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Evaluating the Effects of the Exercise Is Medicine Program on Biopsychosocial and Behavioral Outcomes in Individuals with Cardiovascular Risk Factors

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ABSTRACT

NEMATI, D., A. SOMMER, S. ZHAO, A. WILLIAMS, J. HAUBEN, J. LUTHY, M. OMAR, K. LARTEY, A. BRENGARTNER, N. OJEMBE, J. PARO, K. URSE, G. BROCK, and J. J. JOSEPH. Evaluating the Effects of the Exercise Is Medicine Program on Biopsychosocial and Behavioral Outcomes in Individuals with Cardiovascular Risk Factors. *Med. Sci. Sports Exerc.*, Vol. 58, No. 7, pp. 1377–1387, 2026. **Introduction:** The benefits of exercise for cardiovascular disease prevention are well established, yet most patients fail to adopt regular exercise despite healthcare provider recommendations. While healthcare provider recommendations provide interpersonal support, exercise adoption requires the development of intrapersonal motivation and the presence of a supportive environment. The Exercise is Medicine (EIM) program utilizes healthcare provider referrals to connect patients with a community that fosters the translation of exercise beliefs into behaviors. The purpose of this study was to examine the biopsychosocial and behavioral outcomes of the EIM program. **Methods:** Participants were referred by healthcare providers through electronic medical records. Participants engaged in 16 group sessions and three one-on-one sessions (two before and one after the group sessions) and completed validated measures to assess the biopsychosocial model of health. **Results:** The EIM program demonstrated significant improvements in biological and behavioral markers. Notably, exercise participation increased by an average of 64.7 min (95% confidence interval [CI]: 46.6 to 82.8). Body mass index decreased by 0.48 units (95% CI: –0.63 to –0.32), while perceived stress scores declined by 1.08 points (95% CI: –1.59 to –0.56). Participants also experienced an improvement in health-related quality of life, with general health scores rising by 5.59 points (95% CI: 4.39 to 6.78). Systolic blood pressure decreased by 2.9 mm Hg (95% CI: –3.9 to –1.9). Additionally, there was a 22% reduction in depressive symptoms ($P < 0.001$) and a 9% reduction in perceived stress ($P < 0.001$). Increases in exercise time were associated with improvements in key behavioral determinants such as self-efficacy, affective judgment/passion, and tolerance. **Conclusions:** Overall, these findings underscore the program's positive impact on cardiovascular health and mental well-being in a real-world community setting. **Key Words:** BEHAVIOR, CARDIOVASCULAR, DISEASES, EXERCISE, PHYSICAL ACTIVITY

Exercise is one of the most effective behavioral medicines an individual can adopt for multidimensional health improvement, including biopsychosocial factors such as cardiovascular health (1–3), diabetes (4–6), psychological health (7–9), and social health (10,11). Although the medicinal benefits of exercise are scientifically well-established in modern medical science, the concept of Exercise Is Medicine (EIM) is not a recent development (12). Rather, it is an ancient medical theoretical framework introduced by Galen (c. 129–210 AD), which was adopted from Hippocrates (c. 460-370 BC), stating, "Eating alone will not keep a man well; he must also take exercise (1,13,14)." Collectively assessing these health factors is recognized as the biopsychosocial model of health. Despite accumulating evidence supporting exercise

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over the past 2000 yr, adopting regular exercise behavior remains a significant challenge. Over 100 billion dollars in economic cost to the healthcare system is attributed to inactivity-related noncommunicable diseases (15).

The challenge of adopting exercise can be attributed to the complex requirements of psychological and environmental determinants, which, if not supported, can act as barriers to successful behavioral initiation and maintenance. Recognized determinant pillars include intrapersonal variables (e.g., knowledge and self-efficacy), interpersonal dynamics (including social support and role modeling), and environmental factors (such as accessibility, safety, and cost). Among inactive adults at risk of noncommunicable diseases, at least one of these pillars is often missing. For example, while the importance of prescribing physical activity from healthcare providers is well documented in shaping social support (interpersonal dynamics), many patients lack a supportive environment and intrapersonal skills, failing to translate their exercise intention into behavior. There is a need for community programming to support the environmental and intrapersonal pillars that would translate their intention to exercise behavior.

The EIM program established at The Ohio State University Wexner Medical Center (OSUWMC) connects healthcare providers with a supportive community-based exercise program to address the critical gap between intention and behavior. The program integrates exercise as a key component of disease prevention and management (16–18). EIM fosters a collaborative partnership between healthcare providers and local organizations, facilitating patients with physician referrals to engage in personalized exercise programs. The EIM program is tailored to each participant's specific conditions and capabilities and led by American College of Sports Medicine (ACSM) Certified Exercise Physiologists with an EIM credential (19). The EIM credential is a certification from EIM, in partnership with the ACSM, which indicates that the exercise professional has demonstrated evidence-based expertise in integrating physical activity assessment, prescription, and counseling into clinical care. The credential signifies that the individual has standardized training and knowledge for tailoring exercise for clinical population groups and emphasizes collaboration with healthcare providers. The EIM program incorporates essential elements such as education sessions, social support, behavior change coaching, and a safe, resourceful environment that facilitates intrapersonal and environmental determinants to promote exercise participation.

