Received: 31 July 2018 | Revised: 4 December 2018 | Accepted: 5 December 2018

DOI: 10.1002/eat.23005

WILEY

International Journal of EATING DISORDERS

ORIGINAL ARTICLE

Depressive symptoms, alcohol and other drug use, and suicide risk: Prevention and treatment effects from a two-country online eating disorder risk reduction trial

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Funding information
National Health and Medical Research Council, Grant/Award Number: 1047192; South Australian Government Youth Connect grant

Abstract

Objective: Eating disorders are known to have high comorbidity, and the current report outlines the impact of an online eating disorder risk reduction program on brief, self-report measures of depressive symptoms, alcohol and other drug use, and suicidality.

Method: An online pragmatic, randomized-controlled trial was conducted with *N* = 316 young-women (*M* age = 20.80 years) across Australia and New Zealand. *Media Smart-Targeted (MS-T)* was a 9-module program released weekly while control participants received positive body image tips. Prevention effects (asymptomatic at baseline) and treatment effects (symptomatic at baseline) were investigated.

Results: *MS-T* participants were 94% and 91% less likely than controls to develop Moderate or higher depressive symptoms at 6-month (*MS-T* = 3.3%; controls = 35.4%) and 12-month follow-up (*MS-T* = 3.4%; controls = 29.4%), respectively. *MS-T* participants did not commence using recreational drugs at any assessment point, compared to 18.2% of controls at a least one assessment point. Regarding treatment effects, *MS-T* participants were 84% more likely to no longer be using recreational drugs at 12-month follow-up (*MS-T* = 60%; controls = 21.1%). Mutitvariate logistic regressions revealed group, depressive symptoms and alcohol use to be significant predictors of elevated suicide risk, where being an *MS-T* participant, without depressive symptoms and not drinking alcohol, significantly lowered likelihood of developing elevated suicide risk. Disordered eating at post-program mediated the relationship between group and depressive symptoms across post-program to 12-mnoth follow-up.

Discussion: *MS-T* shows promise as a program with important mental health benefits in addition to previous reports of lowered eating disorder diagnosis, risk and impairment.

KEYWORDS

depression, substance use, early intervention, eating disorders, online, prevention, suicide

1 | INTRODUCTION

Eating disorder (ED) risk reduction trials evaluate outcome by program impact on ED risk factors, disordered eating attitudes and behaviors, and ED diagnosis. Given that over 70% of individuals with EDs report comorbidity (Keski-Rahkonen & Mustelin, 2016), it is appropriate to assess whether such programs also have an impact on comorbid symptoms that are associated with poorer response to treatment, greater impairment and increased risk of adverse outcome (Hudson, Hiripi, Pope, & Kessler, 2007; Kask et al., 2016; Keel & Brown, 2010). This has the potential to identify transdiagnostic benefits, thereby increasing the utility of ED risk reduction programs, where this could in turn lead to increased support for program dissemination. Thus, the purpose of this report is to investigate the impact of *Media Smart-Targeted* (*MS-T*) on the following common comorbid symptoms: depressive symptoms; alcohol use; recreational drug use; and, suicidality.

MS-T is a 9-module mobile website adaptation of the *Media Smart* universal school program (full classes of girls and boys) that has been found to lower ED risk factors in early-adolescent girls and boys (Wilksch et al., 2015; Wilksch & Wade, 2009), prevent growth in girls'

weight concerns over a 2.5-year follow-up (Wilksch & Wade, 2009), and halve the risk of developing clinical levels of shape and weight concerns at 12-month follow-up (Wilksch et al., 2015). *MS-T* has been evaluated in a two-country pragmatic randomized controlled trial (RCT) where we sought to evaluate how the program would be used and its effectiveness under real-world conditions, that is, at-scale across two countries with minimal exclusion criteria (Ford & Norrie, 2016). Young-adult women (18–25 years) self-referred to the study and were ineligible only if one or more of the following were present: extreme anorexia nervosa; high suicidality; alcohol or substance abuse (Wilksch, O'Shea, Taylor, et al., 2018).

Thus, this research differed from other ED risk reduction trials in three major ways: (1) incorporating national, community-level recruitment (rather than individual college sites); (2) including participants with a current ED diagnosis given the very low rates of patients accessing treatment; and, (3) using a fully automated mobile website that did not require an online therapist moderator, thus minimizing delivery costs and avoiding a potential barrier to making the intervention available at-scale. This approach led to the recruitment of a sample where 69.6% met criteria at baseline for an ED as assessed by the EDE-Q, however just 14.7% of participants had received treatment for an ED in the last 12 months (Wilksch, O'Shea, & Wade, 2018). In those who did not meet ED criteria at baseline, *MS-T* reduced ED onset (prevention effect) at 12-month follow-up by 66% relative to controls (*MS-T* = 11.1%, controls = 27.1%) and it increased ED remission rates (treatment effect) by 75% at 12-month follow-up for those who met ED diagnosis at baseline (*MS-T* = 47.6%, controls = 18.5%). *MS-T* participants scored significantly lower than controls on: disordered eating (EDE-Q global); media internalization; depressive symptoms; ineffectiveness; and, clinical impairment (Wilksch, O'Shea, Taylor, et al., 2018). A further aim of this pragmatic RCT was to investigate the impact of *MS-T* on important, comorbid symptoms that are typically not assessed beyond baseline for inclusion criteria purposes (or at all) in ED risk reductions trials.

