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RESEARCH PAPER

Effectiveness of the Fun For Wellness Online Behavioral Intervention to Promote Subjective Well-Being in Adults with Obesity: A Randomized Controlled Trial

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Abstract

Fun For Wellness is a self-efficacy theory-based online behavioral intervention developed to promote growth in well-being and physical activity by providing capability-enhancing opportunities to participants. Evidence has been provided for the efficacy of Fun For Wellness to promote subjective well-being in adults in a relatively controlled setting. The objective of this study was to evaluate the effectiveness of Fun For Wellness to increase subjective well-being in adults with obesity in the United States of America in a relatively uncontrolled setting. The data described in this manuscript were collected within a more broadly focused trial: the Well-Being and Physical Activity Study (ClinicalTrials.gov, identifier: NCT03194854, https://clinicaltrials.gov/ct2/show/NCT03194854). The study design was a large-scale, prospective, double-blind, parallel group randomized controlled trial. Participants were recruited through an online panel recruitment company. Data collection occurred at three time points: baseline, 30 days and 60 days after baseline. Participants ($N=667$) who were assigned to the Fun For Wellness group ($n_{FFW}=331$) were provided with 30 days of 24 h access to the online intervention (i.e., from baseline to 30 days after baseline). Participants assigned to the usual care group ($n_{usual\ care}=336$) were asked to conduct their lives as usual. There was evidence for a positive indirect effect of Fun For Wellness on both occupational and psychological subjective well-being at 60 days after baseline through occupational and psychological well-being self-efficacy at 30 days after baseline, respectively. There was evidence for a positive direct effect of Fun For Wellness on both community ($d=0.33$) and physical ($d=0.26$) subjective well-being at 60 days after baseline. Results from this study provided some initial evidence for both the effectiveness (e.g., promoting community, occupational, physical, and psychological subjective well-being), and the ineffectiveness (e.g., failing to promote interpersonal, economic, and overall subjective well-being), of the Fun For Wellness intervention for increasing subjective well-being in adults with obesity in the United States of America.

Keywords e-health · m-health · Self-efficacy theory · Well-being self-efficacy · Mediation

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10902-020-00301-0) contains supplementary material, which is available to authorized users.

1 Introduction

The objective of the current study was to evaluate the effectiveness of the Fun For Wellness (FFW) intervention to increase subjective well-being in adults with obesity in the United States of America (USA) in a relatively uncontrolled setting. The study described in this manuscript was conceptualized as an effectiveness trial that built upon a FFW efficacy trial completed in a relatively controlled (i.e., adult employees at a major research university in the USA) setting (Myers et al. 2017a, b). The current study is important because the potential utility of interventions should be evaluated under both ideal (e.g., more controlled) and real-world (e.g., less controlled) conditions (Singal et al. 2014). Before describing the relevant results from the previous FFW efficacy trial and the hypotheses in the current study, we begin with a brief review of the target population, the theoretical framework, and the proposed mediator and outcome in the current study.

1.1 Adults with Obesity

Roughly two billion adults are overweight (World Health Organization [WHO] 2018). Furthermore, roughly one-third of adults who are overweight (i.e., body mass index falls within a range of: 25.00–29.99 kg/m^2) can more accurately be categorized as adults with obesity (i.e., body mass index $\geq$ 30.00 kg/m^2) and the size of this category has tripled over the past couple decades (WHO 2018). From a public health viewpoint this movement toward a growing number of adults with obesity is problematic because obesity is a risk factor for major non-communicable chronic diseases such as cardiovascular disease, type II diabetes, musculoskeletal disorders, and some cancers (United States Department of Health and Human Services (USDHHS 2013). There also may be an association between obesity and psychiatric disorders in the US (Simon et al. 2006). To decrease the prevalence of adults with obesity, the WHO (2018) recommends that persons engage in regular physical activity (e.g., 150 min at moderate intensity per week). However, there is data that suggests that a very small percentage (e.g., less than 5%) of adults with obesity meet public health guidelines for physical activity (Tudor-Locke et al. 2010). There is, however, indication that cognitive-behavioral interventions can successfully promote physical activity in adults with obesity (Gourlan et al. 2011; USDHHS 2018). To encourage sustained engagement with physical activity promoting interventions, the potential for experiencing health benefits across a broad array of health dimensions (e.g., subjective well-being) may be targeted and emphasized (Sullivan et al. 2001; USDHHS 2013, 2018). More generally, broadly focused interventions for populations at-risk for a narrower health or social problem is an established practice in prevention science (e.g., United States Preventive Services Task Force 2018). The recent USDHHS (2018) statements for the existence of at least some evidence in adults for a positive correlation between physical activity and quality of life (e.g., Bize et al. 2007; Pucci et al. 2012), as well as a positive correlation between physical activity and possible reductions in depression (e.g., Mammen and Faulkner2013) and anxiety (e.g., Ensari et al. 2015), may provide a possible holistic and evidence-based way forward for interventions in adults with obesity.

1.2 Self-efficacy Theory

Social cognitive theory (SCT; Bandura 2001) has been used as the conceptual framework for numerous effective cognitive-behavioral physical activity promoting interventions for

adults with obesity (Gourlan et al. 2011). Self-efficacy theory (Bandura 1997) exists within SCT and views individuals as proactive agents in the regulation of their emotional, cognitive, and behavioral activities. Self-efficacy beliefs occupy a central role in self-efficacy theory and are operationalized as domain-specific evaluations made by a person about their capability to effectively perform differing levels of a task in defined situations. Self-efficacy beliefs are informed by the cognitive processing of several possible sources of self-efficacy evidence: enactive mastery experiences (e.g., previous performance accomplishments), vicarious experiences (e.g., modeling and social comparison), verbal persuasion (e.g., evaluative feedback and self-talk), and physiological (e.g., fatigue and pain) and/or emotional (e.g., feelings and moods) states (Bandura 1997). Two suggested general outcomes of self-efficacy beliefs are a person's thoughts (e.g., subjective well-being) and behaviors (e.g., physical activity). A requirement for a trustworthy test of self-efficacy theory is a great deal of overlap (i.e., concordant) among the well-defined self-efficacy beliefs (e.g., well-being self-efficacy) and the domains of the proposed outcomes (e.g., subjective well-being) of interest (Bandura 1997). Specifying self-efficacy beliefs as a potential mediator variable in an intervention is an established practice in prevention science because it is a possibly modifiable variable (e.g., MacKinnon et al. 2001). Readers are referred to Bandura (2014) for a fuller accounting of a social cognitive perspective on key positive psychology concepts such as subjective well-being.

