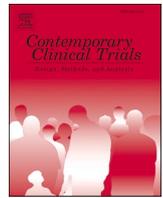


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Linking churches and parks to promote physical activity among Latinos: Rationale and design of the Parishes & Parks cluster randomized trial

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ABSTRACT

Background: Regular physical activity (PA) contributes to positive health outcomes, but a minority of US adults meet minimum guidelines for moderate-to-vigorous PA (MVPA) and muscle-strengthening, and Latinos are less likely than whites to meet these guidelines. Public parks can be leveraged for community PA but tend to be underutilized, while churches have reach within Latino communities and can influence parishioners' health.

Methods: We are conducting a cluster randomized controlled trial to examine the impact of a multilevel, faith-based intervention linking Catholic parishes ($n = 14$) to their local parks on adult Latino parishioners' ($n = 1204$) MVPA and health-related outcomes. Our approach targets multiple levels (individual, group, church, and neighborhood-park) to promote health-enhancing PA through park-based exercise classes led by kinesiology students, peer leader-led walking groups, park-based church events, church-based PA support activities, and environmental advocacy. Data are collected at churches by trained bilingual/bicultural research assistants using accelerometry, surveys, and biometric procedures. We will implement a set of hierarchical repeated-measure linear models to examine effects on the primary outcome (MVPA) and secondary outcomes (self-reported PA, heart rate/fitness, waist circumference, waist-to-hip ratio, body fat, mental health, and perceived social support for PA). We will also conduct a process evaluation.

Conclusion: To our knowledge, this will be the first study examining efficacy of an integrated church and park-based intervention on Latino adults' PA and represents a scalable model of PA programming for low-income communities. The intervention makes use of innovative partnerships within and across sectors – faith-based, local parks/city government, and local universities – further facilitating sustainability.

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Abbreviations: ACSM, American College of Sports Medicine; CAB, Community Advisory Board; CBPR, Community-based participatory research; LA, Los Angeles; PA, Physical activity; MVPA, Moderate-to-vigorous physical activity; PLs, Peer leaders; RAs, Research assistants; RCT, cRCT, Randomized controlled trial, cluster randomized controlled trial.

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1. Background

Engaging in regular physical activity (PA) contributes to many positive health outcomes, including longevity; improved quality of life; reduced incidence of cardiovascular diseases, diabetes, depression, and certain cancers; and the prevention of obesity [1]. Insufficient PA is attributable to 10.8% of premature mortality [2]. In the US, Latinos have the highest prevalence of self-reported inactivity [3], and fewer Latino adults report meeting recommended PA levels and engaging in aerobic and muscle-strengthening PA compared to whites [4–6]. Increasing PA among Latino populations is important for their overall health and because they are disproportionately affected by chronic diseases such as diabetes, for which PA plays an important role in prevention and management [7].

Public parks offer an accessible setting where community members can be physically active, and parks' importance for physical and mental health have been noted, particularly during the COVID-19 pandemic [8]. An estimated 70% of persons in the U.S. live within walking distance of a park [9], and parks have been found to facilitate PA in underserved communities [10–12]. Research has found that people are more likely to engage in moderate-to-vigorous PA (MVPA) when they are outdoors as compared to indoors [13], and parks can be important venues for family gatherings and socialization, particularly for Latinos [14]. Systematic studies of parks have found that they are underutilized for PA, particularly in low-income areas, in part due to the lack of programming [15,16] and community concerns regarding safety and poorly maintained facilities [17], making them unattractive for PA [18]. Multi-sectoral interventions are needed that address community concerns, target the surrounding environment, and “activate” park use by partnering with trusted community institutions. Such strategies can facilitate parks' potential role in reducing chronic and acute disease disparities.

Churches are credible, stable entities that have significant reach within Latino communities and a history of social service provision and advocacy related to health and well-being. Nationally, about 75% of Latinos reported a religious affiliation in 2019, with the most common being Catholic (47%), and 51% of Latino adults reported attending services monthly or more [19]. Historically, churches have played an important role in social services [20] and civic and social integration of recent immigrants [21,22]. In Los Angeles (LA), a majority-Latino city and the location of the current study, the Catholic Church has been at the forefront of advocacy for immigrants' rights and provision of social services for decades [23].