The purpose of this study is to examine: 1) The impact of the EIM program on the biopsychosocial model of health, including biological parameters (e.g., body mass index [BMI], blood pressure), psychological outcomes (e.g., stress and depression), and social factors (e.g., quality of life); and 2) Exercise behaviors and determinants. We hypothesize that the EIM program will demonstrate effectiveness across the biopsychosocial domains of health benefiting enrolled patients.

METHODS

Participants

Eligibility Criteria. The first step in enrollment into the EIM program is healthcare provider referrals, which are entered into the electronic medical record and subsequently reviewed by a clinical exercise physiologist to confirm participant eligibility. After eligibility confirmation, a specialist from the EIM program contacts potential participants via telephone and email to provide program information and facilitate enrollment. Inclusion criteria include: 1) age 18 yr and older without any healthcare provider-imposed limitations on physical activity; and 2) not currently meeting exercise recommendations or have ≥1 chronic health condition. Exclusion criteria include a history of myocardial infarction, revascularization, or stroke/transient ischemic attack within the past 12 months, unstable angina, or congestive heart failure classified as New York Heart Association Class II, III, or IV. Other exclusion factors included ventricular arrhythmia, clinically significant cardiac valve disease, blood pressure > 160/100 mm Hg, uncontrolled seizure disorder, major surgery within the past 3 months, severe or frequent hypoglycemia, inability to independently manage blood glucose during physical activity, severe autonomic or peripheral neuropathy, active foot ulcers, or unstable retinopathy. The study was approved by the Institutional Review Board at The Ohio State University.

Settings

The OSUWMC EIM program was initiated in 2017 and initially offered at a single location in Columbus, Ohio. Within 2 yr, driven by participant interest and growing demand, the program expanded to 10 centers, including community centers and ambulatory rehabilitation sites covering the entire Columbus metropolitan region. The community centers were selected as they serve as anchor institutions for community health and wellness and are essential for increasing community participation in exercise programming. The centers provide individuals with a familiar environment, which helps develop and support the intrapersonal motivation needed to achieve success in behavior change. Each center is required to have the capacity to support exercise interventions, including weight training and aerobic activities. The collaboration with these community partners also allows access to the facilities outside of the EIM program sessions, and participants are encouraged to exercise outside of the structured program sessions.

Intervention

The EIM program consists of three one-on-one and 16 group exercise sessions over a 12-wk period. All sessions are led by an ACSM-Certified Exercise Physiologist with an EIM credential. The first session includes a detailed assessment of the participant's physical activity and medical history and incorporates behavior change coaching to evaluate barriers, strengths, motivation, and readiness for change. These elements inform subsequent SMART health and fitness goal setting and the development of a personalized exercise program.

The second one-on-one session implements the exercise program through a personal training session. The EIM specialist educates the participants on how to safely perform each prescribed exercise, make modifications if necessary, and provides any needed physical activity education. The core components and delivery structure of the OSU EIM program are summarized in Table 1.

Group Exercise sessions. Sixteen group sessions (1 h each; 2× wk^{-1} for 8 wk): These sessions consist of up to eight to 10 EIM participants. Based on feedback from the personal training session, each participant completes their exercise program at their own pace, while the EIM specialist is present for support and supervision. The general approach is 10 min of warm-up, 35–45 min of resistance training, and 5–10 min of an aerobic cooldown. Participants are given personalized recommendations for physical activity outside of the class periods based on their current level of physical fitness and participant goals.

Final one-on-one session. The final session is similar to the initial one-on-one session. The EIM specialist reviews progress over the 16 group sessions, updates goals, and provides an updated exercise program. The revised program accounts for the resources available to the individual upon program completion (e.g., at-home exercises, alternate fitness facilities, continuation at the current facility, and virtual resources).

Measures

With the exception of demographic data (collected at baseline only) and fidelity measures (timepoints described below), all measures were collected before week 1 (baseline) and at the end of week 12 (follow-up measures) to assess change over the course of the EIM program.

Demographic data and history of chronic disease. Standard demographic questions including age, sex, race, ethnicity, insurance status, and chronic conditions, including hypertension, diabetes, and heart disease (history of myocardial infarction, revascularization, or stroke/transient ischemic attack or heart failure) are extracted by THE EIM specialist from patients' medical chart.

Program fidelity. In the current evaluation, program fidelity was operationalized at the program level, consistent with the pragmatic implementation focus of the OSUWMC EIM program. Specifically, fidelity was assessed using clinician referral volume, recruitment, and completion of study assessments, rather than individual session attendance or exercise dose delivered.

