TBM

ORIGINAL RESEARCH

Initial engagement and attrition in a national weight management program: demographic and health predictors

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Cite this as: *TBM* 2016;6:358–368
doi: 10.1007/s13142-015-0335-y

Abstract

Inconsistent attendance and participant withdrawal limit the effectiveness of weight control programs, but little is known about predictors of initial and ongoing engagement. The purpose of this study was to identify these predictors with respect to the Veterans Affairs MOVE!® program, using medical record data. Logistic regression models were used to predict initial and ongoing engagement (n=39,862 and 1985, respectively). Those who initially engaged in MOVE!® (vs. did not) were more likely to have high BMIs, to be female, live closer to the medical center, and receive health benefits from the VA; they also were less likely to use tobacco (ps<0.02). Older veterans were more likely to continue to engage (p<0.001), with trends toward continued engagement for those with (vs. without) benefits and higher BMIs (ps<0.10). Findings highlight characteristics that may inform program improvements that promote ongoing engagement and prevent dropouts in a weight management programs.

Implications

Practice: To increase initial engagement in any weight management program, staff can provide additional encouragement to patients with a lower body mass index (albeit categorized as overweight/obese), live farther from the medical center, and who smoke tobacco.

Policy: Policy makers need to ensure that weight loss programs have identified ways to examine factors that predict initial and continued engagement and develop targeted ways to increase engagement rates.

Research: Additional investigation into factors associated with initial and continued engagement using a more diverse sample, and different types of interventions can be used to increase engagement and attendance.

Keywords

Obesity, Weight management, Health care, Engagement

Obesity is now a global epidemic, and although effective treatment programs exist, these programs are hindered by inconsistent session attendance and participant withdrawal [1]. Current estimates of attrition from individual weight loss programs range from 5 to 85 %, with most estimates between 20 and 50 %. Initial engagement is necessary for any potential change, and ongoing engagement is a strong predictor of weight loss outcome [2]. Poor attendance and attrition thus limit participant and program success and impede accurate program evaluation [3]. Consequently, enhancing current knowledge about predictors of initial and ongoing engagement would allow for program improvements that promote engagement, prevent dropout, and increase likelihood of participant success.

ATTRITION FROM WEIGHT LOSS PROGRAMS

Much of the existing knowledge regarding initial and ongoing engagement is framed in terms of program attrition. Previous work across many types of behavioral weight loss programs has identified participant characteristics that are associated with attrition. Relative to those who complete such programs, higher percentages of non-completers tend to be female [4, 5], African American [5], divorced [5], and living farther from the treatment center [6]. In other examinations of attrition, however, these differences do not appear; it is not clear whether they were tested and were absent from reports or not examined. Several additional characteristics have shown conflicting relations with completion. For example, Inelmen and colleagues [7] demonstrated that participants who began at low body mass index (BMI) scores were more likely to withdraw, whereas Teixeira and colleagues [8] observed higher dropout rates among participants with high BMIs.

Age has shown similar inconsistencies; some reports identify older participants as more likely to withdraw [9, 10], whereas others find this effect with younger participants [4, 11, 12] or no effect at all [7]. Some studies have identified lower levels of education [11, 13] and low socioeconomic status [12] as related to dropout, yet there is some indication those who withdraw are more likely to be employed [7, 14]. Non-

completers also may have more comorbid medical [7] or psychiatric [15–17] diagnosis, though these characteristics also have been negatively associated with attrition [7]. These discrepancies may be due to any number of factors, including the fit (vs. misfit) of certain programs for specific demographic groups and differences between weight loss research trials and community programs.

One recent attempt to synthesize existing literature on attrition from weight loss trials concluded that inconsistencies across studies (i.e., the large number of variables examined and the few studies that included any one variable) precluded the identification of a reliable set of predictors [1]. This systematic review also noted that existing studies of attrition identify potential predictors retrospectively and that future work would benefit from selecting predictors with strong theoretical or empirical bases. For example, smoking cigarettes has been associated with obesity and its complications [18, 19]. Although there is some evidence that smokers show poorer engagement in weight loss programs [10], there has been little attention to this characteristic in examinations of initial and ongoing engagement.

Furthermore, it is possible that characteristics related to ongoing program engagement may differ from those related to initial engagement (i.e., attending the first program meeting). Few studies describe predictors of attendance to the first meeting, revealing a second, specific gap. Of interest regarding the disseminability of these interventions is the preponderance of evidence from clinical trials, relative to that from community programs. Given the restrictiveness of inclusion criteria for clinical trials, it also is unclear how well our current information about ongoing engagement reflects clinical practice [20].