While depressive symptoms as a continuous outcome variable are commonly reported (e.g., Stice, Rohde, Shaw, & Gau, 2011; Taylor et al., 2006), to the best of our knowledge no study has reported impact of an ED program on indicators of severity of depressive symptoms. Elevated depressive symptoms are known to: increase risk for the development of an ED (Stice, 2001; Stice, Rohde, Gau, & Shaw, 2012); be associated with poorer ED treatment outcomes (James, Jennifer, Susan, & Stewart, 2006; Steel et al., 2000); and be associated with alcohol and other drug use and, suicidality (Franko & Keel, 2006). Depressive symptoms feature in transdiagnostic models of EDs (Fairburn, Cooper, & Shafran, 2003) and other emotional disorders (Farchione et al., 2012), highlighting the importance of these symptoms.

Further, no ED risk reduction trial to date has reported outcomes for suicidality or for alcohol and other drug use. The links between suicidality and EDs are well established (Wade, Fairweather-Schmidt, Zhu, & Martin, 2015). Anorexia nervosa and substance abuse have the highest risk of premature death of all mental disorders where approximately 20% of these deaths are due to suicide (Harris & Barraclough, 1998). There is a documented co-occurrence of suicidality across the eating disorder diagnoses (Kask et al., 2016). Severity of alcohol use has been prospectively linked with suicide attempts in those with an ED (Keel et al., 2003). Alcohol misuse and comorbid depressive symptoms were significantly associated with completed suicide in a meta-analysis (N = 36 studies) of mortality rates in eating disorder patients (Arcelus, Mitchell, Wales, & Nielsen, 2011).

The aims of this research were to examine the efficacy of *MS-T* in relation to prevention effects (outcomes for asymptomatic participants at baseline) and treatment effects (outcomes for symptomatic participants at baseline) for indicators of depressive symptoms, alcohol and other drug use, and suicidality. Investigation of program impact on comorbid psychiatric conditions is a potentially valuable direction for the field to further augment the value of ED risk reduction efforts. While this study was exploratory in nature, the investigation was supported by: previous *MS-T* and *Media Smart* research finding significant effects for continuous measures of depressive symptoms (Wilksch & Wade, 2009; Wilksch et al., 2015; Wilksch, O'Shea, Taylor, et al., 2018); research finding associations between depressive symptoms, alcohol, other drug use, and suicidality (e.g., Farchione et al., 2012; Franko & Keel, 2006); evidence of associations between these symptoms and media usage (e.g., Luxton, June, & Fairall, 2012; Primack, Kraemer, Fine, & Dalton, 2009); and where media internalization is a primary target of *MS-T* and was found to be significantly lower than controls at post-program (Wilksch, O'Shea, Taylor, et al. 2018).

2 | METHOD

2.1 | Participants

Participants were 18–25 year-old women (M age = 20.80 years; *SD* = 2.26 years) seeking to improve their body image. Full information regarding all features of the methods for this RCT has been previously described (Wilksch, O'Shea, Taylor, et al., 2018; Wilksch, O'Shea, & Wade, 2018). Self-referral was used, with the most common sources including advertisements at universities (n = 100; 31.9%) and on social media (n = 87; 27.8%). Participants lived in each state and territory of Australia (n = 243; 77.1%) and New Zealand (n = 72; 22.9%), in capital cities (n = 186; 59.0%), regional towns (n = 113; 35.9%) and rural areas (n = 16; 5.1%). The most commonly reported ethnicity was Caucasian—Australian (n = 190; 60.5%), followed by Caucasian—NZ (n = 67; 21.3%), and Asian (n = 28; 8.9%).

In line with the pragmatic nature of the RCT, exclusion criteria were kept to a minimum: Extreme anorexia nervosa (i.e., severity rating from DSM-5: meeting AN diagnostic criteria with a BMI < 15.0 [American Psychiatric Association, 2013]); high suicide risk (i.e., presence of one or more of the following: suicidal thoughts of severe intensity; feel unable to control suicidal thoughts and impulses; cannot state that will not act upon these thoughts during the study; have a suicide plan [Lecrubier et al., 1997]); and, alcohol or substance dependence (i.e., presence of withdrawal effects when reducing use [Lecrubier et al., 1997]). Thirty-three participants were excluded due to at least one of the following: extreme anorexia nervosa (n = 3); suicide risk (n = 8); alcohol withdrawal (n = 11); and, substance withdrawal (n = 20). Participants were not excluded at other time points in the study for these

criteria but were provided with tailored recommendations for their symptoms and geographical locations to access appropriate care.

2.2 | Procedure

Participants self-referred to the study website where they were provided with study information, consent form, and baseline questionnaires. The website was designed to automatically randomize eligible participants to *MS-T* or control conditions, stratified by age (18–21 years; 21.01 years- 25 years) and baseline Weight Concerns Scale scores (<47; >47: WCS: Killen et al., (1994): see Wilksch, O'Shea, & Taylor, et al., 2018 for further detail). Those in the *MS-T* condition received their modules on a weekly basis, receiving an automated email when their next module was available. Automated email reminders were sent to all participants to complete post-program measures 10-weeks after baseline and at 6- and 12-month follow-up. A gift voucher ($AUD50) was sent to participants who completed a minimum of three waves of assessment, but was not related to completion of *MS-T*. Ethics approval for this research was received from the Flinders University Social and Behavioral Research Ethics Committee. Those allocated to the control condition received an email of 10 tips for positive body image, as used in other targeted ED risk reduction trials (Stice et al., 2011). Control participants with baseline scores in the ED range were also provided with a list of contact options for assessment and treatment of such symptoms.