1.3 Fun For Wellness

Distinguishing between a theory (e.g., self-efficacy theory) and an intervention (e.g., Fun For Wellness) is a common and scientifically important practice (e.g., Michie et al. 2018). Fun For Wellness is a self-efficacy theory-based online behavioral intervention developed to promote improvements in well-being and physical activity by providing capability-enhancing opportunities to participants (Myers et al. 2019a, b). The complete conceptual model for the FFW intervention is larger than the current study and proposes that exposure to the intervention brings to bear both a positively signed direct effect, and a positively signed indirect effect through self-efficacy (i.e., well-being self-efficacy, well-being actions self-efficacy, physical activity self-efficacy, self-efficacy to regulate physical activity), on well-being (i.e., subjective well-being, well-being actions, and physical activity). The present study focuses more narrowly (as compared to the complete FFW conceptual model) on the FFW conceptual model for the promotion of subjective well-being (as depicted in Fig. 1).

Self-efficacy theory provided the conceptual background for creating the capability-enhancing learning opportunities (i.e., the BET I CAN challenges) that FFW participants

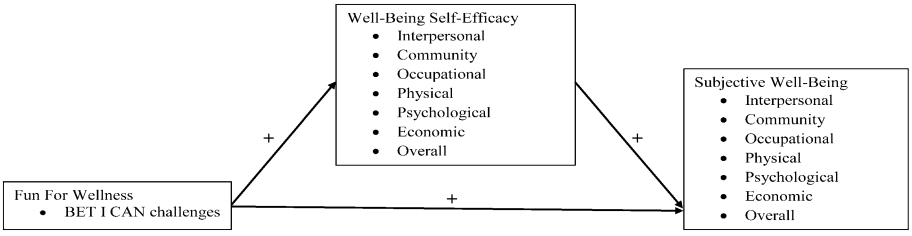

Fig. 1 The Fun For Wellness conceptual model for the promotion of subjective well-being

engage with (Myers et al. 2017a, b). Specifically, there are 152 interactive and scenario-based challenges that are ordered in the web-based setting by the BET I CAN acronym, where "B" = a behavior-centered set of challenges (e.g., set a goal), "E" = an emotion-centered set of challenges (e.g., cope with negative emotions), "T" = a thought-centered set of challenges (e.g., challenge negative assumptions), "I" = an interaction-centered set of challenges (e.g., communicate with others), "C" = a context-centered set of challenges (e.g., read cues in the environment), "A" = an awareness-centered set of challenges (e.g., know yourself), and "N" = a next steps-centered set of challenges (e.g., make a plan). Readers are referred to Myers et al. (2019a, b) as well as to Myers et al. (2019a, b) for a review of the supporting literature for the entire set of BET I CAN challenges.

Within the FFW intervention, the operational definition for well-being self-efficacy construct is the degree to which a person believes that they have the capability to attain a positive status in key domains of their life (Myers et al. 2017a, b). As depicted in Fig. 1, the FFW intervention was specified to exert a positively signed direct effect on well-being self-efficacy (Myers et al. 2019a, b). The seven dimensions of well-being self-efficacy targeted in the FFW intervention are denoted by the I COPPE acronym. Interpersonal well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in their relations with significant individuals. Community well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in the surrounding area within which they live. Occupational well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in their primary occupation. Physical well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in their wellness and physical health. Psychological well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in their emotional experiences. Economic well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in their financial outlook. Overall well-being self-efficacy is the degree to which an individual perceives that they have the capability to attain well-being in the general status across the aforementioned areas of their life. The well-being self-efficacy (WBSE) Scale was piloted in the 2015 FFW efficacy trial and was designed to measure only overall well-being self-efficacy. Results from the 2015 FFW efficacy trial provided some initial evidence for the efficacy of FFW to promote overall well-being self-efficacy (Myers et al. 2017a, b). However, a noteworthy limitation of the 2015 FFW efficacy trial was failing to measure six of the seven I COPPE dimensions of well-being self-efficacy.

Within the FFW intervention, the operational definition for the subjective well-being construct is as a person's satisfaction with their status in key domains of their life (Myers et al. 2017a, b). As portrayed in Fig. 1, the FFW intervention was specified to exert both a positive signed direct effect, and a positive signed indirect effect through well-being self-efficacy, on subjective well-being (Myers et al. 2019a, b). The seven dimensions of subjective well-being targeted in the FFW intervention are concordant with the seven dimensions of well-being self-efficacy targeted in the FFW intervention and also are denoted by the previously defined I COPPE acronym. Interpersonal subjective well-being is how satisfied an individual is with their relations with significant individuals. Community subjective well-being is how satisfied an individual is with the surrounding area within which they live. Occupational subjective well-being is how satisfied an individual is with their primary occupation. Physical subjective well-being is how satisfied an individual is with their wellness and physical health. Psychological subjective well-being is how satisfied an individual is with their emotional experiences. Economic subjective well-being is how satisfied an

individual is with their financial outlook. Overall subjective well-being is how satisfied an individual is with the general status across the aforementioned key domains in their life. Results from the 2015 FFW efficacy trial provided some initial evidence for the efficacy of FFW to promote interpersonal, community, psychological, and economic subjective well-being (Myers et al. 2017a, b). However, a noteworthy limitation of the 2015 FFW efficacy trial was failing to evaluate proposed relationships between well-being self-efficacy and subjective well-being.