OVERWEIGHT AND OBESITY AMONG VETERANS

One promising model for such investigation is the Veterans Health Administration's (VHA) MOVE!® weight management program. In the early 2000s, the VHA developed the program to address the growing problem of overweight and obesity in its patient base (i.e., rates of 77 % [21], which exceed rates found in the general US population). Primary care providers' meeting with veterans aging 69 or younger whose weights are classified as overweight or obese (i.e., BMI of 25 or higher) are electronically reminded to refer the patient to MOVE!®. Although program delivery is flexible to accommodate patient needs, veterans enrolled in MOVE!® receive tailored individualized feedback, and ideally, 6–10 supportive group sessions focused on nutrition, physical activity, and other evidence-based weight control skills led by multidisciplinary team members [22].

MOVE!® is a requirement for all VHA medical centers and is currently the largest nationally disseminated weight control program in the USA [23]. Previous reports have characterized attrition from MOVE!® based on VHA provider and staff perceptions [24, 25]. To date, however, there has been little systematic investigation of ongoing engagement in MOVE!® based on actual participant characteristics. In addition, engagement in MOVE!® sessions after initial referral has been described only for certain geographical locations and suggest very low rates of ongoing engagement [26].

AIMS OF THE PRESENT STUDY

The present study was designed to augment existing work by examining demographic and health predictors of initial and ongoing engagement in a large sample of participants in a national weight loss program. Although MOVE!® serves a specialized population, insights derived from this program may inform the examination of potential predictors of initial and ongoing engagement in other target groups. MOVE!® also is delivered in a clinical setting (rather than in the context of a research trial) and may thus more closely reflect initial and ongoing engagement under real-world conditions.

Potential predictors for the present study were selected from the set of demographic and health characteristics obtained from the VHA's electronic medical record. Extracting the data from veterans' electronic medical records circumvents the known limitations of self-reported health information [27, 28]. We examined the following characteristics: (1) background information, (2) vital sign information, (3) prior experience with the MOVE!® program, (4) common medical problems, and (5) previous healthcare utilization assessed by the number of primary care and behavioral health visits.

In addition, of unique interest in samples of veterans who use VHA facilities is "service connected benefits" status, which indicates whether a veteran receives health benefits for a condition related to his or her service [29]. MOVE!® is provided free to veterans irrespective of their service connected benefit status. However, service connected benefits may be an indicator of income or of the level of treatment received for a physical or psychiatric condition; whether veterans who receive service connected benefits (vs. not) are more likely to engage in MOVE!® is unknown. As existing information regarding relations between participant characteristics and various definitions of program engagement is limited and equivocal, our examination of direction among the predictors was exploratory, and we performed both exploratory and confirmatory logistic regression analyses.

METHOD

Participants and procedure

Initial engagement in MOVE!®–Data were extracted by a VA information technologist for all primary care patients seen by a VHA primary care provider in any of five VA Medical Centers and 29 Community-Based Outpatient clinics within the upstate New York area (VISN 2) between July 1, 2009 and July 1, 2010

(*n*=110,343). Veterans with BMIs less than 24 (*n*=37,897) and those aging 70 years and older (*n*=28,512) were excluded because they would not trigger the electronic medical record alert for the primary care provider to refer the veteran to MOVE!®. In addition, those with at least one MOVE!® encounter within 60 days prior to their primary care visit (*n*=300) were also excluded as they were already engaged in the program. The final dataset for analysis of MOVE!® engagement comprised 39,862 veterans who had complete demographic and health information.

Ongoing engagement in MOVE!®–Data were extracted by a VA information technologist for veterans seen by a primary care provider/staff between July 1, 2009 and July 1, 2010. As each veteran had multiple visits in primary care during this time period, the most recent primary care appointment to July 1, 2010 was used as the target date. Those who met the following criteria were included: (1) considered overweight/obese (i.e., BMI≥25), (2) no MOVE!® encounters within 60 days preceding the target date, (3) at least one MOVE!® encounter between July 1, 2009 and July 1, 2011 that also occurred following the target date, and (4) first post-primary care MOVE!® encounter occurred prior to May 19, 2011 (to allow for ample time to examine attendance rates). The age restriction criterion was removed as the electronic clinical reminder to refer the veteran to MOVE!® has no impact on the veteran's ongoing engagement, only the increased likelihood of a referral to MOVE!®. Only those with complete demographic and vital signs data were included in the final dataset, leaving a sample size of 1985.

