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RESEARCH

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Quality of life, mental health and social relationships among older adults participating in the Recreovía physical activity community program

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Abstract

Background By 2050, over 2 billion people will be aged 60 or older, with most living in low- and middle-income countries (LMICs). In Latin America, this demographic shift presents challenges for under-resourced health and social systems. Community-based physical activity programs, such as Bogotá's Recreovía, play a critical role in supporting older adults' health and well-being. During the COVID-19 pandemic, the program was adapted to offer both outdoor and virtual sessions, aiming to maintain physical activity and social connections despite mobility restrictions. However, there is limited evidence on how such programs influence broader healthy aging outcomes, including mental health and social relationships, particularly during crisis settings. This study describes these outcomes among older adults who participated in Recreovía during the COVID-19 pandemic in Bogotá, Colombia.

Methods We conducted a mixed-methods study using a simultaneous bidirectional framework design. A survey measured program use and outcomes related to healthy aging, complemented by a network analysis of social relationships. In-depth interviews explored participants' perceived impacts on quality of life.

Results Recreovía participation showed significant benefits for older adults' quality of life. Quantitative data revealed improvements in physical health, mental and psychological well-being. Participants reported enhanced self-esteem, sustained health measures, and strengthened mental resilience. The program also fostered intergenerational relationships, promoted independence, and created supportive peer networks. Qualitative findings highlighted the importance of outdoor environments for physical activity and their holistic contributions to spiritual well-being. The integration of both data sources confirmed these benefits, underscoring Recreovía's role in enhancing overall well-being and social relationships.

Conclusions Community-based physical activity programs like Recreovía enhance older adults' social engagement, foster intergenerational relationships, reduce social isolation, and promote healthy aging. Outdoor spaces that support physical activity and socialization are vital for maintaining independence, mental health, and quality of life. These programs also help older adults sustain relationships and contribute meaningfully to society, promoting a more

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equitable and supportive environment for healthy aging. By prioritizing the development and support of such spaces and programs, policymakers and community leaders can enhance aging populations' well-being by prioritizing such initiatives, which are critical for public health strategies in resource-limited settings.

Keywords Healthy aging, Physical activity, Community-based programs, Older adults, COVID- 19 pandemic, Mixed-methods, Latin America

Introduction

By 2050, more than 2 billion people will be aged 60 or older, with 80% residing in low- and middle-income countries (LMICs) [1]. Latin America is experiencing a rapid demographic transition, yet its health and social systems remain under-resourced, struggling to meet the needs of an aging population [2]. While research has extensively documented the physical health benefits of physical activity in older adults, its role in mental health and social well-being—two critical components of healthy aging—remains underexplored, particularly in LMICs [3, 4].

The World Health Organization's (WHO) Global Strategy and Action Plan on Aging and Health highlights the need for environments that promote well-being and social participation among older adults, defining healthy aging as "the process of developing and maintaining the functional ability that enables wellbeing in older age." [5]. As we move through the Decade of Healthy Aging (2020–2030), it is crucial to prioritize strategies in LMICs that support older adults' intrinsic capacities and their interaction with the environment to enhance quality of life, autonomy, and social participation [6]. Community-based physical activity programs are particularly relevant in this context, as they provide structured opportunities for exercise and social engagement in accessible public spaces [7, 8]. These types of interventions have been widely implemented in community settings in Latin America, with promising results [9, 10].

However, there is limited evidence on how such programs influence psychosocial health outcomes, particularly during periods of crisis such as the COVID- 19 pandemic [11]. The pandemic underscored the importance of maintaining physical activity opportunities for older adults, as prolonged social isolation and movement restrictions disproportionately affected their physical and mental health [12]. These measures have had negative impacts on older people's lives in terms of quality of life, mental health, social isolation and loneliness [13].