1.4 Hypotheses

Three construct-level a priori hypotheses were investigated in the current study based on the conceptual model depicted in Fig. 1. Hypothesis 1 was that the FFW intervention would exert a positive direct effect on well-being self-efficacy. Hypothesis 2 was that well-being self-efficacy would exert a positive direct effect on subjective well-being. Hypothesis 3 was that the FFW intervention would exert a positive direct effect on subjective well-being. One additional construct-level exploratory hypothesis (i.e., Hypothesis 4) also was investigated based on the conceptual model depicted in Fig. 1: the FFW intervention would exert a positive indirect effect on subjective well-being through well-being self-efficacy. Dimension-specific hypotheses were not made due to a lack of previous research on the effectiveness of the FFW intervention.

2 Method

The data described in this manuscript were collected within a more broadly focused trial, the Well-Being and Physical Activity Study (see the Other information and Declarations section). Within this section we provide an overview of the relevant methods used in the Well-Being and Physical Activity Study to provide a context for the specific focus of this manuscript (American Psychological Association 2010). Readers are referred to Myers et al. (2019a, b) for a fuller description of the protocol for the Well-Being and Physical Activity Study. A populated CONSORT (Consolidated Standards of Reporting Trials)-EHEALTH checklist was provided for the Well-Being and Physical Activity Study by Myers et al. (2020), who reported on the physical activity outcome data. The subjective well-being outcome data that are the primary focus of this manuscript have not been considered in any previous report. The demographic covariate variables and participant compliance data briefly reported in subsequent sections of this manuscript, however, have also been reported by Myers et al. (2020). Some of the text that describes the methods used in Well-Being and Physical Activity study in the section that follows is similar to the text that in Myers et al. (2020). We provide this text in the current manuscript so that the reader does not need to read Myers et al. (2020) in order to understand methods used in the Well-Being and Physical Activity Study that are important to understand the data used in the present study.

The study design was a large-scale, prospective, double-blind (i.e., investigators, outcome assessor were masked), parallel group randomized controlled trial (RCT). Recruiting, screening, random assignment and collection of data were conducted online from August 2018 through November 2018. Data collection occurred at three time points: baseline (T1), 30 days (T2) and 60 days (T3) after baseline. The timeline for this study was similar to

timelines used in other well-being (Hendriks et al. 2019) and physical activity (de Vries et al. 2016) interventions.

2.1 Recruitment and Eligibility

Nine hundred participants were targeted for enrollment in the study based on statistical power estimation and budgetary constraints (see Myers et al. 2019a, b for details). Participants were recruited through the general population panel of the SurveyHealth (https://www.surveyhealthcare.com/) recruitment company. Partnering with an international panel recruitment company is consistent with recruitment in preliminary research on FFW (e.g., Prilleltensky et al. 2015) and with a movement toward larger and smarter health promotion interventions (Bauer et al. 2014; Reis et al. 2016). The eligibility criteria were: (a) ability to access the online intervention; (b) living in the USA; (c) 18 years old $\leq$ age $\leq$ 64 years old; (d) body mass index $\geq$ 25.00 kg/m^2; and, (e) absence of simultaneous enrollment in another intervention program promoting either well-being or physical activity. The BMI criterion included the overweight (i.e., 25.00–29.99 kg/m^2) category, as well as the obese category ($\geq$ 30.00 kg/m^2), consistent with many physical activity promoting interventions for adults with obesity (Gourlan et al. 2011).

2.2 Random Assignment

Random assignment of each eligible participant occurred after a unique and secure login credential was created, informed consent was obtained, a medical disclaimer was agreed to, and the T1 survey battery was completed. Eligible participants were randomly assigned to the intervention (i.e., FFW) or the usual care (i.e., UC) group via software code that was written to accomplish equal allocations to the FFW and UC groups. Participants assigned to the FFW group were given immediate access to the intervention. Participants assigned to the UC group were put on a waitlist for access to the intervention.

2.2.1 Usual Care

Participants assigned to the UC group were asked, in an e-mail, to conduct their lives as usual. The login credential for each UC participant provided access to a secure website to complete the survey battery at T1, T2, and T3. Usual care participants had the opportunity to earn up to $30 worth of Amazon electronic gift cards. Specifically, UC participants could earn $5 for completing the T1 survey battery, $10 for completing the T2 survey battery, and $15 for completing the T3 survey battery. Usual care participants were given one month of 24 h access to the FFW intervention after data collection for this study was closed. We note that some scholars may believe that this group would more accurately be described as a (no intervention or a waitlist) control group.

2.2.2 Fun For Wellness

Participants assigned to the FFW group were asked, in an e-mail, to engage with the FFW intervention. The login credential for each FFW participant provided 30 days (i.e., from T1 to T2) of 24 h access to the 152 BET I CAN challenges, as well as access to a secure website to complete the survey battery at T1, T2, and T3. Fun For Wellness participants had

the opportunity to earn a total of $45 worth of Amazon electronic gift cards. Specifically, FFW participants could earn $5 for completing the T1 survey battery, $10 for completing both the T2 survey battery and at least 15 BET I CAN post-introductory challenges (plus an additional $15 for completing at least 30 BET I CAN post-introductory challenges), and $15 for completing the T3 survey battery.

Each of the first four BET I CAN challenges required the participant to do one of the aforementioned activities while focusing on introductory material (e.g., orientation to the website; an introduction to the characters that appear in the vignettes; etc.) to provide an important context for capability-enhancing opportunities (Bandura 1997). Participants were required to complete these introductory challenges in order to gain access to the remaining 148 post-introductory BET I CAN challenges. Participants self-selected which post-introductory BET I CAN challenges to complete. Challenges completed by each participant were tracked by computer software to provide data (i.e., participation points) for the FFW engagement scoring system (Myers et al. 2017a, b). Earning at least 21 participation points was the operational definition for being engaged with the FFW intervention (Myers et al. 2019a, b). An overview of the BET I CAN challenges is provided in the supplemental material.