Biological factors. Collected biological variables included the assessment of: 1) blood pressure using oscillometric sphygmomanometer (Omron 7 Series Upper Arm Blood Pressure Monitor, Hoffman Estates, IL), 2) weight (scale), height (stadiometer), and body fat was assessed using an Omron Body Composition Monitor and Scale (Model: HBF-514C, Hoffman Estates, IL), 3) waist and hip circumference were measured at the level of the umbilicus (waist circumference) and at the largest diameter of the hips (hip) using a standard tape measure with 4 oz. tension. Multiple anthropometric measures were collected to provide comprehensive body composition assessment, as BMI alone does not distinguish fat from lean mass or capture fat distribution patterns associated with cardiometabolic risk (20,21).

Psychological factors. Psychological factors included assessments to measure depressive symptoms, perceived stress, and health-related quality of life.

TABLE 1. Core components and structure of the Exercise Is Medicine (EIM) program.

Program Component	Description
Program framework	EIM initiative is integrated within The Ohio State University Wexner Medical Center, linking clinical care with community-based exercise programming
Referral pathway	Physician referral following clinical assessment and medical clearance
Target population	Adults with chronic conditions or elevated cardiometabolic risk who are insufficiently physically active
Program duration	Twelve weeks
Delivery settings	Community recreation centers and ambulatory rehabilitation facilities across the Columbus metropolitan area
Personnel	ACSM-certified Exercise Physiologists holding an EIM credential
Initial one-on-one session	Comprehensive assessment of physical activity behavior, medical history, barriers, motivation, readiness for change; SMART goal setting and development of an individualized exercise prescription
Second one-on-one session	Supervised personal training session focused on exercise technique, safety, modifications, and physical activity education
Group exercise sessions	Sixteen 1-h supervised sessions (2×·wk for 8 wk), delivered in small groups (8–10 participants)
Exercise content	Structured sessions including warm-up, resistance training, and aerobic exercise, tailored to individual capabilities
Behavior change strategies	Individualized goal setting, behavior change coaching, education, and social support
Supportive environment	Supervised, resource-equipped community facilities providing a safe and familiar setting for exercise participation
Final one-on-one session	Review of progress, reassessment of goals, and refinement of individualized exercise prescription based on participant progress and available resources

All sessions were supervised by ACSM-certified Exercise Physiologists with EIM credentials. Exercise prescriptions were individualized based on clinical status, functional capacity, and participant goals.

Depressive symptoms. The Patient Health Questionnaire-9 is a validated and reliable tool used to evaluate depressive symptoms in adults. It consists of nine items, each addressing different aspects of mood and behavior associated with depression. Respondents rate the frequency of each item on a scale from 0 to 3, resulting in a total score ranging from 0 to 27. Patient Health Questionnaire-9 scores fall into four categories: scores of 5–9 indicate mild depression, 10–14 indicate moderate depression, 15–19 indicate moderately severe depression, and scores of 20 or higher indicate severe depression (22).

Perceived stress. The Perceived Stress Scale is a valid and reliable assessment tool that comprises 10 questions designed to measure perceived stress over the past month. Scores on the Perceived Stress Scale range from 0 to 40, with higher scores indicating greater levels of perceived stress (23).

Health-related quality of life. The RAND 36-Item (RAND-36) Scale is designed to assess health-related quality of life (HR-QOL) with high validity and reliability among clinical populations. RAND-36 measures several aspects of physical and mental health, including physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health. Participants respond to 36 questions across these domains, with each domain producing a score ranging from 0 to 100, where a higher score indicates better health-related quality of life (24).

Exercise behavior. Behavioral factors included the assessment of physical activity and its determinants.

Physical activity. To calculate moderate exercise minutes per week, two items from the Centers for Medicare and Medicaid Services survey were utilized to assess self-reported leisure-time physical activity (25). The first item asked: "In the last 30 days, other than activities performed for work, on average, how many days per week did you engage in moderate exercise (such as brisk walking, running, jogging, dancing, swimming, biking, or similar activities)?" This item had eight response options ranging from 0 to 7 $d \cdot wk^{-1}$. The second item inquired: "On average, how many minutes did you usually spend exercising at this level on one of those days?" This item had seven response options ranging from 0 to a maximum of 60 min per session, in 10-min intervals. The total weekly moderate physical activity was calculated by multiplying the reported number of sessions per week by the average duration per session. If the physical activity variable from the Centers for Medicare and Medicaid Services survey was missing, the International Physical Activity Questionnaire-Short Form was utilized to measure self-reported physical activity levels over the past 7 d. The International Physical Activity Questionnaire-Short Form is primarily designed for population surveillance of leisure-time physical activity among adults. It has demonstrated excellent validity and reliability and is widely used in public health surveillance. Participants were asked to estimate their physical activity levels over the last 7 d for vigorous, moderate, and light activities, providing the duration of their physical activity in hours and minutes per session for each intensity level (26). Due to the pragmatic, real-world nature of the EIM program and its integration within routine clinical workflows, device-based physical activity monitoring was not uniformly available for this evaluation, consistent with prior pragmatic healthcare system-level physical activity interventions (19,27).