Measures

Information obtained from electronic medical records included vital signs (i.e., height, weight, systolic/diastolic blood pressure), demographic data (i.e., age, marital status, zip code to be used to calculate distance, service connection), and other health information (i.e., pain, tobacco use) gathered at each veteran's most recent primary care visit. For the ongoing engagement analysis, we also examined current medical diagnoses (as described below), whether the veteran had any prior MOVE!® encounters from July 1, 2004 to July 1, 2009 and the number of behavioral health and primary care visits from July 1, 2004 to July 1, 2009 (as an indication of the veteran's previous exposure and engagement in other VHA services).

Service connected benefits–If the veteran had a missing value listed for whether he/she has received service connected benefits in the electronic medical record, it was interpreted as a zero as this study was interested in those participants currently receiving benefits from the VHA. Then, a dichotomized service connected benefits variable was created identifying those not receiving benefits as 0 and those receiving service connected benefits as 1.

Distance from the MOVE!® treatment center–The distance from a veteran's residence to a primary care clinic was calculated using the *zipcitydistance* function in SAS, based on the zip codes of primary residence listed in the electronic medical record and the VHA primary care clinic, where a majority of the MOVE!® programming is offered. The distance ranged from 0 to 7837.4 miles likely due to many veterans in this area having two residences and the current address in the electronic medical record being linked with where they may spend either the winter or summer months, which included such places as Florida, Hawaii, and Guam. Individuals with a distance of greater than 95 % of the sample (i.e., greater than 85 miles) were excluded as outliers due to the difficult ability to assess whether that may have contributed to their lack of engagement.

Tobacco use–VHA patients are asked about his/her tobacco use (current user, quit less than a year ago, or never used) by primary care staff at least one time per year, and their verbal response is recorded in the electronic medical record. Follow-up questions address patients' tobacco use history and interest in treatment. Individuals with the following designations within the past 12 months were considered current tobacco users: current smoker, current tobacco user, currently enrolled in a smoking cessation program, quit tobacco in the last 12 months, refused smoking cessation program, offered patients medication to quit tobacco use, offered patient smoking cessation program. Individuals were considered current non-tobacco users if they had one of the following indications within the prior 12 months: former smoker with less than 100 cigarettes in lifetime, lifetime non-user of tobacco, quit tobacco greater than 12 months ago. If the veteran's chart had multiple conflicting codes (i.e., coded as both a smoker and non-smoker on different days within the year), the individual was classified as a tobacco user. Therefore, individuals were classified as current tobacco users, non-tobacco users, and unknown (i.e., no information on tobacco user currently located in the electronic medical record) in the analyses.

Vital signs–Vital sign data extracted from the electronic medical record is complicated by repeated measures on the same day, biologically implausible data, and missing values. In an effort to obtain usable and accurate data for the vital signs on the target primary care date, we developed algorithms to address these challenges for blood pressure, height, and weight. For repeated values obtained on the same day, each algorithm-based decisions on whether to use the mean or mode, based on the distribution for each set of repeated measures.

We identified commonly accepted plausible ranges for height (48–84 in.) and weight (75–700 lb) [30] to eliminate implausible values. Consequently, 439 height values and 567 weight values were removed. Due to the number of primary care visits that had missing values for height (35.0 %) and weight (1.4 %), we used height data from within that 5 years and

Table 1 | Descriptive statistics for predictors used in initial engagement analysis