2.3 | Program

The key targets of *MS-T* are media internalization and over-evaluation of eating, shape and weight (Fairburn, 2008; Stice, 2001). Media internalization refers to investment in societal ideals of appearance that become rigid, guiding principles (i.e., typically thin-ideal for females), and has been prospectively identified to lead to eating pathology both directly and through the dual-pathway model of bulimic pathology (Field, Camargo, Taylor, Berkey, & Colditz, 1999; Stice, 2001). Further, media internalization has also been prospectively implicated in the development of over-evaluation of eating, shape and weight, the core cognitive component of eating disorders (Wilksch & Wade, 2010) where individuals come to place excessive importance on appearance as a determinant of self-worth (Fairburn, 2008).

A full description of *MS-T* is presented in the original RCT report (Wilksch, O'Shea, Taylor, et al., 2018). While *MS-T* was developed based on the universal *Media Smart* school curriculum for young-adolescent girls and boys, content was altered to be appropriate for a young-adult, female audience in an online setting. Learning activities targeted: peer pressure; digital alterations to images; social media comparisons; reducing unhelpful body checking behaviors; eating tips that protect against EDs (e.g., regular eating); developing self-worth that is not related to appearance or eating; activism; and goal setting. There was no content in the program that explicitly targeted the outcomes of the current report.

2.4 | Measures

Table 1 provides a summary of the measures and criteria used for defining caseness with each of the following: depressive symptoms; dependence on alcohol; dependence on recreational drugs; and high suicidality. Specifically, the Depression Scale from the Depression, Anxiety, Stress Scale (DASS-21: Lovibond & Lovibond, 1995) and relevant items relating to alcohol, recreational drug use and suicidality from self-report format of the MINI International Schedule were used (Lecrubier et al., 1997). The DASS-21 is a widely used self-report measure found to have high internal consistency and concurrent validity in both clinical and non-clinical populations (Antony, Bieling, Cox, Enns, & Swinson, 1998). While primarily used as a continuous measure, the use of qualitative severity descriptors (i.e., Mild through to Extremely Severe) are also widely used, including in eating disorder prevalence research (Swinbourne et al., 2012) and a recent web-based RCT for depressive symptoms that had the primary eligibility criteria of Mild–Moderate depression measured by the DASS-21 (Proudfoot et al., 2013). Normative data have been published for an Australian adult community population where the DASS-21 Depression *M* scale score for 18–24 year-old females and males was 7.92 (*SD* = 4.52: Crawford, Cayley, Lovibond, Wilson, & Hartley, 2011). A clinical cut-off ≥10 was used in an Australian study investigating the transition to young-adulthood (Teng, Venning, Winefield, & Crabb, 2015). In the present study, a more conservative score of ≥14 was used as the cut-off for moderate or higher depressive symptoms as per the severity rating guide for the measure (Lovibond & Lovibond, 1995). Of further relevance, an Australian anorexia nervosa outpatient treatment RCT (*N* = 120*)* found a baseline DASS-21 Depression score of *M* = 19.30 (*SD = 13.14:* Byrne et al., 2017).

The MINI has been validated against the Structured Clinical Interview for DSM diagnoses (SCID) and the Composite International Diagnostic Interview (Sheehan et al., 1997), and linguistically validated in over 70 languages. A recent review of Substance Use assessment (drug and alcohol) found the MINI modules to be "Highly Recommended" for use, based on excellent test–retest reliability, construct validity, and clinical utility (Rohsenow, 2018). Indeed, symptoms of alcohol dependence and drug dependence were among the highest concordance rates with the Structured Clinical Interview providing evidence of construct validity (Sheehan et al., 1997). Among adults who have received mental health treatment, the suicidality module has been found to prospectively predict suicidal behavior in the 12-months following assessment, including amongst participants without any known previous suicide attempts (Roaldset, Linaker, & Bjørkly, 2012).

Two questions assessing dependence were used for both alcohol use and recreational drug use: *Did you need to drink a lot more in order to get the same effect that you got when you first started drinking or did you get much less effect with continued use of the same amount?* (0 = No; 1 = Yes) and *When you cut down on drinking did your hands shake, did you sweat or feel agitated? Did you drink to avoid these symptoms (for example, "the shakes", sweating or agitation)?* (0 = No; 1 = Yes). At baseline, a response of Yes to the second question (withdrawal effects) was a criterion for exclusion, while at later time

TABLE 1 Symptoms, description of criteria and baseline frequencies for MS-T and controls