2.3 Survey Battery

Instruments designed to measure demographic information, well-being self-efficacy and subjective well-being were included in the survey battery. Proposed demographic covariates of subjective well-being were collected via self-report at T1 and included participant gender, race/ethnicity, highest level of education completed, marital status, employment status, age, and household annual income (Rubenstein et al. 2016). This set of demographic variables is collectively referred to as the demographic covariates from this point forward.

2.3.1 Subjective Well-Being

This construct was measured at T1, T2, and T3 with the well-established 21-item I COPPE Scale (Prilleltensky et al. 2015). Each of the seven dimensions of subjective well-being purported to be assessed by the I COPPE Scale—interpersonal, community, occupational, physical, psychological, economic, and overall—was measured with an exclusive item stem that referenced three unique periods of time: past (i.e., 30 days ago), present (i.e., right now), and future (i.e., 30 days from now). Reference to the past, present, and future is an established practice in the assessment of subjective well-being (e.g., Durayappah 2011). Responses to each item were ordered by an eleven-category rating scale structure that ranged from 0 (*worst your life can be*) to 10 (*best your life can be*). Evidence for the validity and reliability of scores derived from responses to the I COPPE Scale has previously been provided (e.g., Myers et al. 2016; Prilleltensky et al. 2015). The corresponding author will make the WBSE Scale available upon request.

2.3.2 Well-being Self-efficacy

This construct was measured at T1, T2, and T3 with an expanded version (i.e., from 7-items to 21-items) of the WBSE Scale as recommended in Myers et al. (2017a, b). The 21-item version of the WBSE Scale was designed to be more concordant with subjective well-being as conceptualized in the FFW context based on guidelines for the construction

of self-efficacy scales (Bandura 2006). Specifically, the seven dimensions of well-being self-efficacy purported to be measured by the WBSE Scale—interpersonal, community, occupational, physical, psychological, economic, and overall—match the seven dimensions of subjective well-being measured by the I COPPE Scale (Myers et al. 2019a, b). Each of the seven dimensions of well-being self-efficacy purported to be measured by the WBSE Scale has an exclusive item stem that referenced three unique periods of time: past (i.e., 30 days ago), present (i.e., right now), and future (i.e., 30 days from now). Responses to each item were ordered by a five category rating scale structure, where 0 = no, 1 = low, 2 = moderate, 3 = high, and 4 = complete confidence. The corresponding author will make the WBSE Scale available upon request.

2.4 Data Analytic Approach

Statistical models were fit in M*plus* 8.3 with maximum-likelihood (ML) estimation with robust standard errors (Muthén and Muthén 1998–2017). Type I error rate was set equal to 0.05. Missing data were addressed with full information ML estimation using the observed information matrix under the assumption of missing at random (Schafer and Graham 2002). Indexes of model-data fit considered were: the exact fit test $\left(\chi^2_R\right)$, root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), and the Tucker–Lewis index (TLI) (Kline 2016). Latent variable reliability was measured with coefficient *H* (Hancock and Mueller 2001). Indexes of effect size considered for direct effects were latent mean difference (Hancock 2001) and percentage of variance explained. The latent mean difference coefficient is an analog to Cohen's *d* (1988) and it is denoted as *d* from this point forward. Commonly used heuristics were used to assist in the interpretation of an absolute value of Cohen's *d*: 0.20 (small effect), 0.50 (medium effect), and 0.80 (large effect). For each indirect effect a bias-corrected bootstrapped estimate of the 95% confidence interval (CI) was obtained with the number of draws set equal to 2000 (MacKinnon 2008). An index of effect size was not considered for indirect effects because an effect size index for complex mediation models with latent variables has not yet been firmly established (Lachowicz et al. 2018).

2.4.1 WBSE Scale

Evidence for the proposed internal structure for responses to the revised WBSE Scale was evaluated consistent with standards for the use of revised instruments (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education 2014). A seven-factor exploratory structural equation model (ESEM; Asparouhov and Muthén 2009) with oblique geomin rotation (Yates 1987) was fit to T1 data consistent with relevant recommendations (Myers et al. 2015). Residuals for each pair of items that referenced the same period of time (e.g., past) were free to covary based on evidence provided by Prilleltensky et al. (2015) for three method effects (i.e., past, present, and future). A standardized pattern coefficient was considered meaningful if the absolute value was ≥ 0.31 (Comrey and Lee 1992) and it was statistically significant.

2.4.2 Path Model

A path model was fit for each concordant pair of dimensions of well-being self-efficacy and subjective well-being (e.g., interpersonal) depicted in Fig. 1 under an intent to treat approach

(Hollis and Campbell 1999). In each model ($df = 160$), there were two continuous latent outcome variables, well-being self-efficacy at T2 and subjective well-being at T3. Latent well-being self-efficacy at T2 was regressed on FFW (i.e., 0 = UC, 1 = FFW), latent well-being self-efficacy at T1, and the demographic covariates. Latent subjective well-being at T3 was regressed on FFW, latent subjective well-being at T1, latent well-being self-efficacy at T2, and the demographic covariates. The expression "adjusted latent mean difference", is used from this point forward to acknowledge the statistical adjustment made by including covariates in the model. Each of the four latent variables had three unique indicators. Consistent with relevant methodological recommendations for mediation analyses (e.g., MacKinnon 2008) there is a time lag between the more proximal proposed mediator (i.e., interpersonal well-being self-efficacy measured at T2) and the more distal proposed outcome (i.e., interpersonal subjective well-being at T3). Figure 1s in the supplemental material depicts key parameters of the path model for the concordant pair of interpersonal well-being dimensions.