Variable	Not initially engaged $N = 38,078$	Initially engaged $N = 1784$
Age**	Mean = 56.1 years	Mean = 57.1 years
	Median = 60.0 years	Median = 61.0 years
	SD = 11.3 years	SD = 10.1 years
	Range 31–69	Range 22–69
Male***	35,936 (94.4 %)	1624 (91.0 %)
Race	10,288 (27.0 %) white	472 (26.5 %) white
	1344 (3.5 %) black or African-American	84 (4.7 %) black or African-American
	2082 (5.5 %) other	94 (5.3 %) other
	Missing = 24,634	Missing = 1134
Hispanic***	439 (1.1 %) Hispanic	85 (4.7 %) Hispanic
	Missing = 3029	Missing = 85
Married	20,430 (53.6 %)	956 (53.6 %)
Service connection***	17,896 (47.0 %)	931 (52.2 %)
Distance between residence and primary care clinic***	Mean = 13.5 miles	Mean = 11.2 miles
	Median = 9.9 miles	Median = 7.9 miles
	$SD = 13.3$ miles	$SD = 12.3$ 11.93 miles
	Range 0–85 miles	Range 0–84.4
Body mass index***	Mean = 31.9 kg/m^2	Mean = 35.7 kg/m^2
	Median = 30.7 kg/m^2	Median = 34.6 kg/m^2
	SD = 5.3 kg/m^2	SD = 6.5 kg/m^2
	Range 25–84 kg/m^2	Range 25–81 kg/m^2
High blood pressure*	32,920 (86.5 %)	1575 (88.3 %)
Tobacco use***	13,669 (35.9 %) current tobacco user	439 (24.6 %) current tobacco user
	13,326 (35.0 %) non-tobacco user	787 (44.1 %) non-tobacco user
	11,083 (29.1 %) unknown	11,641 (31.3 %) unknown
Pain score	Mean = 2.9	Mean = 2.2
	Median = 0	Median = 0
	SD = 2.89	SD = 2.9
	Range 0–10	Range 0–10

The pain score ranges from 0 (no pain) to 10 (worst pain)

*p<.05, **p<.01, ***p<.001

Table 2 | Descriptive statistics for predictors used in ongoing engagement analysis

	1 or 2 post-primary care MOVE!® visits, N= 1419	3 or more post-primary care MOVE!® visits, N= 566
Age***	Mean (SD) = 58.3 (11.4) years	Mean (SD) = 60.3 (9.8) years
	Median = 62.0	Median = 63.0
	Range 22–88	Range 24–90
Male	1294 (91.1 %)	525 (92.8 %)
Race*	378 (26.6 %) white	168 (29.7 %) white
	56 (3.9 %) black/African-American	35 (6.2 %) black/African-American
	4 (0.3 %) other	2 (0.3 %) other
	Missing = 981	Missing = 361
Hispanic	16 (1.1 %), missing = 80	8 (1.4 %), missing = 14
Married	766 (54.0 %)	308 (54.4 %)
Service connected benefits*	681 (48.0 %)	305 (53.9 %)
Distance between residence and primary care clinic	Mean (SD) = 11.3 (12.1) miles	Mean (SD) = 10.9 (11.2) miles
	Median = 7.8	Median = 7.8
	Range 0–84.4	Range 0–70
Body mass index***	Mean (SD) = 35.3 (6.2) kg/m^2	Mean (SD) = 36.4 (6.8) kg/m^2
	Median = 34.3	Median = 35.1
	Range 25–82	Range 25–82
High blood pressure	1244 (87.7 %)	500 (88.3 %)
Tobacco use***	355 (25.0 %) current tobacco user	100 (17.7 %) current tobacco user
	627 (44.2 %) non-tobacco user	297 (52.5 %) non-tobacco user
	437 (30.8 %) unknown	169 (29.9 %) unknown
Pain score	Mean (SD) = 2.1 (2.9)	Mean (SD) = 2.1 (2.8)
	Median = 0	Median = 0
Prior MOVE!® experience**	274 (21.5 %)	146 (28.6 %)
Diagnosis of CAD and diabetes	1100 (77.5 %) neither	426 (75.3 %) neither
	77 (5.4 %) diabetes	30 (5.3 %) diabetes
	186 (13.1 %) CAD	78 (13.9 %) CAD
	56 (4.0 %) both	32 (5.7 %) both
Diagnosis of depression and PTSD	1214 (85.5 %) neither	473 (83.6 %) neither
	106 (7.5 %) depression	55 (9.7 %) depression
	43 (3.0 %) PTSD	19 (3.4 %) PTSD
	56 (4.0 %) both	19 (3.4 %) both
Primary care visits**	Mean = 0.9	Mean = 1.1
	Median 1.0	Median = 1.0
	SD = 1.3	SD = 1.4

	Range 0–11	Range 0–8
Behavioral health visits	Mean = 8.3	Mean = 11.1
	Median = 0	Median = 0
	SD = 42.8	SD = 42.4
	Range 0–914	Range 0–411

Prior MOVE experience = at least one MOVE!® encounter between January 1, 2005 and 60 prior to the index primary care date. The pain score ranges from 0 (no pain) to 10 (worst pain)

CAD coronary artery disease, *PTSD* posttraumatic stress disorder

*p<.05; **p<.01; ***p<.001

weight data from within a month of the index primary care visit to calculate BMI at time of the target primary care date. To deal with repeated values for height, we selected the mean height if (1) there were two values that differed by 3 in. or less, (2) there were three or more values with a range of 3 in. or less and no mode, or (3) mean and mode differed by 3 in. or less. Otherwise, the mode was selected. A similar procedure was used for multiple weight values. The mean was used when the range was less than 10 lb; otherwise, the mode was used.