Symptoms	*MS-TN = 122 n* (%)	Controls *N = 194 n* (%)	OR (95% CI) MS-T vs. control	Measure and criteria
Depression	63 (51.6)	84 (43.5)	1.39 (0.88–2.18)	DASS-21 (Lovibond & Lovibond, 1995)—Depression Scale (7-items; α =0.93), e.g., *I felt I wasn't worth much as a person, 0 = Not at All to 3 = Very much or most of the time.* **Depression Scale score ≥14 indicated presence of at least Moderate depression** (0 = *No*, **1 = yes**).
Alcohol use	80 (65.6)	125 (65.4)	1.01 (0.62–1.62)	MINI International Neuropsychiatric Interview (Lecrubier et al., 1997). 3 items ***In past 12 months, have you drunk 3 or more alcoholic beverages in a 3-hr period, on 3 or more occasions?*** (0 = *No*, **1 = yes**). Two follow-up questions relating to dependence (see in text):
Alcohol dependence	29 (24.2)	44 (23.2)	0.95 (0.55–1.64)	**Baseline: Presence of alcohol tolerance** (0 = *No*, **1 = yes**). **Post- 12-month follow-up: Presence of alcohol tolerance OR withdrawal effects** (0 = *No*, **1 = yes**).
Drug use	29 (23.8)	30 (15.7)	1.67 (0.95–2.96)	MINI International Neuropsychiatric Interview (Lecrubier et al., 1997) 3 items. ***In the past 12 months, have you taken a recreational drug/s (not alcohol) more than once to get high, to feel elated, to get "a buzz" or to change your mood?*** (0 = *No*, **1 = yes**) *If Yes, specify drug/s used*. Two follow-up questions relating to dependence as for alcohol use.
High suicidality	34 (28.1)	48 (25.3)	1.16 (0.69–1.93)	MINI International Neuropsychiatric Interview (Lecrubier et al., 1997) 6 items, e.g., *In the past month did you think about suicide?*, (0 = *No*, 1 = yes) Frequency (*Occasionally* = 1 to *Very Often* = 3) and Intensity (*Mild* = 1 to *Severe* = 3) **Suicidal thoughts AND at least one of: Thought frequency > =2; thought intensity > =2; unable to state will not act on thoughts; feel unable to control thoughts; or, have a suicide plan** (0 = *No*, **1 = yes**).

Note. Bolded = meeting criteria for the presence of that comorbid condition. Depression scale score doubled to be consistent with full DASS scoring.

points Yes to either of these questions was considered indicative of alcohol dependence.

Table 1 also provides a definition of caseness for suicidality that included (in addition to ideation frequency and intensity): *"Can you state that you will not act on these impulses during this research study?* (0= Yes; 1= No)*"; Feel unable to control these suicidal thoughts and impulses?* (0 = No; 1 = Yes)*; or*, *Have a suicide plan?* (0 = No; 1 = Yes). While answering yes to one or more of these questions was an exclusion criteria at baseline this was not the case at subsequent assessments.

2.5 | Statistical analyses

Only reported data were used and no imputation was employed. Both prevention (did not meet outcome variable criteria at baseline) and treatment outcomes (did meet outcome variable criteria at baseline) were investigated for those who completed measures at post-program (*N* = 215; 68.2% of baseline sample); 6-month follow-up (*N* = 201; 63.8% of baseline sample); and 12-month follow-up (*N* = 204; 64.7% of baseline sample). Rates of data completion by group have been previously reported but in brief were: post-program (*MS-T* = 69/122 [56.6%]; controls = 146/194 [75.3%]); 6-month follow-up (*MS-T* = 63/122 [51.6%]; controls = 138/194 [71.1%]); and 12-month follow-up (MS-T = 60/122 [49.2%; controls = 144/194 [74.2%]). Analyses reported in the original RCT suggested that measure completion at post-program or either follow-up was not related to EDE-Q Global, risk factor scores, BMI or disordered eating (Wilksch, O'Shea, Taylor, et al., 2018). The only variable it was significantly related to was module completion, where greater program module completion was associated with increased likelihood of measure completion at post-program and follow-up (OR = 2.02, 95% CI [1.44–2.84]).

The baseline frequencies of cases meeting criteria for each outcome were investigated between conditions using Chi Square analyses. Odds ratios (OR) and 95% CI from logistic regressions were then used to compare proportions of cases for *MS-T* participants relative to controls at post-intervention, 6- and 12-month follow-up. Treatment effect analyses were adjusted for receiving face-to-face treatment (e.g., medication, psychologist, and psychiatrist) during the trial. Multivariate logistic regressions were used to investigate prevention and treatment effects for high suicidality present at any point across the three post-intervention assessment points. Baseline outcome variables were entered as predictors (drug use, alcohol use, and depressive symptoms), along with group allocation (*MS-T* = 0; controls =1) and ED diagnosis (0 = no; 1 = yes: Wilksch, O'Shea, & Wade, 2018). Suicidality was the only outcome variable subjected to a multivariate analysis, because it was conceptualized as the most distal variable. Depressive symptoms and abuse of alcohol or other substances were considered more proximal because they have been implicated in the development of elevated suicide risk (Arcelus et al., 2011; Favaro & Santonastaso, 1997; Keel et al., 2003).