Exercise determinants.

Exercise self-efficacy scale (ESES). The ESES was employed to measure an individual's confidence in performing physical activities under various constraints, such as time, energy, or competing priorities. The ESES comprises seven items rated on a 4-point Likert scale, with scores ranging from 7 to 28. A higher score indicates greater self-efficacy. The ESE scale demonstrates excellent validity and reliability (28).

Stage of change. The Change Readiness Assessment assesses an individual's readiness and willingness to engage in and adapt to change. The Change Readiness Assessment consists of 35 items rated on a 6-point Likert scale, measuring several behavioral domains, including resourcefulness, optimism, adventurousness, passion/drive, adaptability, confidence, and tolerance for ambiguity. Each domain represents characteristics that facilitate or hinder working towards personal goals. For instance, high scores in the resourceful domain indicate that individuals excel at adapting to challenges, finding creative solutions, and utilizing available resources effectively. A high score in the optimism domain indicates focusing on opportunities rather than obstacles that improve readiness to change. A high score in tolerance for ambiguity can reflect healthy tolerance that is essential for navigating change, as discomfort with uncertainty can lead to rushed decisions, while excessive tolerance may result in indecisiveness and unfinished tasks. The response is measured on a Likert scale ranging from 1= Not like me, to 6 = Exactly like me. The optimal score for each domain, which consists of a total of five items, falls between 22 and 26, indicating a high readiness for change or adoption of a new behavior (29).

Analysis

The demographic and clinical characteristics of participants were summarized using mean (standard deviation) for continuous variables and frequencies (proportions) for categorical variables. Linear mixed models with a random intercept for each participant and an unstructured covariance matrix were employed to examine the change in clinical, psychological, social, and behavioral outcomes pre- and post-EIM program. All analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary, NC), with statistical significance defined as $P < 0.05$.

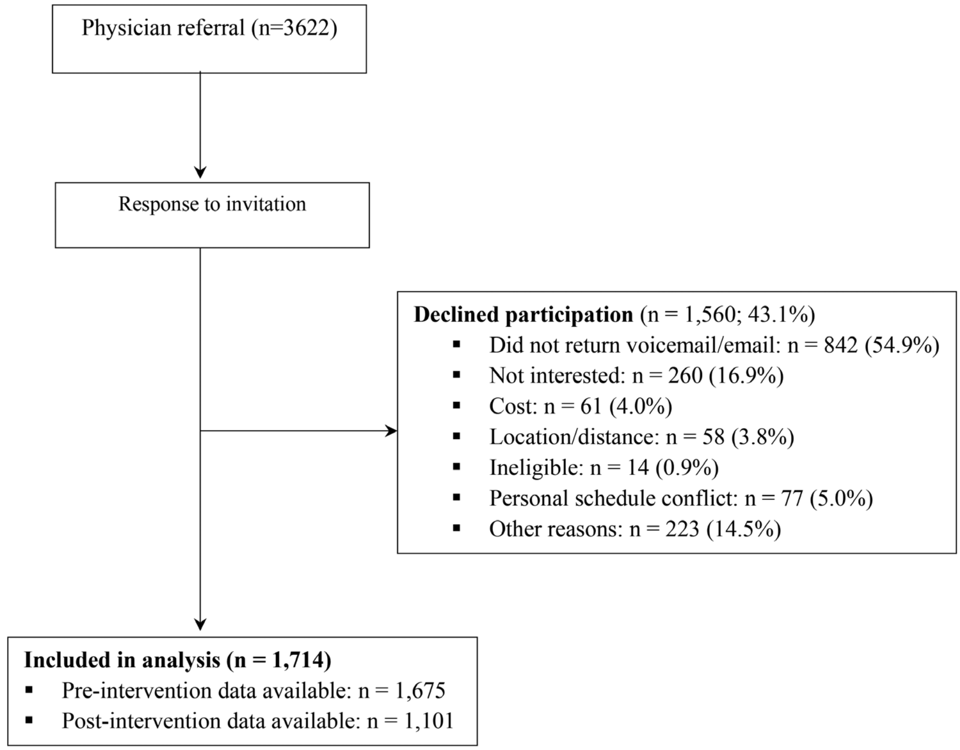

FIGURE 1—Flow of participants through referrals, enrollment, and analysis in the Exercise Is Medicine (EIM) program.

