set at an α-level of 5% and a *p*-value of $p < .05$. The total sample (N1) was divided into a healthy subsample (N2) and a sample fulfilling criteria for an eating disorder or OSFED according to the DSM-5 (N3). Analyses were focused on N2, but results for N1 and N3 are also reported. Analogous to Wick et al. (2011), we conducted analyses of covariance (ANCOVA) to control for potential baseline differences. The factors group and type of school were entered as independent factors, the baseline was included as covariate and the post-intervention and the 12-month follow-up were included as dependent variables. Statistical effect sizes ($\eta part^2$) were calculated according to Cohen (1988) and assessed as small at $\eta part^2 \geq 0.009$, medium at $\eta part^2 \geq 0.058$ and large at $\eta part^2 \geq 0.138$. Supplementary analyses for the distribution of underweight participants in the different groups across the measurement points were calculated with a k·l-χ^2 test (Bortz, 2006).

Table 3
Mean outcome measure for intervention groups (IG1, IG2) and active control group (ACG) at all time points.

		Measurement time points									
		Baseline			Post-intervention			Follow-up			
	Group N1	IG 1 (n = 498)	IG 2 (n = 474)	CG (n = 682)	IG 1 (n = 498)	IG 2 (n = 474)	CG (n = 682)	IG 1 (n = 498)	IG 2 (n = 474)	ACG (n = 682)	
EDI-2	Drive for thinness	2.20 (1.17)	2.29 (1.17)	2.27 (1.19)	2.09 (1.15)	2.20 (1.12)	2.23 (1.22)	2.06 (1.16)	2.14 (1.12)	2.17 (1.16)	
	Bulimia	1.53 (0.67)	1.56 (0.66)	1.56 (0.69)	1.47 (0.66)	1.56 (0.76)	1.52 (0.69)	1.51 (0.66)	1.55 (0.73)	1.53 (0.74)	
	Body dissatisfaction	2.65 (1.31)	2.86 (1.32)	2.87 (1.37)	2.65 (1.32)	2.83 (1.33)	2.85 (1.35)	2.69 (1.31)	2.82 (1.30)	2.78 (1.30)	
	Ineffectiveness	2.11 (0.79)	2.14 (0.80)	2.14 (0.75)	2.06 (0.79)	2.11 (0.87)	2.10 (0.78)	2.03 (0.77)	2.10 (0.83)	2.07 (0.77)	
	Perfectionism	2.73 (0.92)	2.79 (0.86)	2.63 (0.96)	2.58 (0.96)	2.72 (0.94)	2.53 (0.97)	2.68 (0.97)	2.66 (0.89)	2.55 (0.99)	
	Interoceptive awareness	2.00 (0.74)	1.99 (0.70)	1.98 (0.75)	1.84 (0.69)	1.95 (0.78)	1.92 (0.79)	1.86 (0.73)	1.95 (0.77)	1.92 (0.78)	T0 > T1**, T0 > T2*
BSQ	Body shape questionnaire	1.80 (1.01)	1.91 (1.05)	1.90 (1.06)	1.74 (1.04)	1.88 (1.11)	1.88 (1.10)	1.78 (1.08)	1.87 (1.02)	1.88 (1.10)	
BIAQ	Body image avoidance	1.52 (0.48)	1.53 (0.45)	1.52 (0.51)	1.44 (0.48)	1.51 (0.49)	1.49 (0.52)	1.41 (0.46)	1.47 (0.50)	1.47 (0.55)	T0 > T1**, T0 > T2*
	Group N2	IG 1 (n = 460)	IG 2 (n = 447)	CG (n = 625)	IG 1 (n = 460)	IG 2 (n = 447)	CG (n = 625)	IG 1 (n = 460)	IG 2 (n = 447)	ACG (n = 625)	