Longitudinal mediation analysis was conducted to assess if changes in disordered eating levels at post-program, contributed to the outcomes for depressive symptoms at the three post-program

TABLE 2 Prevention effects for comorbid symptoms

Analysis	*MS-TN* (%)	Control*N* (%)	OR (95% CI)MS-T vs. control
Depression			
Post-program	5/34 (14.7)	19/83 (22.9)	0.58 (0.20–1.71)
6-month follow-up	1/30 (3.3)	28/79 (35.4)	**0.06 (0.01–0.49)**
12-month follow-up	1/29 (3.4)	25/85 (29.4)	**0.09 (0.01–0.67)**
Combined	7/39 (17.9)	45/94 (47.9)	**0.24 (0.10–0.59)**
Alcohol			
Post-program	5/25 (20.0)	9/54 (16.7)	1.25 (0.37–4.21)
6-month follow-up	7/24 (29.2)	11/50 (22.0)	1.46 (0.48–04.41)
12-month follow-up	7/24 (8.7)	17/50 (34.0)	0.80 (0.28–2.30)
Combined	12/24 (50)	23/48 (47.9)	1.09 (0.41–2.90)
Drugs			
Post-program	0/53 (0)	9/126 (7.1)	**$\chi^{(1)} = 3.954$, $p = .047$**
6-month follow-up	0/50 (0)	10/120 (8.3)	**$\chi^{(1)} = 4.427$, $p = .035$**
12-month follow-up	0/45 (0)	11/122 (9.0)	**$\chi^{(1)} = 4.343$, $p = .037$**
Combined	0/35 (0)	20/110 (18.2)	**$\chi^{(1)} = 7.382$, $p = .007$**
High suicidality			
Post-program	1/50 (2.0)	7/111 (6.3)	0.30 (0.06–2.53)
6-month follow-up	3/49 (6.1)	12/105 (11.4)	0.51 (0.14–1.88)
12-month follow-up	4/46 (8.7)	14/107 (13.1)	0.51 (0.14–1.88)
Combined	6/39 (15.4)	27/95 (28.4)	0.46 (0.17–1.22)

Note. Analyses only include participants who were not meeting criteria for the outcome at baseline. Chi-square analyses used for drug use due to $n = 0$ new *MS-T* cases. Bolded text: $p < .05$. Combined = number of participants who met criteria for caseness at any time point assessed, after not meeting criteria at baseline.

assessment points. Group (*MS-T*, controls) was entered as the predictor variable, depressive symptoms (mean score across post-, 6- and 12-month follow-up) as the outcome variable, disordered eating (EDE-Q global) at post-program was entered as the mediator, baseline levels of disordered eating and depressive symptoms were entered as covariates. Mediation was tested using "Process" regression analysis macro (Preacher & Hayes, 2004). Bootstrapping with 10,000 resamples was used to generate 95% confidence intervals to determine the statistical significance of the mediator variable, where values not containing zero were considered statistically significant.

3 | RESULTS

3.1 | Participants

This report includes data from $N = 316$ women (M age = 20.80 years, $SD = 2.26$). This included all control participants ($n = 194$) and $n = 122$ *MS-T* participants (63.8% of the 194 participants allocated to MS-T) who accessed the program on at least one occasion. Table 1 provides the clinical criteria used for each outcome variable and the proportion of participants who met criteria at baseline by group. No significant differences between groups were found at baseline.

3.2 | Prevention effects

Table 2 provides prevention effects for new cases of each outcome variable at each assessment point and overall combined risk (i.e., staying a non-case for the whole study). Significant prevention effects were shown for both depressive symptoms and drug use. *MS-T* participants were at lower risk of developing depressive symptoms at each time point with this risk being 42%, 94% and 91% lower than controls at post-program (*MS-T* = 14.7%, controls = 22.9% met depressive symptoms criteria), 6-month follow-up (*MS-T* = 3.3%, controls = 35.4%) and 12-month follow-up (*MS-T* = 3.4%, controls = 29.4%), respectively. The latter two results were significantly different between conditions, as was the risk of developing Moderate or worse depressive symptoms at any point in the trial with 82.1% of *MS-T* participants remaining asymptomatic versus 52.1% of controls.

No significant prevention effects were found for alcohol consumption. Given the high baseline rates of participants drinking >3 alcoholic beverages, it was decided to also investigate prevention of alcohol dependence over the course of the trial. At 12-month follow-up the likelihood of *MS-T* participants developing alcohol dependence ($n = 1/49$; 2.0%) was seven times lower than controls ($n = 15/108$; 13.9%: OR = 0.13, 95% CI [0.02–1.01], $p = 051$).

Recreational drug use was commenced by 7–9% of control participants over the post-program to 12-month follow-up period, while no *MS-T* participant began using such substances at any time point compared to 18.2% of control participants (please note that Chi square analyses were necessary for this analysis due to the zero frequency of recreational drug use in the *MS-T* condition). These respective recreational drug use results were all significant.

For those not meeting high suicidality at baseline, *MS-T* participants were 49% (6-month follow-up: *MS-T* = 6.1%, controls = 11.4%; 12-month follow-up: *MS-T* = 8.7%, controls = 13.1%) to 70% (post-program: *MS-T* = 2.0%, controls = 6.3%) less likely to develop high