RESULTS

Participants

The data for this study were extracted from REDCap from January 2020 through March 2024. A total of 3622 individuals were referred by physicians. Of these, 1560 (43%) declined participation, most commonly due to not returning voicemail or email messages (55%). Among referred individuals, 1719 (47.5%) had at least one pre and post assessment available. After excluding five participants younger than 18 yr, the final analytic sample included 1714 participants, of whom 1675 had baseline data and 1101 had post program data. Participant referral, enrollment, and inclusion in the analytic sample are illustrated in Figure 1.

Primary Objective

The EIM program demonstrated substantial reach and engagement within a real-world clinical setting. Based on physician referrals, the recruitment rate was 47.3%, with 1714 participants included in the analytic sample. Documented program completion was observed for 796 participants, corresponding to a completion rate of 46.4% among those included in the analysis. However, completion status was unavailable for 671 participants (39.2%), suggesting that the documented completion rate likely underestimates true program completion in this pragmatic implementation.

Demographics

Participants (n = 1714) had an average age of 54.8 (standard deviation = 14.4) yr and 74% were female. Nearly 62% (n = 1062) of participants were non-Hispanic White, followed by 29% Non-Hispanic Black (n = 491) individuals. The majority of participants were insured through self-paid or private insurance (n = 533; 31%), followed by Medicare (n = 438; 26%) and the OSU Health Plan (n = 388; 23%). In terms of chronic conditions, 42% self-reported hypertension, 17% self-reported diabetes, and 11% self-reported heart disease. (Table 2).

Biopsychosocial Outcomes

Clinical outcomes. From pre to post-EIM, multiple clinical outcomes improved as shown in Table 3. Among anthropometric measures, BMI, weight, waist circumference, and body fat percentage decreased by 0.48 kg·m^{-2}, 2.9 pounds, 2.2 cm, and 0.9%, respectively, all $P < 0.001$. Among cardiovascular measures, systolic and diastolic blood pressure decreased by 2.9 and 1.9 mm Hg, both $P < 0.001$, with no significant change in resting heart rate.

Psychological outcomes. From pre to post-EIM, there was a 22% reduction in depressive symptoms (1.06 point reduction, 95% confidence interval [CI] [−1.35 to −0.77], $P < 0.001$) and a 9 % reduction in perceived stress (1.08 point reduction, 95% CI [−1.59 to −0.56], $P < 0.001$).

Health-related quality of life. The results of the RAND-36 Health Survey demonstrated significant improvements in multiple domains of health-related quality of life after EIM. Participants showed a significant increase in mental component summary scores by 1.60, 95% CI (0.67 to 2.54), $P < 0.001$, and physical component summary scores by 3.19, 95% CI (2.51 to 3.87), $P < 0.001$. Improvements were also observed in emotional well-being with an improvement of 1.94 points (95% CI [0.83 to 3.05], $P < 0.001$), general health of 5.59 points, (95% CI [4.39 to 6.78], $P < 0.001$), and pain levels of 5.78 points (95% CI [4.17 to 7.39], $P < 0.001$). Additionally, significant increases were observed in physical functioning by 5.85, 95% CI (4.49 to 7.21), $P < 0.001$, role limitations due to emotional problems by 5.77, 95% CI (2.51 to 9.03), $P < 0.001$, and social functioning by 4.63, 95% CI (2.86 to 6.40), $P < 0.001$. Improvements were most pronounced in vitality (energy/fatigue) by 6.78, 95% CI (5.41 to 8.15), $P < 0.001$, and role limitations due to physical health by 9.66, 95% CI (6.60 to 12.73), $P < 0.001$ (Table 3).

Behavioral Outcomes

Linear mixed models were tested for change in behavioral variables in Table 3. The models found an increase in: 1) exercise self-efficacy by 1.02, 95% CI (.45 to 1.59), $P = 0.002$. A series of tests for change in the stage of readiness traits revealed an increase in passion.42, 95% CI (0.12 to 0.72), $P = 0.007$, and tolerance scores.33, 95% CI (0.01 to 0.64), $P = 0.040$. However, resourcefulness, optimism, adventure, and adaptability traits did not reveal significant changes ($P > 0.05$). Finally, change in exercise time increased by 64.69 min·wk^{-1}, 95% CI (46.62 to 82.75), $P < 0.001$, over the duration of the EIM program.

TABLE 2. Demographic and clinical characteristics of participants (n = 1714).

Characteristic	Total
Age (SD)	54.8 (±14.4) Range: 18.5–94.6
Sex, n (%)	
Female	1260 (74)
Race, *n* (%)	
White	1062 (62)
Black	491 (29)
Asian	31 (2)
More than one race	36 (2)
Native American/Alaska Native	2 (0.1)
Unknown/Not reported	92 (5)
Ethnicity, *n* (%)	
Hispanic or Latino	45 (3)
Not Hispanic or Latino	1580 (92)
Unknown/Not reported	89 (5)
Insurance, *n* (%)	
Medicaid	248 (15)
Medicare	438 (26)
OSU health plan	388 (23)
Self-paid or private	533 (31)
Veterans NOW	8 (1)
Unknown/Not reported	99 (6)
Chronic conditions, *n* (%)	
Hypertension	719 (42%)
Heart disease	194 (11%)
Diabetes	286 (17%)
Obesity	962 (70%)
Overweight	256 (19%)

Heart disease is defined as a self-reported history of myocardial infarction, coronary revascularization, stroke or transient ischemic attack (TIA), or heart failure.
Obesity is defined as BMI ≥ 30 kg·m^{-2}.
Overweight is defined as 25 ≤ BMI < 30 kg·m^{-2}.