Working with religious congregations to develop and test community-based health promotion programs has become a popular strategy among public health researchers over the past several decades [24,25]. Early studies (1980s) focused on cardiovascular disease [26], but later studies approached diverse health issues, including physical activity [27]. Over time, this work has evolved from initially seeing faith-based organizations only as recruitment sites, to working with clergy and lay leaders within the congregations to develop and deliver intervention activities [26]. During this latter phase, community-based participatory research (CBPR) approaches have been emphasized, especially to facilitate tailoring of interventions [25,28].

Although a number of faith-based PA interventions have been tested, recent systematic reviews found that few have been conducted with Latino populations, evidence quality is generally low, and most interventions have focused on individual and interpersonal levels while few have included environmental or policy change [27,29]. Results from only three church-based PA interventions focused on Latinos have been published – two of these were pilot studies with only one intervention church and infrequent intervention activities [30,31]. The third was a full-scale cluster randomized controlled trial (cRCT) of 16 Catholic churches in San Diego, CA and found increased MVPA (via accelerometry) at 12 months among churchgoing Latina women through a multilevel approach involving *promotora*-led church-based exercise

classes, motivational interviewing, church events, and environmental advocacy [32,33]. Few faith-based PA interventions have included activities in the community surrounding the church and, to our knowledge, none has involved PA programming at parks, which could be important for sustainability of PA activities. Rarely have faith-based interventions assessed environments around churches to inform interventions [34,35]. Pairing environmental, organizational, and interpersonal level components through multilevel faith-based interventions could have sustained influence on congregants' PA.

This paper describes the design of a cRCT of a multilevel intervention that links predominantly Latino churches with local parks to increase PA among adult parishioners. Our intervention follows the socioecological framework [36] by targeting multiple levels of influence and integrates the vast social networks and moral authority of churches with the structural and organizational capacity of parks and exercise professionals. The study will examine intervention impact on participants' objectively measured MVPA, various biometrics (heart rate/fitness, waist circumference, waist-to-hip ratio, body fat), self-reported PA, mental health, and social support for PA.

2. Methods

2.1. Study setting and collaborating partners

The study is being conducted in LA (a large metropolitan area), specifically areas with high concentrations (>80%) of Latino residents in East LA and surrounding communities. In 2020, East LA had a population density of 15,938/square mile, compared to 253/sq. mile for California. Among East LA residents, 96% were Latino (vs. 39% in CA), 55% were high school graduates (vs. 84% in CA), 16% of families lived in poverty (vs. 9% in CA), and 14% were uninsured (vs. 7% in CA) [37]. The Catholic Church represents a strong infrastructure to reach Latinos as they represent 75% of the local Archdiocese's 5 million members [38]. The study uses a CBPR approach and involves partners from the RAND Corporation, California State Universities (Cal State LA, Cal State Northridge and San Diego State University), and the Archdiocese of LA. In addition, a Community Advisory Board (CAB) guides all phases of the research, is chaired by a paid Latino clergy consultant with vast experience in urban communities and has representatives from the LA County Department of Public Health, the LA Department of Recreation and Parks, the Archdiocese and various Catholic parishes, and several grassroots community development organizations.

2.2. Study design

We are staggering study implementation across 2 cohorts (6 churches in cohort 1 and 8 in cohort 2). The intervention is implemented over 12 months and evaluated through pre- and post-assessments. As of the writing of this article, we have implemented much of Cohort 1's activities but have not started Cohort 2, thus we use the present tense to refer in general to the procedures followed.

2.2.1. Identification of potential church-park pairs

For each cohort, we identify churches through Archdiocesan-provided lists of parishes, which include head priest, address, contact information, and number of families; we append US Census zip code data for each parish on total population and by subgroups (Latinos, foreign-born, from Latin America), % Latino, and % of individuals and families living in poverty (used with parish size for comparability and for randomization, see below). The parishes are then mapped to identify those with a park ≤ 1 km away (<10 -min walk) [39] and each potential parish-park pair are visited to evaluate walkability of routes between the church and park. We talk with the park director about the project and ensure that the park has sufficient space, facilities, and safety for the exercise classes. Study parishes and parks must be in zip codes that are >80% Latino and within 5 miles of Cal State LA. To reach our

recruitment goals, parishes need a minimum of 350 adults attending weekend masses; all potential parishes exceeded this, with a range of 350 to 2000.