For blood pressure, we developed a least restrictive range of biologically plausible values based on the mixed definitions from previous literature [31, 32], that is, 75≤systolic≤250; 25≤diastolic≤180. We removed 1472 systolic and 424 diastolic values due to biological implausibility. For each pair of diastolic and systolic blood pressure measures, observations were categorized as high (versus normal) based on the following criteria: if diastolic blood pressure was >70 or systolic blood pressure was >119. If an individual had two or more discordant classifications for a single visit, they were coded as follows: (1) the most common category (i.e., high or normal) was used or (2) they were coded as a missing value if there were equal numbers of normal and high measures. The numeric rating scale for pain is collected at each visit with vitals and is a self-report of pain that ranges from 0 (no pain) to 10 (worst pain imaginable). As there were fewer discordant within-visit repeated measures for pain (0.13 %), we excluded observations that had multiple different scores for these factors.

Current diagnoses–ICD-9 code data was extracted from all of the encounter codes (up to three per encounter) given by the provider during any primary care visit between July 1, 2009 and July 1, 2010 to identify the presence of a diagnosis of depression (i.e., ICD-9 codes 296.2, 296.3, 300.4, 311), PTSD (ICD-9 codes 309.81), diabetes (ICD-9 codes 249–250), or coronary artery disease (CAD; ICD-9 codes 402–404, 410–416, 428–438, 441–443). As the diagnoses of PTSD and depression were significantly correlated (r=0.30, p<0.0001), we considered the potential issue of multicollinearity. However, given that the strength of the correlation was modest (highly significant due to the samples size), we treated these diagnoses as one categorical variable to differentiate the contributions of each without using multiple, related predictors. This variable was classified as depression only, PTSD only, both diagnoses, or neither diagnosis. Likewise, CAD and diabetes were significantly correlated (r=0.12, p=0.0001) and were classified as CAD only, diabetes only, both diagnoses, or neither diagnosis.

Data analysis

All analyses were completed in SAS version 9.2 [33]. Due to this study being exploratory in nature and a fairly large sample size, we chose to divide our sample

Table 3 | Results of exploratory and confirmatory logistic regressions of post-primary care visit initial and ongoing engagement in MOVE!®

Analysis of maximum likelihood estimates						
Parameter	Estimate	SE	Wald chi-square	Pr< ChiSq	Odds ratio	95 % confidence limits
Final exploratory model for post-primary care visit initial engagement in MOVE!®						
Intercept	−5.45	0.24	519.7	<0.0001		
Male	−0.59	0.12	23.62	<0.0001	0.55	0.44–0.70
Distance	−0.020	0.003	26.03	<0.0001	0.98	0.98–0.99
Service connected benefits	0.21	0.07	8.98	0.003	1.23	1.08–1.42
High blood pressure	0.31	0.12	7.05	0.008	1.36	1.08–1.71
Body mass index	0.09	0.005	314.37	<0.0001	1.09	1.08–1.10
Tobacco use						
Current user vs non-user						
	−0.48	0.09	29.79	<0.0001	0.62	0.52–0.74
Unknown vs non-user						
	−.16	0.08	3.59	0.06	0.855	0.73–1.01
Confirmatory model for post-primary care visit initial engagement in MOVE!®						
Intercept	−5.46	0.24	527.64	<0.0001		
Male	−0.32	0.13	6.07	0.01	0.73	0.56–0.94
Distance	−0.02	0.003	32.55	<0.0001	0.98	0.98–0.99
Service connected benefits	0.19	0.07	7.67	0.006	1.21	1.06–1.39
High blood pressure	−0.08	0.10	0.59	0.44	0.92	0.76–1.12
Body mass index	0.09	0.005	349.24	<0.0001	1.10	1.09–1.11
Tobacco use						
Current user vs non-user						
	−0.48	0.09	29.28	<0.0001	0.63	0.53–0.74
Unknown vs non-user						
	−.13	0.08	2.69	0.10	0.88	0.75–1.03
Final exploratory model for post-primary care visit ongoing engagement in MOVE!®						
Intercept	−3.63	0.60	36.66	<0.0001		
Age	0.02	0.01	8.70	0.003	1.02	1.01–1.03
Body mass index	0.04	0.01	11.96	0.0005	1.04	1.02–1.06
Service connected benefits	0.35	0.15	5.77	0.016	1.42	1.07–1.89
Confirmatory model for post-primary care visit ongoing engagement in MOVE!®						
Intercept	−2.96	0.59	24.47	<0.0001		
Age	0.02	0.01	8.76	0.003	1.02	1.01–1.04
Body mass index	0.02	0.01	3.29	0.07	1.02	0.99–1.04
Service connected benefits	0.27	0.14	3.62	0.06	1.31	0.99–1.73