DISCUSSION

Healthcare providers play a vital role in prescribing and informing patients about the importance of engaging in regular exercise, which has been shown to foster positive attitudes and intention of adopting the behavior (27,30,31). However, these beliefs often fail to translate to successful exercise adoption, reflecting an intention-behavior gap. The EIM program at OSUWMC aims to bridge the gap between clinicians and a supportive community environment to guide and facilitate exercise engagement for patients. The purpose of this evaluation was to examine the effectiveness of the EIM program from January 2020 through March 2024. Across the evaluation period, the program demonstrated moderate-to-high levels of clinician referral, recruitment, and documented assessment completion that were comparable to or exceeded the 40%–50% benchmarks reported for similar integrated exercise programs in the healthcare system (32). The relatively high referral volume observed in the OSUWMC EIM program may be attributed to integrated referral workflows and sustained clinician engagement. OSU-affiliated clinicians complete referrals directly through the Integrated Healthcare Information System embedded within routine clinical workflows, while external clinicians can refer patients using publicly available instructions. Additionally, EIM program staff conduct regular outreach to physician offices, rehabilitation services, and specialty clinics to maintain awareness and reduce logistical barriers to referral. While this evaluation did not assess individual implementation strategies, these features likely contributed to program reach and warrant further study using implementation-focused designs.

Additionally, the program demonstrated effectiveness by facilitating improvements in biopsychosocial outcomes. Several biological measures including weight, BMI, waist circumference, body fat, and blood pressure improved with participation in the EIM program. Among these findings over the course of 3 months, the most impactful may be the reduction in systolic and diastolic blood pressure by 3 mm Hg and 2 mm Hg, respectively, which is clinically significant. A meta-analysis that evaluated over 60 epidemiological studies revealed that a 2-mm Hg reduction in systolic blood pressure

TABLE 3. Model-estimated baseline values and changes in outcomes among participants (n = 1714).

Outcome Measures	*N* (Pre, Post)	Baseline Mean (95% CI)	Change Score (95% CI)	*P* Value
Biological domain				
Body mass index (kg·m^{-2})	1368, 760	35.43 (34.95 to 35.91)	−0.48 (−0.63 to −0.32)	<0.001
Body fat (%)	1225, 719	41.39 (40.90 to 41.88)	−0.87 (−1.20 to −0.55)	<0.001
Waist circumference (cm)	1235, 697	109.04 (107.91 to 110.17)	−2.24 (−2.98 to −1.49)	<0.001
Hip circumference (cm)	1235, 696	119.85 (118.76 to 120.93)	−1.73 (−2.60 to −0.85)	<0.001
Waist-to-hip ratio	1234, 695	0.92 (0.90 to 0.93)	−0.01 (−0.01 to −0.00)	0.009
Weight (lb)	1386, 766	220.54 (217.34 to 223.74)	−2.87 (−3.38 to −2.35)	<0.001
Systolic blood pressure (mm Hg)	1352, 737	130.25 (128.60 to 131.89)	−2.91 (−3.93 to −1.88)	<0.001
Diastolic blood pressure (mm Hg)	1352, 737	81.20 (80.64 to 81.76)	−1.91 (−2.61 to −1.21)	<0.001
Resting heart rate (beats·min^{-1})	1252, 693	76.01 (75.31 to 76.70)	−0.24 (−1.07 to 0.59)	0.565
Psychological domain				
Exercise self-efficacy	1337, 424	19.40 (19.12 to 19.68)	0.75 (0.29 to 1.21)	0.002
Resource appraisal	1312, 409	21.53 (21.29 to 21.77)	−0.05 (−0.35 to 0.25)	0.749
Optimism	1312, 409	21.39 (21.12 to 21.65)	0.22 (−0.11 to 0.54)	0.190
Appraisal (adventure)	1312, 411	16.68 (16.44 to 16.92)	−0.02 (−0.36 to 0.32)	0.922
Passion (affective judgment)	1312, 409	16.71 (16.46 to 16.96)	0.42 (0.12 to 0.72)	0.007
Adaptability	1312, 410	18.15 (17.95 to 18.35)	0.20 (−0.10 to 0.51)	0.195
Tolerance	1312, 409	15.61 (15.38 to 15.83)	0.33 (0.01 to 0.64)	0.040
Safety	1336, 415	4.88 (4.80 to 4.96)	−0.01 (−0.10 to 0.09)	0.907
PsychoSocial health-related quality of life domain				
PHQ-9 (depressive symptoms)	1333, 428	4.73 (4.49 to 4.97)	−1.06 (−1.35 to −0.77)	<0.001
Perceived stress (total score)	1291, 408	12.30 (11.91 to 12.69)	−1.08 (−1.59 to −0.56)	<0.001
Mental component summary	1302, 419	46.76 (46.07 to 47.45)	1.60 (0.67 to 2.54)	<0.001
Physical component summary	1302, 419	45.06 (44.49 to 45.63)	3.19 (2.51 to 3.87)	<0.001
Emotional well-being	1305, 419	73.91 (72.95 to 74.87)	1.94 (0.83 to 3.05)	<0.001
General health	1327, 429	56.32 (55.23 to 57.40)	5.59 (4.39 to 6.78)	<0.001
Bodily pain	1306, 421	68.14 (66.88 to 69.41)	5.78 (4.17 to 7.39)	<0.001
Physical functioning	1316, 424	72.14 (70.84 to 73.43)	5.85 (4.49 to 7.21)	<0.001
Role limitations (emotional)	1306, 421	71.32 (69.33 to 73.32)	5.77 (2.51 to 9.03)	<0.001
Social functioning	1306, 421	78.74 (77.47 to 80.01)	4.63 (2.86 to 6.40)	<0.001
Energy/fatigue	1305, 419	48.13 (46.93 to 49.33)	6.78 (5.41 to 8.15)	<0.001
Role limitations (physical)	1310, 423	65.59 (63.54 to 67.65)	9.66 (6.60 to 12.73)	<0.001
Behavioral domain				
Physical activity (moderate min·wk^{-1})	1410, 466	134.52 (122.03 to 147.02)	64.69 (46.62 to 82.75)	<0.001