There were four focal (i.e., of primary interest) parameters in the path model. The first focal parameter was the direct effect of FFW on latent well-being self-efficacy at T2 (i.e., β_1). This parameter was interpreted as the adjusted latent mean difference on well-being self-efficacy at T2 for the FFW group as compared to the UC group. The second focal parameter was the direct effect of latent well-being self-efficacy at T2 on latent subjective well-being at T3 (i.e., β_2). This parameter was interpreted as the path coefficient from latent well-being self-efficacy at T2 to latent subjective well-being at T3. The third focal parameter was the direct effect of FFW on latent subjective well-being at T3 (i.e., β_3). This parameter was interpreted as the adjusted latent mean difference on latent subjective well-being at T3 for the FFW group as compared to the UC group. The fourth focal parameter was the indirect effect of FFW on latent subjective well-being at T3 through latent well-being self-efficacy at T2 (i.e., β_4, where $\beta_4 = \beta_1 * \beta_2$). This parameter was interpreted as the product of path coefficients from FFW to latent subjective well-being at T3 through latent well-being self-efficacy at T2. Each of focal parameters tested the numerically corresponding hypothesis (e.g., β_1 tested Hypothesis 1).

2.4.3 Necessary Sample Size

Necessary sample size was determined for a fixed level of power for rejecting the null hypothesis that the population model-data fit of the path model was at or exceeded a particular value for poor model-data fit (MacCallum et al. 1996) using an online utility (Preacher and Coffman 2006) consistent with relevant recommendations (Myers et al. 2018). Population model-data fit (i.e., ε) in the RMSEA metric was set equal to 0.05 in the null condition (i.e., ε_0), which defined the boundary for poor model-data fit. Two values of population model-data fit were specified, 0.02 and 0.04, in the alternative condition (i.e., ε_1). Type I error was set equal to 0.05. Degrees of freedom were set equal to 160. Power was set equal to 0.80. When $\varepsilon_1 = 0.02$ necessary sample size was equal to 161. When $\varepsilon_1 = 0.04$ necessary sample size was equal to 561.

3 Results

3.1 Participant Characteristics

Figure 2 depicts participant flow from eligibility screening to randomization to retention over the three measurement occasions for the subjective well-being data. A total of 821

consented participants were randomly assigned to FFW ($n=410$) or UC ($n=411$). Forensic analysis by a computer scientist done prior to data analysis identified 154 cases as fraudulent and these cases were excluded from analysis leaving 667 analyzed cases (i.e., participants), FFW ($n=331$) or UC ($n=336$). The researchers initiated the forensic analysis with consultations from the designated IRB, legal counsel, and the office of research compliance and quality assurance about the computer scientist's report of suspicious activity on the website (e.g., participants logging in very close temporal proximity and sending identical e-mails to the computer scientist in broken English). The forensic analysis revealed that all of these 154 accounts were made by one user and/or group through two virtual private server services. The analysis was reported as a Reportable New Information (RNI#00,003,760) incident to the designated IRB in December 2018.

A majority of the participants identified as female (67.2%), White, non-Hispanic (74.1%), having completed at least a 4-year college degree (60.1%), married (65.2%), a full-time employee (62.6%), at least 40-years old (55.6%), and as residing in a household with an annual income of at least $70,000 (51.6%). Table 1 provides a comparison

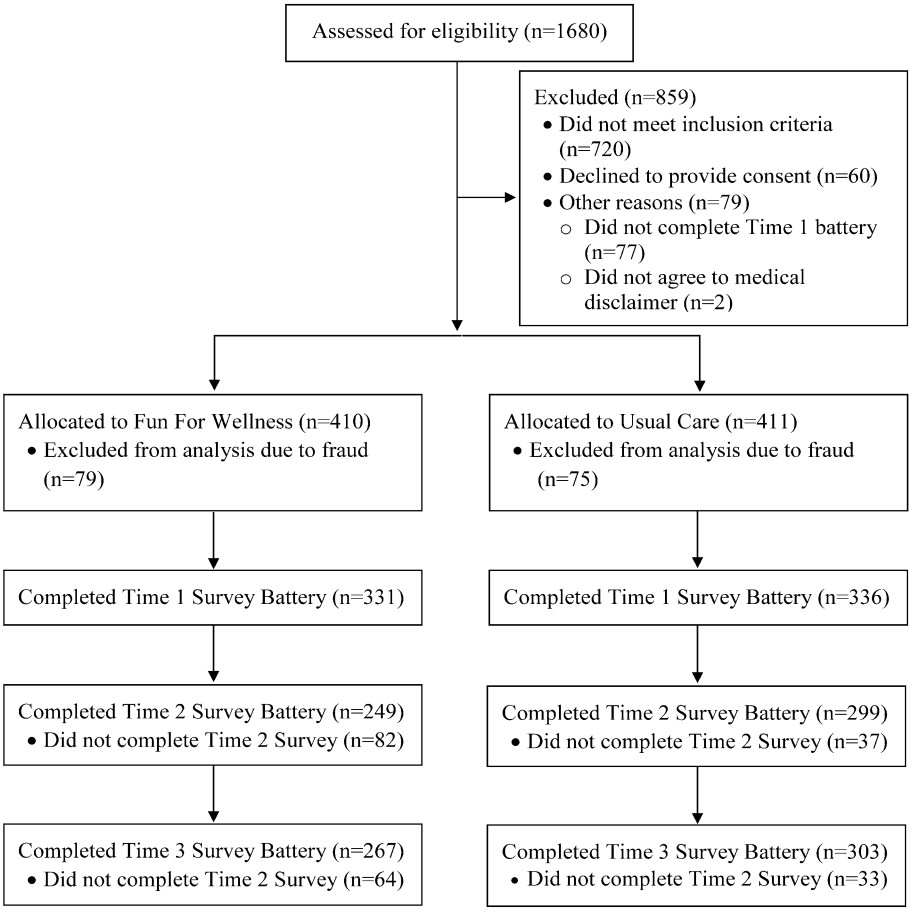

Fig. 2 Participant flow from screening to randomization to retention over the three measurement occasions for the subjective well-being data

of demographic characteristics, well-being self-efficacy scores, and subjective well-being scores at T1 for participants by randomization group. There were no statistically significant differences in the proportions of demographic characteristics or the mean well-being self-efficacy scores or the mean subjective well-being scores at T1 by randomization group. A majority (81.9%) of the participants who were assigned to the FFW group were engaged with the FFW intervention.