using a SAS program to randomly select two equal-size groups by gender to allow for exploratory (n=19,931) and confirmatory (n=19,931) analysis to strengthen the results. Descriptive analyses verified that the two groups did not differ by demographic variables (ps>0.05). Using the exploratory sample, we conducted exploratory hierarchical logistic regressions to model engagement in MOVE!®. Demographic variables were first included as predictors then the vital sign information. Variables that were not significant (i.e., p>0.05) were eliminated in a backward fashion. The final exploratory model was then applied to the second confirmatory sample.

Regarding ongoing engagement, we found that 1110 veterans had one post-primary care MOVE!® visit, 309 veterans had two visits, and 566 had three or more visits. The mean number of days in this 2-year time period between the date of the MOVE!® visit closest to the primary care target date, and the most recent date was 84 days (SD=1.98). Veterans in the first two categories did not differ significantly on sex, age, BMI, or race (ps>0.05) and were thus combined into one group (n=1273) identifying those individuals as "less engaged" in the MOVE!® program than the intended goals of the program. Therefore, ongoing engagement in MOVE!® was defined as having three or more visits; those with fewer than three visits were classified as unengaged.

Similar to the engagement analyses, the dataset for ongoing engagement analyses was randomly divided into two equal-size groups by gender creating an exploratory (n=993) and confirmatory (n=992), which were comparable in demographic variables (ps>0.05). In the first step, we regressed ongoing engagement on the demographic variables and numbers of behavioral health and primary care visits. In the second step, we added the vital signs. Prior MOVE!® experience (i.e., engagement in MOVE!® between January 1, 2005 to 60 days prior to the index primary care date) was added in the third step, and diagnoses were added in the fourth step. Nonsignificant predictors were removed with backward elimination, and the final exploratory model was confirmed using the second subsample.

RESULTS

Participant characteristics

As shown in Tables 1 and 2, the final samples were predominantly male and white, although race data were missing for the majority of participants. The average age was approximately 57 years. About half of the veterans were married and approximately half received service connected benefits.

Initial engagement in MOVE!®

As noted, 1784 (5 %) veterans engaged initially in MOVE!® after their identified primary care visit. Results of exploratory and confirmatory analyses are shown in Table 3, and the samples did not differ significantly on any demographic or clinical variables (all ps>0.10). In the confirmatory model, the likelihood of initial engagement in MOVE!® significantly increased as the distance between residence and clinic decreased (p<.0001) and BMI increased (p<.0001). In addition, tobacco users were less likely to engage initially in MOVE!® than non-tobacco users (p<.0001). Males were also less likely to engage initially in MOVE!® than females (p<.01), and those without service connected benefits were less likely to engage than those with service connected benefits (p<.01). Odds ratios showed meaningful differences in the likelihood of initial engagement for between-person differences in these predictors (see Table 3). High blood pressure was not a significant predictor of initial engagement in the confirmatory model.

Ongoing engagement in MOVE!®

A total of 1985 veterans were included in the ongoing engagement analysis. Only 29 % of those who attended at least one MOVE!® session continued to engage in MOVE!® past two visits. The exploratory and confirmatory samples did not differ significantly on any demographic or clinical variables (all ps>0.10), and results of the analyses are shown in Table 3. Only age was a significant predictor of ongoing engagement (i.e., 3 or more sessions) in the confirmatory analysis. However, both BMI and receiving service connected benefits displayed trends toward significance (p<0.10), with veterans with higher BMI and those who received service connected benefits (i.e., receiving benefits from the VA) were more likely to continue to engage in MOVE!®. Of note, the odds ratio for receiving service connected benefits (OR=1.31) suggests a potentially meaningful difference in the likelihood of ongoing engagement for those receiving service connected benefits, relative to those who do not receive service connected benefits.