2.2.2. Church recruitment

To recruit churches, the principal investigator and project manager first meet with the dean of the deanery to which the parishes belong to discuss the project and then present at the next deanery meeting to meet the priests and obtain updated parish size (number of families, number of adults attending mass on the weekend) and other information (e.g., whether the church has a group that focuses on health). The final list of eligible parish-park pairs is discussed with the CAB to select the set for each cohort. Formal recruitment then begins, during which we: (1) send an official letter co-signed by the principal investigator and the Catholic Bishop overseeing the selected parishes, inviting the head priest and their congregation to participate, and (2) conduct in-person follow-up meetings involving the principal investigator, project manager and each priest to obtain institutional commitment. Each parish is asked to identify a church coordinator (lay leader or church staff member), who receives a small stipend as the study liaison.

2.2.3. Church randomization

Once churches are recruited, we apply a blocked and balanced randomization strategy to assign churches to intervention and control groups. Specifically, we first blocked all study churches into two cohorts. All subsequent randomization operations are within each cohort. We randomize half (3 churches in cohort 1, 4 churches in cohort 2) to the treated condition and the other half to the control condition. Two-sample tests are conducted to test if there are significant differences in parish size, park acreage, and zip code level socio-demographics (listed above). If balance between the two study conditions is poor, i.e., >5% two-sample tests are statistically significant at two-sided $p < .05$ level, we redo the randomization until covariate balance is achieved.

2.2.4. Sample recruitment and screening

We aim to recruit approximately 86 Latino participants per parish (total = 1204). Eligibility criteria include: (1) 18+ years of age; (2) live within 15-min driving distance from the church; (3) report being able to attend at least some activities at or nearby the church during the week; (4) attended the study church for at least the past 6 months and more than once per month; (5) plan on attending the church for the next 12 months; and (6) do not currently attend one of the other study churches at least once per month. We do not exclude anyone based on race-ethnicity though expect nearly all to be Latino based on the membership of participating churches and our experience with the first cohort. Those eligible complete a health screener to assess history and symptoms of health conditions that could preclude PA (cardiovascular, metabolic, or renal disease) [40]; if an individual reports one or more of the listed health symptoms, they are asked to get a doctor's note authorizing participation. Those who report a health condition but already engage in exercise at least three times a week in the last three months are eligible. We did not exclude individuals based on prior PA activity levels, as done in a previous study [32,33], since parish leaders in our study wanted to be inclusive and have more physically active lay leaders to recruit others. Baseline and 12-month assessments are conducted before and after Sunday services.

2.2.5. Tracking and retention

To reduce drop-out rates, we collect extensive contact information (cell, home, and work phones; personal email and Facebook; primary and secondary addresses; and name, address, and phone number of at least one and up to three personal or church contacts) and send reminders about the follow-up assessments. Participants receive increased incentives for follow-up assessments.

2.3. Description of multi-level intervention

Our intervention intervenes at multiple levels [36,41], which has been emphasized for addressing health disparities [42]. Fig. 1 provides an overview of activities at each level and Table 1 provides additional detail on each activity, including faith-based aspects and tailoring.

2.3.1. Individual and interpersonal (group) levels

Peer leaders (PLs). As in prior work [43], we conduct a brief training at each church for volunteer PLs to be champions for PA activities at their church. We chose to train PLs rather than promotoras based on research showing that social network approaches in which a larger number of minimally trained individuals reach out to others in their network are more successful and sustainable than models relying on a small number of more highly trained individuals [44]. The initial PL workshop lasts 90–120 min; additional training is scheduled with those leading walking groups and conducting park audits.

Regular walking groups are organized by PLs, who undergo additional training with Cal State Kinesiology faculty and students and receive a guide adapted from a previous study [33]. Routes are determined by PLs, but they are encouraged to walk from the church to the park and back to provide a concrete link between the two.

Text messaging. At study enrollment, participants are offered the option of receiving daily reminders about PA as done in our previous work [45,46] and described in-depth elsewhere (under review). The messages are standardized across participants (tailored by preferred language), and include motivational, informational, and challenges; some messages incorporate spiritual content (see Table 1). Other messages are tailored to each church regarding specific project activities and announcements; limited messages are tailored to each participant (e.g., birthday greetings).