EDI-2	Drive for thinness	2.08 (1.08)	2.21 (1.12)	2.13 (1.09)	1.98 (1.07)	2.14 (1.08)	2.12 (1.15)	1.96 (1.10)	2.09 (1.08)	2.07 (1.09)	T0 > T1*
	Bulimia	1.48 (0.61)	1.51 (0.61)	1.51 (0.64)	1.43 (0.61)	1.52 (0.70)	1.48 (0.65)	1.46 (0.61)	1.51 (0.69)	1.50 (0.72)	
	Body dissatisfaction	2.54 (1.27)	2.79 (1.29)	2.75 (1.31)	2.55 (1.28)	2.77 (1.31)	2.52 (1.24)	2.59 (1.29)	2.76 (1.27)	2.71 (1.28)	
	Ineffectiveness	2.08 (0.76)	2.09 (0.77)	2.09 (0.72)	2.03 (0.79)	2.08 (0.87)	2.06 (0.76)	1.99 (0.75)	2.07 (0.82)	2.04 (0.76)	
	Perfectionism	2.68 (0.88)	2.78 (0.86)	2.63 (0.96)	2.55 (0.94)	2.70 (0.93)	2.51 (0.96)	2.65 (0.95)	2.67 (0.89)	2.54 (1.00)	
	Interoceptive awareness	1.94 (0.69)	1.95 (0.69)	1.92 (0.72)	1.79 (0.68)	1.92 (0.75)	1.88 (0.77)	1.81 (0.68)	1.92 (0.75)	1.88 (0.76)	T0 > T1**, T0 > T2*
BSQ	Body shape questionnaire	1.69 (0.89)	1.82 (0.96)	1.78 (0.94)	1.63 (0.93)	1.82 (1.06)	1.79 (1.03)	1.69 (1.00)	1.81 (0.97)	1.81 (1.05)	T0 > T1*
BIAQ	Body image avoidance	1.49 (0.44)	1.51 (0.43)	1.48 (0.48)	1.41 (0.44)	1.49 (0.47)	1.47 (0.50)	1.38 (0.44)	1.45 (0.49)	1.46 (0.56)	T0 > T1**, T0 > T2**
	Group N3	IG 1 (n = 38)	IG 2 (n = 27)	CG (n = 57)	IG 1 (n = 38)	IG 2 (n = 27)	CG (n = 57)	IG 1 (n = 38)	IG 2 (n = 27)	ACG (n = 57)	
EDI-2	Drive for thinness	3.60 (1.25)	3.54 (1.32)	3.85 (1.16)	3.37 (1.25)	3.14 (1.35)	3.47 (1.29)	3.20 (1.31)	2.97 (1.29)	3.27 (1.31)	
	Bulimia	2.11 (1.04)	2.26 (1.03)	2.06 (0.97)	2.02 (0.89)	2.20 (1.25)	2.03 (0.89)	2.02 (0.98)	2.18 (1.02)	1.89 (0.90)	
	Body dissatisfaction	3.88 (1.19)	3.90 (1.39)	4.07 (1.43)	3.83 (1.15)	3.68 (1.44)	3.90 (1.49)	3.82 (1.05)	3.75 (1.42)	3.53 (1.33)	
	Ineffectiveness	2.55 (0.95)	2.84 (0.88)	2.76 (0.85)	2.40 (0.77)	2.63 (0.82)	2.66 (0.81)	2.44 (0.86)	2.67 (0.87)	2.46 (0.80)	
	Perfectionism	3.27 (1.16)	2.90 (0.79)	2.69 (1.04)	3.01 (1.11)	2.92 (1.07)	2.68 (1.04)	3.01 (1.16)	2.58 (0.79)	2.66 (0.95)	
	Interoceptive awareness	2.60 (1.00)	2.59 (0.61)	2.61 (0.80)	2.36 (0.69)	2.53 (0.94)	2.39 (0.82)	2.39 (0.96)	2.56 (0.94)	2.35 (0.84)	
BSQ	Body shape questionnaire	3.09 (1.35)	3.31 (1.39)	3.20 (1.36)	2.96 (1.39)	2.82 (1.48)	2.90 (1.36)	2.83 (1.39)	2.77 (1.32)	2.65 (1.34)	
BIAQ	Body image avoidance	1.95 (0.70)	1.96 (0.52)	1.97 (0.61)	1.79 (0.67)	1.82 (0.59)	1.76 (0.61)	1.68 (0.63)	1.82 (0.60)	1.56 (0.45)	

Note. N = total sample; N2 = healthy subsample; N3 = subsample fulfilling criteria for an eating disorder or OSFED according to DSM-5; IG = Intervention Group; ACG = Control Group.
Standard deviations appear in parentheses. Significant main effects of training (ANCOVA) appear in the column on the far right.