DISCUSSION

This study represents one of the first efforts to determine the predictors of initial engagement (i.e., attendance at one session post-referral) in a real-world weight management program. It also provides further exploration as to the types of predictors of ongoing engagement from a weight management program delivered in a clinical setting. Findings were generally consistent with limited previous research [6, 7,8], with respect to the meaningful roles of age, BMI, tobacco use, and distance between the residence and the medical center. These and other predictors tested herein also are commonly assessed or present within an electronic medical record. Therefore, this information is easily available to most primary care team members when referring a patient to a primary care-based weight management program.

Initial participant engagement

Our findings suggest that background information available within the electronic medical record, such as sex, service connected benefits, and distance to the medical center may be useful in predicting initial participant engagement. For example, those who live in closer proximity to their VHA primary care clinics were more likely to engage initially in MOVE!®. This is consistent with previous research that has found that logistical difficulties, such as inconvenient program access, were a barrier to initial engagement in treatment for obesity [6]. In addition, females were more likely to engage initially in MOVE!® than males. The role of sex may be particularly relevant to veterans, as this population is predominantly male [34]. As some non-VHA programs have shown greater completion rates among men [4, 5], attention to the specifics of these programs may provide information about how to better engage men in weight loss treatment.

Also unique to the veteran population is the role of service connected benefits, representing VHA healthcare benefits for conditions related to military service. In the present study, those who received service connected benefits were 1.21 times more likely to attend an initial MOVE!® session than those who were not. This finding aligns with previous work that demonstrates service connected benefits as a protective factor against negative outcomes such as veteran homelessness [35] and suicide [29]. Although MOVE!® is a free program, and the lack of a service connected benefits does not present a financial barrier, it is possible that those who receive service connected benefits have more familiarity with their VHA clinics and/or are more comfortable engaging in a new program. As these speculations warrant further investigation, service connected benefits should play a key role in future research.

Several indices of vital sign information also may be predictive of initial participant engagement. Primary care patients with higher BMIs were more likely to engage initially, which is consistent with previous investigations of retention in weight management programs [10, 36]. Individuals with higher BMIs may experience more severe impairment of quality of life [37, 38], leading to greater motivation to engage in a weight management program. Disorders comorbid with obesity such as cardiovascular disease, respiratory disease, and sleep disruption, however, have been found to constitute a barrier to the treatment of obesity [39].

Finally, current tobacco use was significantly predictive of lower initial engagement, with smokers 0.63 times less likely to engage initially in MOVE!® than nonsmokers. This finding has some precedence in prior weight management program research [10], which found that persons who smoked attended significantly fewer sessions of an obesity treatment program than did nonsmokers. Lack of initial engagement by smokers may be due to smokers' poorer physical practices (e.g., eating behaviors and exercise) compared to nonsmokers [40, 41]. Therefore, the endorsement of tobacco use may be a way to identify those patients with poor health practices overall.

There is also a substantial body of research linking continued tobacco use with concerns about weight management [10, 42, 43]. Concern about weight control has been shown to be the strongest predictor of a participant never attempting smoking cessation [44]. Dietary and physical activity interventions may be less effective for tobacco users than non-tobacco users due to the combination of poorer health behaviors in tobacco users and the usage of tobacco as a weight maintenance strategy [10]. This may help to explain why tobacco users are significantly less likely to engage initially in MOVE!®. Importantly, missing information about smoking status may have underestimated the risk associated with smoking; encouraging primary care staff to check smoking status during visits could increase the accuracy and utility of follow-up work in this area.

Ongoing engagement in MOVE!®

Our findings for ongoing engagement were more limited. As noted, age has shown both positive and negative relations with attrition in previous examinations of weight management programs. In the present study, older age was related to ongoing engagement in MOVE!®, with each year of increased age associated with 1.02 greater likelihood of ongoing engagement. Older participants may be more likely to engage in weight control programs on an ongoing basis due to poorer health (and thus, greater motivation to improve health) and declining familial obligations [4, 5, 11]. BMI and service connected benefits both trended toward significance for ongoing engagement in MOVE!®, with higher BMI (vs. lower) and receiving service connected benefits (vs. not) associated with greater likelihood of ongoing engagement.