TABLE 3 Treatment effects for comorbid symptoms

Analysis	*MS-TN* (%)	Control*N* (%)	OR (95% CI)MS-T vs. control
Depression			
Post-program	9/35 (25.7)	19/63 (30.2)	1.34 (0.52–3.45)
6-month follow-up	11/33 (33.3)	12/58 (20.7)	0.51 (0.19–1.37)
12-month follow-up	9/31 (29.0)	21/58 (36.2)	1.45 (0.56–3.74)
Combined	8/43 (18.6)	10/67 (14.9)	0.84 (0.29–2.40)
Alcohol			
Post-program	11/44 (25.0)	11/95 (11.6)	0.40 (0.16–1.01)
6-month follow-up	6/40 (15.0)	15/92 (16.3)	1.17 (0.41–3.30)
12-month follow-up	6/36 (16.7)	15/91 (16.5)	0.97 (0.34–2.74)
Combined	1/49 (2.0)	3/103 (2.8)	1.36 (0.14–13.52)
Drugs			
Post-program	5/16 (31.3)	4/22 (18.2)	0.40 (0.08–2.00)
6-month follow-up	5/14 (35.7)	8/22 (36.4)	1.07 (0.26–4.49)
12-month follow-up	9/15 (60.0)	4/19 (21.1)	**0.16 (0.03–0.76)**
Combined	5/19 (26.3)	2/25 (8.0)	0.26 (0.02–3.39)
High suicidality			
Post-program	8/17 (47.1)	9/35 (25.7)	0.34 (0.10–1.22)
6-month follow-up	6/15 (40.0)	10/34 (29.4)	0.61 (0.17–2.19)
12-month follow-up	9/14 (64.3)	14/33 (42.4)	0.41 (0.11–1.51)
Combined	2/15 (11.8)	3/37 (8.1)	0.66 (0.10–4.45)

Note. Analyses only include participants who were meeting criteria for the outcome at baseline. ($p < .05$). Bolded text: $p < .05$. Combined = number of participants no longer meeting criteria for caseness for that variable at any time point assessed.

suicide-risk and 54% less likely to develop high suicidality at any point in the trial (*MS-T* = 15.4%, controls = 28.4%). These respective suicidality results were not statistically significant.

3.3 | Treatment effects

Table 3 provides the proportion of cases who were symptomatic at baseline but were no longer symptomatic at later assessment points. The only statistically significant treatment effect was found for recreational drug use at 12-month follow-up where *MS-T* participants using drugs at baseline were three times more likely than controls to have ceased using such substances (*MS-T* = 60.0%, controls = 21.1%).

No treatment effects were detected for depressive symptoms. For alcohol consumption, *MS-T* participants had a 60% lower risk of continuing to consume alcohol (>3 drinks) with 25% of *MS-T* participants were no longer consuming alcohol compared to 11.6% of controls. Regarding those with high suicidality at baseline, *MS-T* participants were at 66%, 39%, and 59% lower risk than controls of continuing to have high suicidality at post-program (*MS-T* = 47.1%, controls = 25.7% no longer meeting criteria), 6-month follow-up (*MS-T* = 40.0%, controls = 29.4%) and 12-month follow-up (*MS-T* = 64.3%, controls = 42.4%), respectively. Amongst those with high suicidality at baseline, *N* = 13 control cases remained at elevated risk at each of the subsequent time points, compared to *N* = 1 *MS-T* case. These findings were not statistically significant.

3.4 | Multivariate analyses

Multivariate logistic regressions were conducted to assess if there was unique variance explained in high suicidality (at any point across the three assessment points). Two separate regressions were run: for those who did not meet baseline suicide risk (prevention effects); and for those with baseline suicide risk (treatment effects).

The prevention analysis revealed three significant predictors in the multivariate model: group (OR = 0.25, 95% CI [0.07–0.96]), depressive symptoms (OR = 0.25, 95% CI [0.09–0.70]), and alcohol use (OR = 5.19, 95% CI [1.77–15.16]), indicating that being in *MS-T*, not having at least Moderate depressive symptoms and not consuming ≥3 alcoholic beverages in a sitting were unique protective factors against the onset of high suicidality. Control participants were twice as likely (*n* = 27/95; 28.4%) as *MS-T* participants (*n* = 6/39; 15.4%) to develop high suicidality at one or more assessment points in the trial. No significant predictors were identified for the treatment analysis.

3.5 | Mediation analyses

The results of the mediation analyses suggested that changes in disordered eating at post-program did mediate the relationship between group (*MS-T*, controls) and depressive symptoms (mean score across post, 6- and 12- month follow-up). The direct effect of group on mean depressive symptoms was 0.26 (SE = 0.09), but this dropped to 0.05 (SE = 0.03, 95% CI: 0.00–0.11) when the mediating effect of disordered eating at post-program was taken into account.

4 | DISCUSSION

MS-T is a program that has been previously found to have both prevention and treatment effects for ED diagnosis, as well as lowering disordered eating, risk factors and impairment (Wilksch, O'Shea,

Taylor, et al., 2018; Wilksch, O'Shea, & Wade, 2018). This report extends this research by investigating the impact of *MS-T* on depressive symptoms, alcohol and other drug use and high suicidality onset and remission in an online pragmatic RCT of young-adult women who self-referred to improve their body image. It is common for ED risk reduction trials to measure and report depressive symptoms as a continuous outcome variable. However, to the best of our knowledge, this is the first ED risk reduction RCT to investigate depression outcomes using an indicator of severity and the first to report on outcomes for alcohol and other drug use and suicide risk.