Values represent model-estimated baseline means and model-estimated changes from baseline with 95% confidence intervals derived from longitudinal models. *N* reflects the number of participants contributing baseline and follow-up data, respectively.

is associated with a 7%–10% lower risk of stroke and a 5%–7% lower risk of coronary heart disease (33,34). Relatedly, another meta-analysis found that every 10-mm Hg reduction in systolic blood pressure lowers the risk of major cardiovascular disease (CVD) events by 20%, suggesting that a 3-mm Hg drop corresponds to an approximate 6% reduction in CVD risk (35). Thus, EIM demonstrates that blood pressure findings have the potential to have a meaningful impact on CVD. The blood pressure benefits in EIM may be attributed to the program offering both aerobic and resistance training exercises, which have both been shown to reduce systolic and diastolic blood pressure (16).

Assessments of psychological determinants revealed significant and meaningful improvement across scores in depression, stress, and mental health-related quality of life. In addition to reflecting well-being, the assessed psychological and social health determinants also function as determinants of future exercise participation (36). Specifically, health scores across psychological/intrapersonal determinants situate an individual to anticipate future participation with fewer psychological barriers, while social/interpersonal provide support in the environment to participate in exercise.

A similar exercise intervention assessed the effectiveness of physical exercise in treating depression by comparing it to an antidepressant treatment group in a randomized controlled trial. The hypothesized inhibitory effect of physical activity on depression was supported by a significant dropout rate, with 39.2% and 58.2% of participants withdrawing at the 3- and 6-month follow-ups, respectively (37). These findings align with EIM's recommendations for further investigating reasons to explain participant dropout. Aligning with EIM results, Hidalgo et al. (38) study also reported a decrease of 4.04 points in depression ratings using the Montgomery–Asberg Depression Rating Scale and a 15.1-point increase in self-perceived health status over 6 months. The observed improvement in depressive symptoms is also aligned with the results of systematic reviews. Specifically, in our study, the improvement in depression scores was at a small-to-medium magnitude (39), which corroborates previous meta-analysis on the role of physical activity in improving symptoms of depression (40,41). This effect might be attributed to the mechanistic effect of physical activity on depressive symptoms. Physical activity likely alleviates depression by reducing inflammation and increasing dopamine levels, which enhance mood and motivation (42). Additionally, physical activity promotes neuroplasticity through increased brain-derived neurotrophic factors, which improves cognitive function and self-esteem (42).

Finally, exercise behavior and its determinants demonstrated a significant increase in participation time across the 16-wk program. Specifically, the increase in 64.69 min reflects a 48.9% improvement from baseline measurement. Participants also showed a significant increase in physical HR-QOL. Improvement in HR-QOL is a common and vital dependent variable among lifestyle interventions, and specifically the increase in physical participation time is predictive of improvement in HR-QOL as observed in previous systematic reviews (43,44) and also among individuals with hypertension (45). These patterns suggest that physical activity could have contributed to improvements in HR-QOL in the present study.