Strengths, limitations, and future directions

Strengths of the current study include a large sample size, statistical validity due to the usage of both exploratory and confirmatory analyses, the inclusion of a large number of health characteristics commonly found within electronic medical records, and analysis of initial and ongoing engagement in the MOVE!® program. The clinical setting of the MOVE!® program may more accurately represent initial and ongoing program engagement in real-world versus the research settings typically examined in tests of attrition.

Limitations of the present study also bear noting. First, data related to specific medical diagnoses were not collected for our initial engagement analyses and the data that was pulled for ongoing engagement focused on only those diagnoses included on the encounters. Second, the population in the sample was skewed toward more white and male participants in comparison to the national veteran population [34], somewhat limiting the generalizability of the study's findings. Another limitation is that a significant amount of data related to race and ethnicity (n>

19,000) were missing from veteran medical records, excluding them from analyses. While this decreased the pool of participants, the resultant final sample size was still over 15,000 individuals for the initial engagement analyses, providing more than ample statistical power.

Of potential interest is the effect of within-person predictors of initial engagement, such as self-driven initiation of engagement versus provider-driven initiation. As this information is not collected within the electronic medical record, we were unable to examine such relations. Although future research should examine these variables to obtain a comprehensive understanding for the predictors of initial engagement, the benefit of focusing on what is located within the electronic medical record is that it can be used by providers to identify those who may need additional intervention or support. We also were unable to examine the number of times the veteran was previously referred to the MOVE!® program due to the lack of specific data available within the electronic medical record. This could be a valuable piece of information to collect in future research.

Finally, the sizes of some of the odds ratios were weak, hovering around 1.0. Although an odds ratio of 1.02 for a one-unit increase in a continuous variable such as age may be clinically useful, other predictors may also be necessary to accurately predict initial or ongoing engagement. As noted, however, the advantage of this study was the examination of predictors readily available to primary care providers from the electronic medical record. With the wider use of electronic medical records, identifying factors *from existing data sources* that may detect those patients in need of additional encouragement to engage in weight management programs initially or on an ongoing basis would be helpful.

Implications

Due to the dearth of available information concerning participant engagement in weight management programs, the predictors identified in this study may have meaningful implications for healthcare systems/providers as they contemplate how to engage patients in such programs. Overall, we found that of those patients eligible and meeting the criteria for the electronic clinical reminder to refer the patient to the MOVE!® program to be activated, only 5 % of patients engaged initially and attended at least one MOVE!® appointment. Although similar to the 3 % rate found in another internet-based weight loss program's evaluation [45], these low rates suggest that, within the VHA, primary care teams may need to do more than the typical one-time brief referral–especially for those patients who are current tobacco users, do not receive service connected benefits, or live farther away from the medical center.

In addition, primary care teams may need to provide continued encouragement to those patients who do engage initially to reinforce ongoing engagement, as only 29 % of those who attended at least one MOVE!® session continued to engage in MOVE!® past two visits. Future research should continue to examine the types of interventions primary care staff or the integrated behavioral health/care manager can provide within primary care that would efficiently facilitate initial and ongoing engagement. However, another option may be to examine MOVE!® programmatic changes that may help to increase initial and ongoing engagement among these groups of veterans. For instance, some VHA clinics are exploring a self-management/home version of MOVE!® and/or a telephone support system that may be valuable to veterans [46].

The present findings also suggest other lines of inquiry that warrant further study. For example, can we better understand why tobacco use is associated with lower initial engagement and what can we do to improve initial engagement due to the combined health risks associated with tobacco use and obesity? Our findings fail to confirm previous studies' conclusions regarding the value of depression in predicting initial or ongoing engagement in MOVE!® [10], so additional research needs to better understand how depression diagnoses may contribute to initial and ongoing engagement in programs such as MOVE!®.

Finally, a broad implication of our work relates to ways that policy makers should evaluate weight management programs and how weight management programs choose to identify and manage the various factors that relate to initial and ongoing engagement, as these are vital to the success of the program. The ultimate goal should be a more effective program design and delivery; this means more empirical attention to improvements that will promote initial and ongoing engagement and increase overall participant success, while recognizing the constraints of real-world practice of weight management programs within the current healthcare environment.

Acknowledgments: The views expressed in this article are those of the authors and do not reflect the official policy of the Department of Veterans Affairs or other departments of the US government. This material is based upon work supported by the VA Center for Integrated Healthcare.

Conflict of interest: The authors declare that they have no competing interests.

Compliance with ethical standards: All procedures were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

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