Considering the need to comply with the containment measures and the urgence to provide opportunities for older people to stay mentally and physically active [13], Bogotá's Recreovía program, a long-standing community-based physical activity initiative, was adapted during the pandemic to continue providing exercise opportunities both in-person and online [11]. However, little is known about how these adaptations influenced older adults' quality of life, mental health, and social relationships. To address this gap, this study seeks to describe the role of Recreovía participation in supporting healthy aging during the COVID- 19 pandemic in Bogotá, Colombia. Specifically, we explore how older adults who engaged in the program reported outcomes related to quality of life, mental health, and social relationships, and whether these experiences differed between indoor and outdoor program settings. Additionally, we examine how social networks formed through the program may have fostered intergenerational relationships and contributed to broader social well-being [14–16].

Materials and methods

Study setting

Bogotá, the capital city of Colombia has a population of over 7 million people, of whom 13.3% are older adults. [17]. The main causes of morbidity within the older adult population are hypertensive and cardiovascular diseases (27.3%) as well as endocrine, nutritional and metabolic diseases (11.4%) [11]. Regarding mental health, older adults have been mainly diagnosed with disorders related to stress (29%), organic mental disorders (28.0%) and mood disorders (25.3%) [18].

In March of 2020 the National Government of Colombia declared a public health emergency due to COVID-19 [19]. The Government then sanctioned an additional mandatory preventive isolation measure to protect older adults over 70 years old for four months (from March 20 th to August 31 st, 2020) restricting the amount of time spent outdoors to a maximum of one hour, three times per week [20]. Therefore, older adults were in mandatory isolation for twice as long as the rest of the population. The restriction was lifted due to the advocacy efforts of civil society, leading Bogotá's Court to recognize age discrimination and requesting time for outdoor physical activity for older adults. In Colombia, recreation, physical activity and leisure time are considered rights of all citizens and the State is held accountable for ensuring these rights [21]. As a response, several strategies to promote physical activity have been implemented in Bogotá [22, 23] including the Recreovía, a community-based physical activity program led by the District Institute of

Recreation and Sports of Bogotá (IDRD) since 1995 [22]. During the COVID- 19 pandemic, the IDRD continued delivering the Recreovía program using indoor and outdoor settings to adapt the activities to the restrictions in place at that time [11]. The Recreovía program has existed for over 25 years [23] and has been designed for vulnerable populations, such as older adults and people from low- to middle-income neighborhoods, offering free access to physical activity classes. These classes are held on weekday mornings and evenings, and only in the mornings on Sundays and holidays. During the pandemic, the program was adapted to maintain the previously established settings while implementing the necessary biosafety measures. Thus, outdoor sessions were adopted, keeping the same schedule, and an indoor modality was introduced, consisting of virtual sessions for engaging in physical activity at home.

Study design

We conducted a mixed-methods study with a simultaneous bidirectional framework design to integrate quantitative and qualitative data and describe healthy-aging-related outcomes (quality of life, mental health, and social relationships) [24]. The quantitative component is a cross sectional design and included two instruments: first, a survey administered to measure Recreovía use, quality of life, mental health, and social relationships; second, a network analysis to examine the social relationships within the physical activity program [25]. The qualitative component is a narrative design and included in-depth interviews to participants and instructors inquiring about the perceived impact of the physical activity program in the four domains of quality of life: physical, psychological, social relationships and environment.

We used a pragmatic approach to apply a mixed-methods design aimed at obtaining more comprehensive and corroborated information on how participation in a community-based physical activity program impacts the quality of life, mental health, and social relationships of older adults. Quantitative data provided an overall panorama of all older adult users of Recreovía, using validated measurements of quality of life and mental health. It also allowed for the assessment of participants' social relationships through network analysis. Additionally, qualitative data captured the subjective perspectives of participants based on their experiences. The voices of participants are not directly heard in quantitative data, and both quantitative and qualitative data offer distinct perspectives. Relying on only one type of evidence would result in a partial and inadequate approach. The integration of both perspectives allowed for the confirmation of results and a more comprehensive understanding [26].

Study procedures were approved by the ethics committee. All study participants provided written informed consent prior to participating in this study.