2.3.2. Organizational church-level activities

Sermons/homilies. Because clergy have formal and informal authority and a high level of visibility and influence in the church [25,47], priests are asked to give at least 2 sermons or homilies on the importance of PA for health, with a focus on the moral imperative for addressing health disparities. We provide a sermon guide with suggested talking points developed by the research team and clergy partners, like guides used in prior studies [48,49].

Church-sponsored events in the park. We ask each church to sponsor events in the park every 2–3 months to encourage parishioner use of the park. Specific events are determined by the church coordinator and PLs.

Church announcements and dissemination of PA opportunities. Parishes disseminate information about intervention activities via mass bulletins and announcements. Kinesiology student interns provide demo exercise classes at churches with current participants as role models. Parishioners make periodic testimonials at church.

2.3.3. Park-level programming (physical and social environment and policy)

Park-based fitness and strength-training classes (led by bilingual/bicultural kinesiology student interns who are trained and supervised by kinesiology faculty and staff) are offered 3–4 days per week per church. Student interns, most of whom are from the neighborhoods where churches are located, have completed undergraduate major coursework, and undergo training and supervision focusing on safe and effective exercise session delivery. Students must commit to the project for at least one semester, but some continue for several semesters. Classes incorporate cardiovascular and strength building exercises and are divided into 3 fitness levels (beginner to advanced fitness level), with participants rotating through exercises using weights and resistance equipment [50].

Park Advisory Board. We ask each church to recruit 1 or 2 parishioners to serve on the local Park Advisory Board (PAB), a structure initiated by LA Department of Recreation and Parks in 1998 to

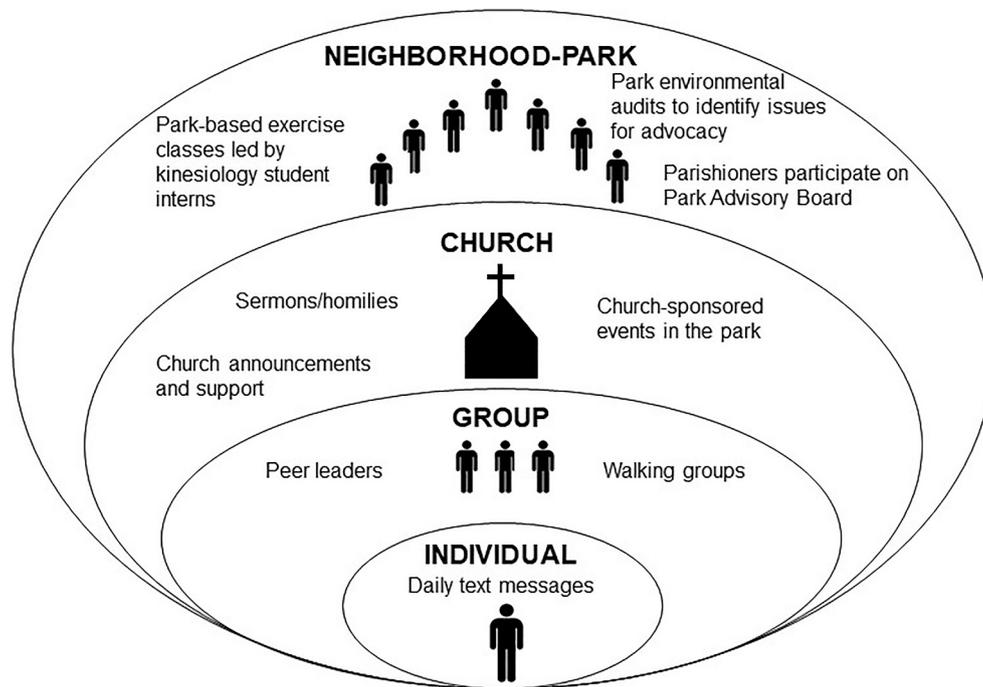


Fig. 1. Parishes & Parks intervention components at various levels of the socioecological framework.

incorporate community input into local park operations [51]. We leveraged this structure in a previous park-based RCT and recommended broader community representation [51].