4.1 | Prevention effects

MS-T lowered the risk of Moderate or higher depressive symptom onset at each time point, with this being statistically significant at 6- and 12-month follow-up. More than a third of control participants developed depressive symptoms over these time points, while just 4.8% of *MS-T* participants did so. The robustness of these findings is highlighted by the fact that *MS-T* participants had an 86% lower likelihood than controls of developing depressive symptoms at *any* point in the trial, where 82.1% of *MS-T* participants remained asymptomatic at each assessment point compared to 52.1% controls. This is a strong finding that extends our original report that the *MS-T* group had significantly lower continuous depression scores at both 6- and 12-month follow-up (Wilksch, O'Shea, Taylor, et al., 2018). These prevention effects for depressive symptoms compare favorably with many targeted prevention programs for depressive symptoms in young-adults (Breedvelt et al., 2018).

The school version of *Media Smart* has also been found to reduce depressive symptoms (Wilksch & Wade, 2009; Wilksch et al., 2015). Further, *Media Smart* participants with high depressive symptoms at baseline reported significantly lower post-program shape and weight concerns (and other risk factors) than equivalent controls, while *Media Smart* participants with low baseline depressive scores had significantly lower growth in shape and weight concerns (and other risk factors) than equivalent controls at 2.5-year follow-up (Wilksch & Wade, 2014). The mediation analyses in the current study found that changes in disordered eating at post-program did mediate the relationship between group and depressive symptoms at post-program through to 12-month follow-up. This is an important finding that further underscores the degree to which disordered eating and the comorbidities measured in this study are related. Additionally, it suggests that prevention scientists need to measure transdiagnostic outcomes related to the primary outcome as the likelihood exists of benefits beyond those being currently measured.

This was the first time the mechanism by which either *MS-T* or *Media Smart* (school program) reduces depressive symptoms has been investigated and should be further expanded in future research. Of further relevance is that *Media Smart* has been associated with reduced media usage (Wilksch et al., 2015), which could lead to improved mood given evidence of a relationship between higher screen time and lower mood (Primack et al., 2009). Indeed, a systematic review found a reciprocal relationship between depressive symptoms and problematic Internet use, where those with higher internet usage were more likely to have elevated depressive symptoms and vice versa in adolescents and young adults (Anderson, Steen, & Stavropoulos, 2017). The impact of *MS-T* on media usage (e.g., screen time) was not assessed in the current trial and does need to be in future trials.

No *MS-T* participant commenced recreational drug use at any point in the trial compared to 18.2% of controls. This finding is consistent with the prevention of depressive symptoms, as level of depressive symptoms during adolescence predict later substance use (Groenman, Janssen, & Oosterlaan, 2017), and prevention programs that target substance abuse are more beneficial to those with lower levels of depression (Amaro, Blake, Schwartz, & Flinchbaugh, 2001). In adult samples, major depressive episodes have been found to occur prior to onset of alcohol and substance dependence (Abraham & Fava, 1999). Indeed, depressive symptoms, some of which are components of negative affect, are targeted as a key risk and maintenance factor in transdiagnostic treatments of both EDs (Fairburn et al., 2003) and emotional disorders more broadly (Farchione et al., 2012), highlighting the importance of this construct and its impact on a range of outcomes. In addition, a relationship between increased screen time and higher levels of recreational drug use (e.g., marijuana) has been identified (Primack et al., 2009) as has television in adolescents' bedrooms and increased likelihood of use of tobacco, marijuana and binge drinking (Gruber et al. 2005). Reductions in media internalization (Wilksch, O'Shea, Taylor, et al., 2018) could be another possibility for how recreational drug use was reduced, however this variable differs from screen time per se that that should be measured in future *MS-T* research.

It was a promising finding that *MS-T* lowered the onset of high suicidality by 37%–70% across the three assessment points (new at post-program: *MS-T* = 2%, controls = 6.3%; 6-month follow-up *MS-T* = 6.1%, controls = 11.4%; 12-month follow-up *MS-T* = 8.7%, controls = 13.1%), though these univariate findings were not statistically significant. In the multivariate model however, group allocation, depressive symptoms and alcohol consumption were found to be significant multivariate predictors of developing high suicidality any point in the trial. This is a promising finding as the high suicidality that accompany eating pathology is well documented (Wade et al., 2015). It also highlights the potential value of ED risk reduction as an underexplored program target in suicide prevention trials.

Future research should investigate additional mechanisms by which *MS-T* reduces suicidality. It is possible that the *MS-T* media literacy message and in particular, examining one's own relationship with social media and becoming a more critical consumer of this medium, played a role in the group's reduced risk of high suicidality onset. While debate continues as to whether the Internet plays a predominantly helpful or harmful role in suicidality, empirically identified risks of social media include (Luxton et al., 2012): much greater access to information on how to attempt suicide in both text and video format; victims of cyberbullying are twice as likely to attempt suicide than those who are not bullied; and the possibility of contagion effects and online suicide pacts. It would be beneficial for future evaluations of *MS-T* to measure Internet and social media usage to explore these relationships empirically.

Taken collectively, the preventative impact of *MS-T* on depressive symptoms, substance use, and high suicidality is promising, given that these three variables have been linked with completed suicide (Bukstein et al., 1993). It was very promising that a fully automated program that can be delivered at scale at low-cost could have these important benefits. Indeed, the cost of ongoing delivery of *MS-T* is very low, limited to website hosting and employment of a research assistant to respond to participant inquiries (in the current trial this equated to approximately 5 hr per week).