Table 1 Demographic Characteristics, Wel l-Being Self- Efficacy (WB SE) Scores, and Subjective Well-Being (SWB) Scores at Time 1 for Participants by Randomization Group

Variable	Usual care ($n=336$) (%)		Fun For Wellness ($n=331$)	
Female	66.1		68.5	
Black	16.1		14.2	
Hispanic	7.7		6.9	
Vocational or technical school	6.7		7.6	
Some college	18.8		18.8	
Undergraduate degree	42.3		37.2	
Graduate or professional degree	19.8		20.5	
Living with partner	6.0		7.3	
Married	66.1		64.2	
Single	15.2		13.9	
Part-time employment	11.9		9.4	
Full-time employment	60.7		64.4	
Retired	9.2		9.8	
	M	SD	*M*	SD
Age in years	43.35	11.12	44.02	11.04
Income	71,986	50,426	76,016	91,859
Interpersonal WBSE (α = .85)	2.66	0.98	2.69	0.97
Community WBSE (α = .85)	2.39	1.01	2.35	1.02
Occupational WBSE (α = .85)	2.38	1.12	2.37	1.09
Physical WBSE (α = .79)	2.30	0.89	2.41	0.88
Psychological WBSE (α = .81)	2.46	0.91	2.42	0.97
Economic WBSE (α = .82)	2.23	0.97	2.22	0.99
Overall WBSE (α = .82)	2.49	0.85	2.51	0.85
Interpersonal SWB (α = .86)	6.95	1.84	7.10	1.77
Community SWB (α = .90)	6.48	1.90	6.49	2.03
Occupational SWB (α = .92)	6.63	2.20	6.65	2.08
Physical SWB (α = .86)	6.27	1.96	6.34	1.82
Psychological SWB (α = .86)	6.72	1.86	6.73	1.84
Economic SWB (α = .90)	6.31	2.06	6.38	2.06
Overall SWB (α = .87)	6.48	1.80	6.57	1.79

The reference group (e.g., male) for each demographic variable (e.g., gender) and subgroups comprising less than 5% of observations are not reported for spatial reasons

Missing data ranged from 0 to 2.10% across all of the variables in this table

Table 1s in the supplemental material provides a comparison of well-being self-efficacy and subjective well-being estimated scores at T2 and T3 for participants by randomization group. Table 2s in the supplemental material provides the estimated correlation matrix for well-being self-efficacy and subjective well-being scores at T1.

3.2 WBSE Scale

There was evidence for exact fit of the seven factor ESEM model at T1: χ^2_R (21) = 21, p = 0.475, RMSEA = 0.000 (0.000, 0.032), SRMR = 0.005, CFI = 1.00, and TLI = 1.00. The rotated standardized pattern matrix was consistent with a priori expectations (see Table 3s in the supplementary material). More specifically, each item had a meaningful standardized pattern coefficient on only the dimension of well-being self-efficacy that it was intended to measure. For example, the item intended to measure interpersonal well-being self-efficacy with regard to the past had a 0.57 standardized loading on interpersonal well-being self-efficacy and a non-meaningful standardized loading, ranging from − 0.06 to 0.14, on each of the other six dimensions of well-being self-efficacy. Percentage of item-level variance explained ranged from 51 to 77%. Bivariate correlations between the dimensions of well-being self-efficacy ranged from 0.21 (interpersonal with economic) to 0.45 (physical with overall). Thus, initial evidence was provided for the proposed internal structure of the revised WBSE Scale.

3.3 Path Model

Table 4s of the supplementary material provides the observed model-data fit indexes, coefficient H estimates, and variance accounted for estimates from the path model for each concordant pair of dimensions of well-being self-efficacy and subjective well-being. There was evidence of close fit (e.g., RMSEA ranged from 0.021 to 0.035; SRMR ranged from 0.018 to 0.023; CFI ranged from 0.962 to 0.988; and, TLI range from 0.938 to 0.981) of the path model to the observed data. There was evidence of at least acceptable levels of latent variable reliability (e.g., coefficient H ranged from 0.77 to 0.93) across the four latent variables in each path model. There was evidence of a considerable amount of variance accounted for in both latent well-being self-efficacy at Time 2 (i.e., R^2 ranged 48.5% to 69.2%) and latent subjective well-being at Time 3 (i.e., R^2 ranged 51.3% to 59.5%). Table 2 provides the unstandardized estimate of each focal parameter from the path model. The paragraphs below briefly interpret these estimates with regard to the corresponding hypothesis tested. Table 5s in the supplemental material provides the standardized estimate of each focal parameter from the path model. Estimates of covariates at T2 and T3 for each concordant pair of dimensions of well-being self-efficacy and subjective well-being are available in Table 6s of the supplementary material.