* $p < .05$.

** $p < .01$.

3. Results

3.1. Total sample (N1)

For the 'interoceptive awareness' subscale of the EDI-2, we found a significant improvement in the intervention groups for post-intervention and follow-up combined: Pillai's trace = 0.008, F(4; 3038) = 3.068, p = .016, η_{part}^2 = 0.004, for post-intervention (F(2; 1519) = 5.627, p = .004, η_{part}^2 = 0.007), and for the 12-month follow-up (F(2; 1519) = 3.929, p = .020, η_{part}^2 = 0.005). No significant differences between the two intervention groups were found for the BSQ. Regarding the BIAQ, a significant reduction emerged in the intervention groups for post-intervention and follow-up combined: Pillai's trace = 0.008, F(4; 2900) = 2.993, p = .018, η_{part}^2 = 0.004, for post-intervention (F(2; 1450) = 4.808, p = .008, η_{part}^2 = 0.007) and for the 12-month follow-up (F(2; 1450) = 4.010, p = .018, η_{part}^2 = 0.006). Please refer also to Table 3.

3.2. Healthy subsample (N2)

To evaluate the efficacy of universal prevention, this analysis was carried out with the healthy subsample (N2). Regarding the EDI-2, a significant reduction emerged on the 'drive for thinness' subscale for the two intervention groups compared to the control group at post-intervention: F(2; 1446) = 3.091, p = .046, η_{part}^2 = 0.004. For the 'interoceptive awareness' subscale, a significant reduction for the intervention groups was found for post-intervention and follow-up combined: Pillai's trace = 0.009, F(4; 2812) = 3.147, p = .014, η_{part}^2 = 0.004, for post-intervention (F(2; 1406) = 5.685, p = .003, η_{part}^2 = 0.008) and for the 12-month follow-up (F(2; 1406) = 4.047, p = .018, η_{part}^2 = 0.006). For the BSQ, a significant reduction for the intervention groups was found at post-intervention: F(2; 1453) = 3.505, p = .030, η_{part}^2 = 0.005. Regarding the BIAQ, a significant reduction for the intervention groups was found for post-intervention and follow-up combined: Pillai's trace = 0.011, F(4; 2684) = 3.674, p = .005, η_{part}^2 = 0.005, for post-intervention (F(2; 1342) = 5.212, p = .006, η_{part}^2 = 0.008) and for the 12-month follow-up (F(2; 1342) = 5.130, p = .006, η_{part}^2 = 0.008).

3.3. Sample with eating disorders/OSFED (N3)

No significant effects of group assignment were found.

3.4. Supplemental analysis

No significant differences were found between the different groups regarding the distribution of underweight participants (BMI percentile < 10) at baseline (2.7% in IG1, 1.5% in IG2 and 2.9% in ACG), post-intervention (2.5% in IG1, 1.8% in IG2 and 3.4% in ACG) and at 12-month follow-up (3.0% in IG1, 2.4% in IG2 and 3.2% in ACG), $\chi^2(4) = 2.055$, p = .726.