Improvements in behavioral determinants, including exercise self-efficacy, passion, and tolerance, were observed in this study. Exercise self-efficacy is one of the most important and widely recognized psychological determinants of exercise, as supported by meta-analyses across all clinical population groups (46–49). Passion, which is analogous to affective judgment, reflects the perceived emotional enjoyment of exercise. Affective judgment is a recognized construct within behavior change taxonomies, and meta-analytic evidence indicates that it is a moderate-to-strong predictor of exercise participation (50). The successful facilitation of recognized psychological determinants likely reflects the combined influence of the EIM program's multicomponent structure, which includes interaction with an exercise physiologist, individualized exercise prescription, group-based delivery, and behavior change coaching. However, the study design does not permit causal inference regarding the independent contribution of specific components. The observed improvements are consistent with established behavior change frameworks (51–53). Future studies using experimental or mediation designs with appropriate temporal sequencing are needed to disentangle the relative contributions of individual program elements.

Strengths and Limitations

The present study demonstrates notable strengths alongside important limitations. A significant strength of this research is its substantial sample size (n = 1714), which enhances both the statistical power and the generalizability of the findings. Moreover, the sample reflects the diverse racial and ethnic composition of the U.S. population, allowing for a more comprehensive understanding of health outcomes across demographic groups. The evaluated program is situated within a translational real-world program that emphasizes the application of scientific principles to practical health interventions, thereby making a meaningful contribution to the field of translational science. Finally, while our findings align with and support several previous community-based studies that have focused on health domain outcomes, the use of the biopsychosocial model of health is sparse in the literature, which provides a comprehensive health assessment through the EIM program.

Several limitations should be acknowledged. Although valid measures were administered to assess the biopsychosocial behavior model, physical activity data were collected through self-report. While device-based measures are often regarded as the gold standard, an acknowledgment of the unique strengths of each measurement type suggests that both methods of assessment should be employed to achieve comprehensive data. Due to the pragmatic nature of the EIM program, and to achieve the highest possible sample size, physical activity behavior was derived from self-reported leisure-time physical activity, assessed using two different survey instruments, as described in the Methods section. Another limitation is the low response rate for post survey data. This challenge may be due to participants not completing the survey on-site during their last visit, and instead historically participants filled out the surveys at home after completing the program. Thus, many participants noted they missed the email invitation to complete the post survey. However, to minimize the amount of missing post data, recently electronic tablets were provided to each EIM location, allowing participants to complete surveys during their final appointment.

Future Directions

To advance the scalability, precision, and sustainability of EIM programs, future research should prioritize the following directions: 1) Measurement and fidelity: refine and strengthen EIM evaluation by incorporating more rigorous measurement approaches within clinical workflows, including device-based objective physical activity assessment and systematic attendance tracking. In addition, integrating mixed-methods designs (e.g., structured qualitative interviews) would provide insight into participant experiences and reasons for dropout, informing strategies to improve engagement, retention, and implementation fidelity; 2) Behavioral profiling: develop behavioral screening profiles using evidence-based psychological exercise determinants (54–56), including habit strength/automaticity, self-regulatory capacity, affective response to exercise, and capacity to overcome disruptive competing actions (55) to identify individuals at higher risk for non adoption and tailor program entry points to enhance reach and engagement; 3) Economic value: conduct formal cost-effectiveness analyses comparing program delivery costs with downstream healthcare utilization and clinical outcomes to quantify the economic value of EIM program and support sustainable reimbursement and health system integration; 4) Mechanism optimization: use theory-informed experimental or mediation-based designs to optimize behavior change mechanisms within EIM, clarifying how intrapersonal (e.g., self-efficacy), interpersonal (e.g., social support), and environmental components interact to promote exercise adoption and maintenance. Such studies should examine whether behavior change is sustained as participants transition from a structured program environment to independent exercise. Identifying predictors of sustained participation versus relapse would inform the development of maintenance-focused strategies, such as booster sessions, alumni networks, or graduated transition protocols to support long-term exercise.

CONCLUSIONS

The hallmark of the OSU EIM program, which sets it apart from other community-based initiatives, lies in its collaborative approach between healthcare providers and community centers to promote physical activity among at-risk patients. The established EIM program demonstrates both feasibility in delivery and effectiveness in outcomes across various biopsychosocial domains of health. The high recruitment numbers underscore the demand within the clinical population for structured exercise intervention opportunities that translate their intentions to engage in physical activity into actual behavior. These findings support the continuation of longitudinal investigations to track changes in trajectory and compare adoption and adherence rates over time. Future qualitative research is warranted to explore the participant perspective on the EIM program to further advance the program's effectiveness and address challenges (e.g., participant dropout). The pragmatic, real-world findings from the OSUWMC EIM program, linking a healthcare system to a community exercise program, are critical as they represent one avenue that healthcare institutions can use to improve the health of patients, ultimately improving population health.

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