Addressing parishioner concerns about the park (environmental advocacy). Using baseline data from each parish, we create handouts that summarize parishioner concerns about the park. We also train PLs to conduct environmental audits of the park using the Community Park Audit Tool [52], which has been found to be appropriate for lay community members [53]. The tool assesses park access and the surrounding neighborhood, and park conditions, quality, and safety. Identified concerns are discussed in meetings between the peer leaders and park director to identify things that can be addressed immediately (e.g., litter, graffiti) and those that need longer term strategies (e.g., drug or alcohol use; crime). Park directors work on issues through their channels (e.g., park maintenance, police) and, over time, PLs work with the park director and PAB to address other concerns (e.g., PA programming).

2.4. Pandemic impacts and adaptations

COVID-19-related closures impacted the extent to which planned in-person and group activities could be conducted during our first cohort and may affect the second cohort. Our text messaging is the one component that can carry on without interruption, regardless of pandemic impacts. For other components, we follow the guidelines of our community partners and local health department. For example, during COVID-19 surges in Los Angeles, many parks closed, and students at Cal State LA engaged in remote activities only. Thus, the kinesiology student-led classes were converted to on-line format (Facebook Live). We also began holding monthly peer leader meetings via Zoom instead of in-person. Activities conducted at the churches (e.g., sermons, announcements) were also affected when churches suspended in-person services. Church events in the park, environmental advocacy, and PAB participation are activities that were harder to transition to virtual formats, and thus were curtailed during the first cohort.

2.5. Control churches

Between baseline and follow-up, control churches receive publicly

available information about PA (tip sheets, posters, handouts) to disseminate among members. We maintain regular contact with participants via text and with the church coordinator and priest via telephone and in person visits. Once follow-up is completed for each cohort, we will invite control churches and participants to exercise classes offered by Cal State LA kinesiology in nearby parks.

2.6. Data collection and measures

Data are collected using Open Data Kit questionnaires on tablets, mostly on-site at participating churches (health survey and the Global Physical Activity Questionnaire or GPAQ are administered via telephone if requested). Trained bilingual research assistants (RAs) conduct biometric assessments and administer the GPAQ and, if requested, the health survey (otherwise, health survey is self-administered). All measures are available in English and Spanish. Most of the survey items are available in Spanish and/or have been used in our previous work. Any new items are translated into Spanish following established procedures for producing culturally equivalent measures (i.e., translation by a certified translator and review by committee including at least four bilingual team members to reach consensus).

2.6.1. Primary outcome: Minutes per week of MVPA (bouted and unbouted)

Accelerometry. Participants wear accelerometers strapped to the right hip for 1 week at each measurement wave. We use the Actigraph GT3x, which are worn while awake. If accelerometry data do not meet minimum wear time criteria (minimum of 3 days with at least 10 h/day, as done in a large cohort study of Latino adults [54]), participants are asked to re-wear an accelerometer for another week. We calculate average minutes per day of bouts MVPA (in 10-min bouts) using total days with valid data, since some may not have worn it all 7 days; we examine non-bouted MVPA as well.

2.6.2. Secondary outcomes

Self-reported PA is measured using the 16-item GPAQ, which evaluates PA in 3 domains (occupational, transport-related, and leisure-time) and sedentary time [55] and has been used with Latinos in

Table 1
Parishes & Parks intervention activities.

Level	Activities	Faith-based*Aspects and Tailoring
Individual and interpersonal (group) levels	<ul style="list-style-type: none"> • Peer Leader (PL) workshops (90–120 min each; 15–25 PLs per parish) <ul style="list-style-type: none"> o Orientation to project, importance of PA, encouraging others, park class demo o Additional training for those interested in being a walking group leader and conducting park audits o PLs become role models at the church who can champion PA and facilitate sustainability of church-led PA efforts after the study • Walking groups led by PLs <ul style="list-style-type: none"> o Routes from church to park and back o Walking group guide provides information about PA, how to motivate others, and logistical and safety issues • Text messaging (daily) <ul style="list-style-type: none"> o Standardized across participants (English or Spanish) o Motivational and/or informational and “challenges” o Messages about project activities and commemorating events (birthdays, holidays, etc.) 	<p>Conducted at church; priest opens with prayer and provides comment on the project’s connection to their faith; priest or church coordinator closes with prayer; PLs are lay leaders in the parish and reach out to other parishioners, bringing their own spirituality and service to the role.</p> <p>PLs are lay leaders in the parish and organize and lead the groups and bring their own spirituality and service to the activity; PLs lead the group in prayer before and at the end of the walks. Some even share a spiritual message, citing scripture.</p> <p>Much of informational and challenge messages are not tailored for spiritual content (e.g., “For muscle strengthening activities, make sure you include all the major muscle groups such as legs, hips, back, chest, stomach, shoulders, and arms” and “Do 5 squats right now!”).</p> <p>Some messages incorporate spiritual content (e.g., “In the hustle and bustle of our busy lives, we often neglect our bodies and souls. Take time to pray and be at peace”).</p>
Organizational church-level	<ul style="list-style-type: none"> • Sermons and homilies (at least twice during intervention) <ul style="list-style-type: none"> o Sermon guide provides talking points and sample homily by Catholic clergy and pretested with CAB o Priests develop actual sermon/homily • Church-sponsored events in the park (every 2–3 mos.) • Church announcements and support for activities (on-going) 	<p>Priests base homily on scriptural references for that day; focus is on the moral imperative (from a faith perspective) for addressing health disparities, particularly around access to safe green space in their community to promote PA.</p> <p>Church coordinator and PLs organize and lead these events (picnics, games, holiday parties) and bring their own spirituality and service to the activities, including spiritual messages.</p> <p>Priests visit intervention activities periodically to offer a prayer/blessing for the activities; PLs make periodic testimonials about the program at</p>