4.2 | Treatment effects

All treatment analyses controlled for participants accessing external treatment services at any point in the study. The only statistically significant treatment effect found was for recreational drug use at 12-month follow-up where *MS-T* participants were 84% less likely than controls to still be using such substances (rates of no longer using substances were *MS-T* = 60%, controls = 21.1%). While not statistically significant, at post-program *MS-T* participants were 60% less likely than controls to still be drinking alcohol (>3 drinks; *MS-T* = 25.0%, controls = 11.6%) or using recreational drugs (*MS-T* = 31.3%, controls = 18.2%), and 66% less likely to still have high suicidality (*MS-T* = 47.1%, controls = 25.7%). The comparatively low frequency at baseline of participants meeting criteria for high suicidality and recreational drug use likely contributed to the mostly non-significant findings for these outcomes. Further, of the n = 14 participants meeting high suicidality at all three post-baseline assessment points (i.e., post-program, 6- and 12-month follow-up), just n = 1 (7.1%) was a *MS-T* participant compared to n = 13 (92.9%) were controls. Up to 44% of people in developed countries do not receive treatment for suicidal ideation (Bruffaerts et al., 2011), thus the fact that *MS-T* reduced the incidence of continuing to have high suicidality at *any* post-baseline point in the study is most encouraging.

4.3 | Limitations & strengths

The limitations of this research have been discussed (Wilksch, O'Shea, Taylor, et al., 2018; Wilksch, O'Shea, & Wade, 2018). There are a number of special relevance to the current report. First, brief online self-report screening measures were used (ranging from 3 to 7 items) rather than clinical interview; as such this provided some indications regarding symptoms of depression and the presence of alcohol and other drug use and suicide risk rather than more informative clinical diagnoses. This may partially explain the high rate of onset of depressive symptoms in the control group. Second, rates of attrition which were higher than interview-based ED risk reduction trials. Third, given the dichotomous nature of the data, analyses were conducted on measure completers rather than on a intention-to-treat basis. Fourth, other common comorbid conditions (e.g., various anxiety disorders) were not measured in order to reduce measure completion burden on participants. Fifth, the full MINI suicide screen was not used and, data were not collected on previous suicide attempts or indeed if an attempt was made during this trial.

The strengths of the study are represented by the sole use of online self-report measures which has the advantages of lower research costs, maximization of the accessibility of participation, and participant anonymity. This is of particular relevance as rates of help seeking behaviors for face-to-face ED treatment services are notoriously low (Aardoom, Dingemans, Spinhoven, Hakkaart-van Roijen, & Van Furth, 2013). The reporting of missing assessment data is also a strength, where a review of 75 efficacy studies of web-based interventions found 40% (n = 30) did not report any information about dropout rates, and no study incorporated such information into their data analysis (Kiluk et al., 2011). Further, while reduction of the typically high levels of attrition for online mental health interventions constitutes a challenge that merits further research, the rate of data completion in the current trial compares favorably with web-based interventions with comparable young-adult samples. For example, an RCT of a transdiagnostic online program to reduce common mental health problems in young-adult university students reported an assessment attrition rate of 61.7% at 12-week follow-up (Musiat et al., 2014). Further, the highly regarded 5-session MoodGYM (a web-based CBT intervention for depression) had an attrition rate of 74% in the intervention group compared to 27% in the waitlist control group over a 12-week follow-up (Powell et al., 2013). Finally, although pragmatic, online intervention RCTs have higher attrition rates than efficacy RCTs, the benefits of an effective program reaching a far greater number of people are likely to offset this (Wade & Wilksch, 2018).

5 | CONCLUSIONS

To the best of our knowledge, this is the first RCT to find that an ED risk reduction program can also reduce risk for common comorbid problems. The current study provides further evidence that ED risk reduction scientists could consider reducing exclusion criteria to allow a wider range of participants. Indeed, the presence of such comorbidity (suicide risk, alcohol and other drug use) can also serve as exclusion criteria at eating disorder treatment services (Watson, Fursland, & Byrne, 2013). People with such comorbidity can "slip through the cracks" and risk developing a complex, chronic clinical presentation requiring prolonged, expensive treatment services. The findings in our current report and those relating to eating disorder diagnosis and risk factors (Wilksch, O'Shea, Taylor, et al., 2018; Wilksch, O'Shea, & Wade, 2018) suggest that it is possible for participants with baseline eating pathology and common comorbidities to benefit from a fully automated online program targeting eating disorder risk factors. That a brief online intervention can reduce such risk is novel and requires further investigation both for the *MS-T* program and other targeted ED risk reduction programs.

ACKNOWLEDGMENTS

Grant 1047192 from the National Health and Medical Research Council (NHMRC) supported this work. The development of the online version of Media Smart (*MS-T*) was supported through a South Australian Government Youth Connect grant. The authors thank the participants for their involvement.

CONFLICT OF INTEREST

Dr Wilksch and Professor Wade are authors of *Media Smart-Targeted* and *Media Smart*, where sales of *Media Smart* (school version) fund further ED prevention research.

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How to cite this article: Wilksch SM, O'Shea A, Wade TD. Depressive symptoms, alcohol and other drug use, and suicide risk: Prevention and treatment effects from a two-country online eating disorder risk reduction trial. *Int J Eat Disord*. 2019;52:132–141. https://doi.org/10.1002/eat.23005