4. Discussion

The results of the post-intervention and follow-up measurement confirmed the positive preventive effects of MaiStep. In the present study, we found a significant decline in the avoidance of body image-related thoughts and behaviors and an improvement of 'interoceptive awareness' (EDI-2) in samples N1 and N2 at post-intervention and follow-up. In the healthy subsample, we additionally found a significant decrease in 'drive for thinness' and the BSQ-8c at post-intervention but not at follow-up. For the subsample N3, no significant results emerged. According to Cohen (1988), the observed significant effects are small. Additionally, no significant decreases or increases in the percentage of extremely underweight participants were detected. In line with other universal prevention studies, the effect sizes in our study were small and some of the significant results did not remain stable over time (Sanchez-Carracedo et al., 2016; Stice et al., 2007; Wick et al., 2011; Wilksch et al., 2015). It appears that the taught skills might have helped the adolescents to deal better with emotions, as reflected in the changes measured with the 'interoceptive awareness' subscale (EDI-2), and with situations prone to body image avoidance behavior, as measured with the BIAQ. Given that no changes in cognitive/affective measures associated with the body ('body dissatisfaction', BSQ) were detected, it is all the more surprising that significant changes in behavior (as measured with the BIAQ) were found. Possibly, it could be easier to change behavior than to change attitudes and cognitions towards the body. Further data acquisition is necessary and could prove whether the behavioral changes are the foundation for a cognitive change. In consideration of the null findings (e.g. 'body dissatisfaction', 'bulimia', 'ineffectiveness'), it is possible that the taught skills are not helpful for changing the targeted risk factors and eating disorder-related behaviors. Future improvements of the program should include units/skills from effective prevention programs, for instance body image programs (e.g. 'Happy Being Me'), in order to foster strategies concerning cognitions and attitudes. In particular, the fact that some of the significant effects in the N2 group were not stable, and the effect sizes in N1 and N2 decreased in the long run, might suggest that the dose was not sufficient. Booster sessions are considered as one of the key elements for achieving the best long-term results (Stice et al., 2012), and it might thus be beneficial to additionally include booster sessions to maintain or even strengthen effects. Another potential reason for some of the non-significant results may be that some risk factors or behaviors might already be deeply entrenched in adolescents, meaning that modification, especially in the field of prevention, may take some time (Sanchez-Carracedo et al., 2016). Furthermore, it is possible that adolescents conceal certain information from adults or other peers, thus rendering it impossible to measure changes. In view of this aspect of social desirability, measuring this influencing factor may provide important information.

Surprisingly, the sample N3 showed no benefit from the program, despite previous findings that prevention seems to be even more effective in high-risk samples (Stice et al., 2007). In contrast to other studies, N3 was compiled directly according to DSM-5 criteria. While universal prevention approaches may be efficient in high-risk groups, it appears that treatment of subclinical or partial disorders (OSFED) is based on different strategies and requires more contact time (e.g. mainly face-to-face) (Ciao et al., 2014; Horney et al., 2015). Therefore, it seems reasonable to assume that preventing the development of eating-disordered behaviors versus reducing the symptoms of existing full-syndrome eating disorders or OSFED require different approaches. In accordance with other authors, we believe that the question of universal versus targeted prevention in eating disorders is somewhat obsolete (Levine, 2017; Wilksch, 2014). Moreover, stepped care approaches, in which universal programs could act as first developmentally appropriate approaches for early adolescents in population-based settings, seem necessary. By contrast, targeted prevention should be delivered to high-risk samples that need stronger interventions and the possibility to refer adolescents to treatment if needed.

4.1. Limitations and strengths

This study is not without limitations. The results might have been influenced by the selectivity of the sample, which was based on a population of adolescents at middle-school age from only one Federal state in Germany. The randomization of the participants by schools differed from other studies, which randomized participants by subject or class. As mentioned above, this randomization procedure was chosen in accordance with the requirements of the State Department of Education and in order to maximize practicability. Moreover, the type of schools was included as a factor in the analysis in order to counter these effects. On the other hand, we tried to protect the study from