Table 1 (continued)

Level	Activities	Faith-based*Aspects and Tailoring
Physical and social environment and policy (park)	<ul style="list-style-type: none"> • Park-based fitness and strength training classes (60 min, 3–4 days per week) <ul style="list-style-type: none"> o Led by kinesiology students trained and supervised by faculty o In addition to kinesiology coursework, students receive 10–15 h of project specific training, including CPR, and then ongoing on-the-job training o Classes incorporate cardiovascular and strength building exercises (beginner to advanced) • Park Advisory Board (PAB) <ul style="list-style-type: none"> o 1 or 2 PLs per church serve on local park’s PAB • Addressing parishioner concerns about park <ul style="list-style-type: none"> o Handouts on parishioner concerns about park (from baseline survey) o PLs trained to conduct park environmental audits o Identified concerns discussed between peer leaders and park directors and PAB to identify short- and longer-term strategies 	<p>church (infusing their own spirituality); activities in mass bulletin and announcements. Parishioners develop strong bonds with one another and student instructors, most of whom are from the local community; builds sense of community and mutual support.</p> <p>Meetings occur at the park; PLs provide service to their community and advocate for park improvements as lay leaders.</p> <p>Meetings occur at the park; PLs provide service to their community and advocate for park improvements as lay leaders; priests attend the first meeting and offer a prayer and message of encouragement (e.g., how faith drives them to advocate for a healthy community using a holistic approach).</p>

* By “faith-based,” we mean not only how intervention materials and messages connect with faith, but also how they are integrated into the on-going activities of the congregation and how faith leaders (priests and peer leaders) shape and deliver intervention activities, integrating their own spirituality and service/advocacy for their communities.

faith-based settings [32]. A Spanish-language version has been validated with Actigraph data [56].

Waist and hip circumferences (for waist and waist-to-hip ratio) are measured by RAs with a tape to the nearest 0.1 cm using ACSM protocols (minimal waist) [57].

Cardiorespiratory fitness is measured by RAs using a modified 3-min submaximal step test [58], as our previous work [32,59]. Blood pressure is assessed and those with normal blood pressure readings (below 140 systolic and 90 diastolic) are asked to wear a heart rate monitor and perform stepping procedure for 3 min while the RAs record heart rate at the 2:00, 2:30, and 3:00 min timepoints and at 30 s and 1:00 min post-test (recovery heart rate).

Body fat is measured by RAs using bioelectrical impedance analysis, a reliable, convenient, non-invasive method to assess body fat [60,61], using the Omron HBF 306 Body Fat Analyzer. RAs review hydration criteria and procedures (noting if participant had anything to eat or drink in past 2 h and having them empty their bladder if they have not urinated for >2 h).

Social support for PA is measured using a scale adapted from Sallis et al. [62] (how often family, friends, or fellow parishioners encourage them to be active, how often they offered to do PA with them and how often

they did PA with them).

Mental health is assessed using the 8-item version of the Patient Health Questionnaire [63] for depressive symptoms, which has been validated with individuals of Mexican American and Central American descent in the U.S. [64], and the Perceived Stress Scale 4-item version [65].