Hypothesis 1 The adjusted latent mean difference on well-being self-efficacy at T2 for the FFW group as compared to the UC group was statistically significant and approximately small in size for the occupational, $\hat{\beta}_1$ = 0.20, p = 0.004, d = 0.33, and psychological, $\hat{\beta}_1$ = 0.15, p = 0.039, d = 0.26, dimensions. The adjusted latent mean difference on well-being self-efficacy at T2 for the FFW group as compared to the UC group was statistically non-significant and negligible in size for the interpersonal, $\hat{\beta}_1$ = 0.03, p = 0.697, d = 0.05, community, $\hat{\beta}_1$ = 0.05, p = 0.450, d = 0.09, physical, $\hat{\beta}_1$ = − 0.05, p = 0.432, d = -0.09,

Table 2 Unstandardized Estimate of each Focal Parameter from the Path Model for each Concordant Pair of Dimensions of Well-Being Self-Efficacy (WBSE) and Subjective Well-Being (SWB), where N = 667 and Path Model df = 160

	Hypothesis and corresponding focal parameter							
	Hypothesis 1: Fun For Wellness → WBSE at Time 2		Hypothesis 2: WBSE at Time 2 → SWB at Time 3		Hypothesis 3: Fun For Wellness → SWB at Time 3		Hypothesis 4: Fun For Wellness → WBSE at Time 2 → SWB at Time 3	
Dimension	β_1 (*SE*)	95% CI	β_2(*SE*)	95% CI	β_3(*SE*)	95% CI	β_4(*SE*)	95% CI
Interpersonal	0.03(.07)	[−0.11, 0.17]	0.80(.14)***	[0.52, 1.07]	0.18(.13)	[−0.07, 0.44]	0.02(.06)	[−0.08, 0.14]
Community	0.05(.07)	[−0.08, 0.18]	1.09(.15)***	[0.80, 1.37]	0.35(.13)**	[0.10, 0.60]	0.05(.07)	[−0.09, 0.20]
Occupational	0.20(.07)**	[0.06, 0.34]	0.80(.13)***	[0.54, 1.06]	0.14(.14)	[−0.13, 0.40]	0.16(.06)**	[0.05, 0.31]
Physical	−0.05(.07)	[−0.19, 0.08]	1.07(.15)***	[0.79, 1.36]	0.31(.13)*	[0.05, 0.56]	−0.06(.07)	[−0.21, 0.09]
Psychological	0.15(.07)*	[0.01, 0.29]	0.92(.16)***	[0.61, 1.23]	0.12(.13)	[−0.15, 0.38]	0.14(.07)	[0.01, 0.30]
Economic	−0.05(.07)	[−0.18, 0.08]	0.95(.14)***	[0.67, 1.22]	0.19(.13)	[−0.05, 0.44]	−0.05(.06)	[−0.19, 0.08]
Overall	0.08(.06)	[−0.05, 0.20]	0.87(.16)***	[0.56, 1.19]	−0.03(.11)	[−0.25, 0.19]	0.07(.06)	[−0.04, 0.19]

*$p < .05$. **$p < .01$. ***$p < .001$

economic,$\hat{\beta}_1$=-0.05, p=0.428, d=− 0.10, and overall,$\hat{\beta}_1$=0.08, p=0.214, d=0.15, dimensions. Thus, only partial support was provided for hypothesis 1.

Hypothesis 2 The path coefficient from latent well-being self-efficacy at T2 to latent subjective well-being at T3 was statistically significant for each dimension: interpersonal,$\hat{\beta}_2$=0.80, p<0.001, community,$\hat{\beta}_2$=1.09, p<0.001, occupational,$\hat{\beta}_2$=0.80, p<0.001, physical,$\hat{\beta}_2$=1.07, p<0.001, and psychological,$\hat{\beta}_2$=0.92, p<0.001, economic,$\hat{\beta}_2$=0.95, p<0.001, and overall,$\hat{\beta}_2$=0.87, p<0.001. Thus, full support was provided for hypothesis 2.

Hypothesis 3 The adjusted latent mean difference on subjective well-being at T3 for the FFW group as compared to the UC group was statistically significant and approximately small in size for the community,$\hat{\beta}_3$=0.35, p=0.006, d=0.27, and physical,$\hat{\beta}_3$=0.31, p=0.018, d=0.25, dimensions. The adjusted latent mean difference on subjective well-being at T3 for the FFW group as compared to the UC group was statistically non-significant and negligible in size for the interpersonal,$\hat{\beta}_3$=0.18, p=0.153, d=0.14, occupational,$\hat{\beta}_3$=0.14, p=0.327, d=0.10, psychological,$\hat{\beta}_3$=0.12, p=0.393, d=0.09, economic,$\hat{\beta}_3$=0.19, p=0.127, d=0.16, and overall,$\hat{\beta}_3$=− 0.03, p=0.778, d=− 0.03, dimensions. Thus, only partial support was provided for hypothesis 3.

Hypothesis 4 The 95% CI for the product of path coefficients from FFW to latent subjective well-being at T3 through latent well-being self-efficacy at T2 did not include 0.00 for the occupational,$\hat{\beta}_4$=0.16, [0.05, 0.31], and psychological, $\hat{\beta}_4$=0.14, [0.01, 0.30], dimensions. The 95% CI for the product of path coefficients from FFW to latent subjective well-being at T3 through latent well-being self-efficacy at T2 included 0.00 for the interpersonal,$\hat{\beta}_4$=0.02, [− 0.08, 0.14], community,$\hat{\beta}_4$=0.05, [− 0.09, 0.20], physical, $\hat{\beta}_4$=− 0.06, [− 0.21, 0.09], economic, $\hat{\beta}_4$=− 0.05, [− 0.19, 0.08], and overall,$\hat{\beta}_4$=0.07, [− 0.04, 0.19], dimensions. Thus, only partial support was provided for hypothesis 4.

4 Discussion

The objective of the current study was to evaluate the effectiveness of the FFW online behavioral intervention to increase subjective well-being in adults with obesity in the USA in a relatively uncontrolled setting. A key motivation in the development of FFW was to create an intervention that would be scalable, affordable, accessible, and interactive. In addition, since it is completely automated, it meets criteria for an intervention with high fidelity. Indeed, there is evidence that online interventions are effective and cost-effective in addressing a number of health risks (e.g., Moessner et al. 2015; Portnoy et al. 2008; Proyer et al. 2014). In light of the physical and mental health risks associated with obesity, we decided to evaluate FFW with this particular population (USDHHS 2013).