contamination through the randomization procedure. Randomizing at the school level should have ensured that participants, especially those from the control conditions, were unable to obtain material or information covered in the prevention condition due to contact with each other (Werner-Seidler et al., 2017). It should be noted that it is possible that information or skills relating to the contents of MaiStep were taught in regular lessons or themed school/project days in the ACG, even though we asked the schools to refrain from doing so during the study period. A further limitation is that process information, and especially the adherence of patients and psychologists/teachers, was not checked and recorded systematically. We failed to include the participants' assessment of treatment beyond attendance (implementation of the strategies during and after MaiStep), which could have provided important information about treatment quality and implementation in the real-life setting. Regarding the adherence of the psychologists or teachers, only scheduled adherence meetings were conducted, while feasibility or adherence was not recorded systematically. The most rigorous treatment studies used adherence ratings to check the quality of program content and implementation, but these studies were often psychotherapy and not prevention studies. Otherwise, it is possible that the stress management program in the ACG was also effective in teaching skills, and therefore protected participants from developing eating-disorder related behaviors. This could also have led to significant but very small effect sizes, thus begging the question of whether the results are clinically meaningful. As described in the sample size calculation and earlier in the discussion, only small effects were expected and recorded in the analysis. However, in universal prevention for eating disorders, even small effects can be beneficial when high morbidity and mortality as well as adverse socioeconomic adjustment are considered (Arcelus et al., 2011; Smink et al., 2012; Tabler and Utz, 2015).

By contrast, some major strengths of the study should be noted. Of initially 1775 informed students, a sample of 1654 students of both sexes was recruited. Good data quality was ensured due to double entry of the data and the low drop-out rate of 25%, keeping in mind that the adherence of young adults in prevention studies is lower compared to studies with adults (López-Guimerà et al., 2011). In contrast to other studies, the implementation of an LOCF approach seems to be a more conservative data analysis strategy (Wick et al., 2011). A further strength is that eating disorder symptoms were systematically measured according to DSM-5 criteria. Moreover, we recruited a large sample of adolescents under the age of 15, which appears to be a high-risk group for developing eating disorders (Hammerle et al., 2016). As the participants attended a mean of 4.51 (SD 0.82) units, it can be assumed that the adolescents liked our program. Nevertheless, we did not measure participants' satisfaction with our content, presentation and program length. Finally, the three-arm design leads to results that give rise to the possibility of broad dissemination in schools.

5. Conclusion

The positive findings of reduced body image avoidance (BIAQ) and improved ‘interoceptive awareness’ (EDI-2) demonstrate that universal prevention and broad dissemination under the age of 15 is possible. Nevertheless, aspects from other evaluated programs could also be added in order to change ‘body dissatisfaction’, or booster sessions could be conducted to extend effects regarding ‘drive for thinness’ or the cognitive and affective awareness of one's body. Our study does not allow conclusions to be drawn regarding process-outcome relationships. Therefore, future research should explore moderating factors for response as well as specific preventive effects of individual methods. To make this possible, it is necessary to improve the measurement of program fidelity beyond attendance, for example by using E-diaries via smartphones to register which skills are used in adolescents' daily routine. This should reveal which units are effective and which are obsolete. Rather than developing new universal prevention programs, it would be beneficial to dismantle units or contents which have been found to be effective in previous studies and compile them together in one program. Another promising possibility would be to build partnerships with experts targeting other mental health problems. As eating disorder programs have also been found to lead to significant reductions in risk factors for other mental health problems such as depression (Wilksch and Wade, 2009), it is feasible that programs seeking to prevent other mental disorders may also help to prevent eating disorder risk factors or behaviors. Therefore, universal prevention should integrate measures of well-chosen risk factors or behavioral measures in order to observe the efficacy in other fields of mental health. This would provide a cost-effective opportunity to increase the quantity and quality of efficacy trials and to explore novel program options (Wilksch, 2014). In terms of broad dissemination, in order to generate long-term effects of universal prevention programs and to transfer the effects to real-world settings, effective dosing needs to be determined, including booster sessions. In view of the discouraging findings from the early days of eating disorder prevention research (Austin, 2000), it is all the more gratifying that the possibility to prevent eating disorders, and their often tragic courses, now appears to be in closer reach.

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Conflict of interest statement

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Submission declaration

All authors declare that the submitted work has not been published before and that the work is not under consideration for publication elsewhere. All authors approve publication.

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