Park use and park-based PA are measured using items from our previous studies [14,66], including number of visits to a park in past week; duration of a typical park visit; and activities engaged in while at the park (exercise, relaxation, etc.). We also ask how they usually get to the park and who usually goes with them to the park.

2.6.3. Co-variates

We collect a variety of co-variates known to affect our primary and secondary outcomes. These are detailed in Table 2, organized by the various levels of our multilevel framework. Under, Neighborhood-Park, we collect data on perceptions of neighborhood [32,67], perceptions of park near church [68], and neighborhood and church cohesion [69,70]. Under the Church-Group levels, we collect data on social norms for exercise. And under Individual level, we collect data on: behavioral strategies for engaging in PA [71]; acculturation [72,73]; religious attendance / involvement in study church; provider-diagnosed health conditions [74]; health status; healthcare utilization; smoking status;

alcohol use [75]; weight and height (BMI is calculated); sleep duration and quality [76]; and socio-demographics.

2.6.4. Process evaluation

To assess intervention fidelity and implementation and gather data for tailoring future dissemination, we collect various types of process data based on prior research with church-based interventions [43,45,48,49]. On the follow-up survey, we include questions for intervention church participants that assess participation in, and opinions about, intervention components on 5-point scales. For those who agree to receive the text messages, we send brief survey items via text to gauge satisfaction with this component, preferences for frequency of messages, other input for future adaptation [45]. We also record and transcribe sermons or homilies given to qualitatively analyze messages transmitted [48,49]. We track attendance at the kinesiology intern classes. Throughout intervention implementation, we meet with PLs and church coordinators to discuss any implementation challenges; notes are taken and summarized across churches. We will analyze the process evaluation data to explore potential variations in intervention implementation and identify how the intervention could be refined for greater effectiveness and future scale-up.

Table 2
Covariates.

Level	Construct	How Measured
Neighborhood-park	Perceptions of neighborhood	8 items taken from the Neighborhood Environment Walkability Scale to assess perceptions of <i>neighborhood safety, aesthetics, and traffic hazards</i> [67], which have been used previously with Latino populations [32]
	Perceptions of park near church	2 items from our previous work with Latinos in Los Angeles [68], which ask <i>how they rate the park</i> (5-point scale from excellent to poor) and <i>what concerns they have about the park</i> (crime, dogs off leash, drug or alcohol use, litter or graffiti safety hazards, etc.)
	Neighborhood and church cohesion	6 items of an established scale for <i>neighborhood cohesion</i> [69] and used in our previous work with Latino women [70] (e.g., The relationships I have with my neighbors mean a lot to me; I feel like I fit in with people in my neighborhood) 2 items adapted for the <i>church environment</i> in our previous work with Latina women (e.g., The relationships I have with fellow church members mean a lot to me) [32]
Church-group	Social norms for exercise	5 items that ask, "How often do you see the following groups [people in your neighborhood, family members, friends, people from your church, and your priest] participating in physical activity, such as walking, jogging, bicycling, or playing sports? (never, rarely, sometimes, often, or very often)
Individual	Behavioral strategies for engaging in PA	13 yes/no items developed by Elder et al. [71] and Arredondo et al. [32] and used with Latinos, which ask about <i>participants' behavioral strategies for engaging in PA in the past 6 months</i> (e.g., bought a pair of shoes to do PA, enrolled in a gym, set short-term goals for PA)
	Acculturation	4-item Brief Acculturation Scale for Hispanics [72,73] 4 items about <i>years in US, age when came to the US, number of parents born outside the US, English proficiency</i>
	Religious attendance and involvement in study church	4 items on <i>length of attendance at study church, frequency of attendance in previous year, number of groups or ministries participated in over last year, number of worship services or activities attended in past 4 weeks</i>
	Provider-diagnosed health conditions	Items adapted from CDC's Behavioral Risk Factors Surveillance System [74] on diagnosed conditions (e.g., diabetes, heart disease, cancer)
	Health status	4 items from the Los Angeles County Health Survey (which is conducted in multiple languages including Spanish) on <i>overall health</i> (excellent, very good, good, fair, poor) and the number of days in the last 30 days that <i>physical health</i> was not good, <i>mental health</i> was not good, and <i>poor physical or mental health</i> kept them from doing usual activities
	Healthcare utilization	Standard questions on <i>health insurance status, regular source of care, and number of physician visits in past 3 months</i>
	Smoking status	Standard questions on smoking [Do you currently smoke cigarettes (Y/N)? If you currently smoke cigarettes, on the days that you smoke, how many cigarettes do you smoke?]
	Alcohol use	3-item AUDIT-C questionnaire to assess problem drinking, which is available in Spanish [75]
	Weight and BMI	<u>Weight</u> is measured to the nearest 0.1 kg using a Tanita digital floor scale with participants standing in light clothing and shoes removed <u>Height</u> is measured to the nearest 0.1 cm using a fixed ruler attached to a Seca height board vertical surface, with participants' back flat against the vertical surface and without shoes <u>BMI</u> is calculated in Kg/m ²
	Sleep	2 items from the Pittsburgh Sleep Quality Index [76] on <i>sleep duration and sleep quality</i>
Socio-demographic variables	Standard questions on <i>age, gender, employment, household income, education, marital status, number of adults in the home, number of children in the home, and race-ethnicity</i>	