In general, results from the current study provide initial evidence that FFW enhances subjective well-being in some domains of life but not in others. Our findings indicate that FFW exerts a positive direct effect on community and physical subjective well-being and an indirect effect on occupational and psychological subjective well-being. At the same time, the study showed that FFW did not improve levels of overall, interpersonal, or economic subjective well-being. Specific findings will be discussed with respect to the four

hypotheses tested within the FFW conceptual model for the promotion of subjective well-being (see Fig. 1) and to the relevant results from the 2015 FFW efficacy trial.

At least partial supportive evidence was observed in the current study for each of the four hypotheses tested. Supportive evidence for hypothesis 1 includes positive direct effects from the FFW intervention to both occupational and psychological well-being self-efficacy at 30 days after baseline. This pair of findings provide some support for the conceptualization of the BET I CAN challenges as capability-enhancing opportunities and extend the literature on the ability of FFW to promote well-being self-efficacy (Myers et al. 2017a, b)—a mediating variable targeted by the intervention. Supportive evidence for hypothesis 2 includes positive direct effects from well-being self-efficacy at 30 days after baseline to subjective well-being at 60 days after baseline for each concordant pair of the following dimensions: interpersonal, community, occupational, physical, psychological, economic, and overall. This consistent set of findings provides full support for a central contention of self-efficacy theory—thought patterns are an omnibus outcome of self-efficacy beliefs (Bandura 1997)—and addresses a limitation of the 2015 FFW efficacy trial: not evaluating proposed relationships between well-being self-efficacy and subjective well-being. Supportive evidence for hypothesis 3 includes positive direct effects from the FFW intervention to both community and physical subjective well-being at 60 days after baseline. This pair of findings replicate a previous finding (i.e., the promotion of community subjective well-being), and provide a new finding (i.e., the promotion of physical subjective well-being) as compared to the 2015 FFW efficacy trial (Myers et al. 2017a, b). The new finding may be due to an increased focus on physical well-being in the current study, as compared to the 2015 FFW efficacy trial (Myers et al. 2019a, b). Supportive evidence for hypothesis 4 includes positive indirect effects of the FFW intervention on both occupational and psychological subjective well-being at 60 days after baseline through occupational and psychological well-being self-efficacy at 30 days after baseline, respectively. This pair of findings addresses a limitation of the 2015 FFW efficacy trial: not evaluating the proposed positive indirect effect of the FFW intervention on subjective well-being through well-being self-efficacy. Beyond the specific hypotheses tested, the current study is important because it provides initial evidence for the effectiveness of the FFW intervention to increase, either directly or indirectly, four (i.e., community, occupational, physical, and psychological) dimensions of subjective well-being in an at-risk population (USDHHS 2013).

Partial unsupportive evidence was observed in the current study for three of the four hypotheses tested. Unsupportive evidence for hypothesis 1 includes null direct effects from the FFW intervention to interpersonal, community, physical, economic, and overall well-being self-efficacy at 30 days after baseline. Thus, it may be that the BET I CAN challenges in the FFW intervention would benefit from being better optimized for providing more meaningful exposure to relevant sources of well-being self-efficacy information (Collins and Kugler 2018). Unsupportive evidence for hypothesis 3 includes null direct effects from the FFW intervention to interpersonal, occupational, psychological, economic, and overall subjective well-being at 60 days after baseline. Unsupportive evidence for hypothesis 4 includes null indirect effects of the FFW intervention on interpersonal, community, physical, economic, and overall subjective well-being at 60 days after baseline. Beyond the specific hypotheses tested, the results from the current study suggest the possible need for revision to the FFW intervention due to the initial evidence against the effectiveness of the FFW intervention to increase three (i.e., interpersonal, economic, and overall) dimensions of subjective well-being in an at-risk population (USDHHS 2013). The null findings for interpersonal and economic subjective well-being, however, are inconsistent with relevant results from the 2015 FFW efficacy trial (Myers et al. 2017a, b) and may be due to chance.

The null finding for overall subjective well-being in the current study is consistent with a relevant result from the 2015 FFW efficacy trial, and thus, the FFW online behavioral intervention in its current configuration may simply have a truly null effect on this proposed outcome.

Based on the findings reported here there are a few lessons for practitioners and researchers. With regards to the former, avenues to increase self-efficacy are crucial in successful interventions. Furthermore, practitioners may consider various ways that well-being self-efficacy can be improved in clinically vulnerable populations (e.g., adults with obesity) in hopes that other outcomes (e.g., health behaviors) may also be improved. With regards to researchers, we recommend a strong alignment among intervention activities, self-efficacy, and targeted outcomes. In other words, it is important to build programs where each activity addresses a specific component of self-efficacy (enactive mastery experiences, vicarious experiences, etc.), and builds mastery in specific domains of well-being such as physical, psychological, or interpersonal. With regards to practitioners and researchers, it may be especially fruitful to work to better understand how interventions like FFW can be successfully implemented on a broader scale and especially in workplace settings where many adults with obesity spend a great deal of their wakeful time and experience various stressors (Brown et al. 2011; USDHHS 2013).

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Compliance with Ethical Standards

Conflicts of interest Two co-authors, Adam McMahon and Isaac Prilleltensky, are partners in Wellnuts LLC. Wellnuts LLC may commercialize the FFW intervention in the future.

Ethical Approval All procedures in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The institutional review board at the University of Miami provided necessary permission (IRB# 20170541) to conduct this study on July 11, 2017. The University of Miami and Michigan State University (STUDY00000979) established an Institutional Authorization Agreement on 26 June 2018 that provided permission for the University of Miami to serve as the designated IRB for this study.

Informed Consent Informed consent was obtained from each participant included in the study. More specifically, immediately after being determined to be eligible for this study, each eligible individual was directed to a web-based IRB-approved informed consent form. Each individual who clicked "Consent to Participate" was enrolled as a participant in the study. Each individual who clicked "Decline to Consent" was denied access to the intervention.

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