2.7. Power calculation

We use a difference-in-differences model between two study arms and two time points for the power calculation. This simplified setting reflects a flexible temporal trend without controlling for covariates. Under the regular conditions of 2-sided p -value $< .05$ and power > 0.80 , we assume the attrition rate as 20% and a potential intra correlation coefficient (ICC) between 0 and 0.02 within in each church to account for potential inflation of standard errors due to the clustering effect [32]. With 1204 initial recruits and 14 churches in total, we can detect an effect size between 0.26 and 0.39 times the standard deviation (SD). For the primary outcome (daily accelerometer-based MVPA minutes in modified bouts of >10 min), the SD is roughly 8–12 min for 40–49-year-old Latino adults [77]. Thus, we have sufficient power to detect a mean change between 1.7 and 4.8 min in the main effect.

2.8. Data analysis

Our analyses will examine effects on the primary outcome, parishioners' MVPA (daily minutes in modified bouts of >10 min and unbouted) and secondary outcomes (self-reported PA, heart rate/fitness, waist circumference, waist-to-hip ratio, body fat, mental health, and perceived social support for PA). Churches are the unit of randomization and participants nested in churches are the level of analyses. We will implement a set of hierarchical repeated-measure linear models to formally test the treatment effect on the outcome measures. All treatment effects are linear contrasts tested by the regular Wald's test. Both models can be readily fitted by general purpose statistical software package such as SAS 9.4. We will apply the robust Huber-White sandwich estimator for potential heteroskedastic error variances in drawing statistical inference.

3. Conclusion

To our knowledge, this is the first RCT to integrate church-level PA programming and advocacy with park-based PA programming to create cross-sectoral synergies for addressing PA disparities. Prior work has demonstrated the efficacy of these two approaches separately—church-based PA programming increasing MVPA [33] and park-based PA programming increasing MVPA [78]—but the synergistic effects of combining these has not been examined.

Our focus on addressing PA disparities by partnering with Latino faith-based organizations is also a contribution, given a recent systematic review [79] found only six full-scale efficacy trials that involved Latino churches – of these, three focused on cancer screening and one each on PA, stroke, and vaccinations. The potential for addressing Latino health disparities through partnerships between faith-based organizations and other community stakeholders remains largely unexamined.

Finally, our park-based aerobic and muscle strengthening classes led by kinesiology student interns is adapted from an established program at Cal State Northridge (3WINS), which, to date, has been sustained over 11 years without any external funding [50,80]. Our study will be the first to assess impact on participants' MVPA, thereby providing critical evidence for scale-up. Kinesiology student interns offer a scalable way of providing park-based PA programming in low-income communities, as there are 875 kinesiology departments in colleges and universities across the country, and the number of students in the major is growing [81]. There are 15,000 kinesiology majors across 21 campuses in the CSU system alone, which reflects a 50% increase over a 5-year period (compared to overall enrollment increase of 6%); similar increases have been observed in other states [81]. By integrating this model with a multilevel faith-based intervention, our approach implements the Healthy People 2020 goals to create positive physical and social environments for supporting healthy behaviors by involving multiple institutions within the community (Latino-serving state universities' kinesiology programs, parks and recreation, and Latinos churches),

which can facilitate sustainability and dissemination.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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