Recruitment and data collection

The study was conducted between November and December 2020 with a follow-up in September 2021. During the COVID- 19 pandemic, the Recreovía program was adapted, and this has been described elsewhere [11]. Participants were recruited in consultation with policymakers, from two types of settings according to these adaptations, outdoors and indoors. Researchers selected two parks from a list of six where the program was operating during the pandemic to recruit participants from the outdoor setting. One of the parks offered sessions on weekdays and the other one on Sundays and National holidays. Older adults were invited to take part in the physical activity classes at the two selected parks. The indoor setting participants were users of virtual sessions of the Recreovía program and were recruited through a contact form advertised on Facebook during four virtual physical activity sessions that were selected as well as through Recreovía social media posts.

Quantitative component

We conducted an in-person survey in the two selected parks to obtain socio-demographic information and administer the social network questionnaire. Second, we conducted a follow-up survey by phone and included Recreovía-use related variables regarding quality of life, social relationships for physical activity, and social relationship measures. A total of 90 individuals who were ≥ 55 years-old (59 from the outdoor setting and 31 from the indoor setting) were included. In Colombia, individuals aged 55 and older may be classified as older adults based on physical, psychological, and functional status, as outlined in Law 1276 of 2009 [27]. Given the significant impact of the COVID- 19 pandemic on both physical and mental health, the research team opted to include this age group to better capture the experiences of adults approaching later stages of life. This study used a non-probabilistic sampling strategy. For the outdoor setting, all eligible older adults present at the selected sessions were invited to participate. For the indoor setting, older adults were invited to enroll by completing a contact form shared during live-streamed physical activity sessions and on Recreovía's social media. While the sample was not designed to be statistically representative, it aimed to capture diverse experiences across both settings. In addition, we collected data from 21 younger and middle-aged adults who were nominated in the network questionnaire by the older adults. The survey was

conducted by trained interviewers using the Qualtrics^{XM} platform to collect data.

The sociodemographic variables included age, sex (female or male), highest formal education level achieved (no formal education/primary, secondary or postsecondary) and household socioeconomic level (low, middle or high). The Recreovía-use related variables included how long they had attended the program (≤ 6 months, 6–12 months or ≥12 months) and reasons for attending the program (health and wellbeing, spending time with relatives/families or recreation and leisure).

To assess quality of life measures, we used the WHO Quality of Life Questionnaire (WHOQOL) [28]. This questionnaire generates four domain scores (physical, psychological, social relationships and environment) and an additional overall score (self-perception of quality of life and health satisfaction) on a scale of 1–100 where a higher score denotes a higher quality of life [28]. There is no specific threshold to indicate a superior or inferior quality of life. Nevertheless, a study in Brazil proposed an estimate of a cut-off point where a score of ≥60 was moderately sensitive for recognizing individuals with good/satisfactory quality of life and has been further evaluated [29, 30]. Furthermore, the WHOQOL-BREF questionnaire has been widely validated in older adult populations, demonstrating strong psychometric properties, with Cronbach's alpha values ranging from 0.70 to 0.85 [29].

Mental health was measured by using the Self-reporting Questionnaire (SRQ) [31]. The SRQ can also be isolated to depressive and anxious symptoms where the answers range from No symptoms (0), Low symptoms (1–2), Middle symptoms (3–4), High symptoms (≥ 5). When using the SRQ score for common mental disorders, there is a clinical cutoff of 7 and a higher score reflects emotional pain [31]. The Self-Reporting Questionnaire (SRQ) is a widely utilized instrument in mental health assessments, featuring a validated cutoff point for the identification of common mental disorders [31].

To assess social relationships, the Sallis Social Support for Exercise Scale was used to evaluate measures of perceived social support specific to health-related exercise behaviors [32]. This scale comprises a 13-item self-report questionnaire designed to evaluate the extent of support individuals have received from friends and family members in participating in physical activity over the preceding three months. Participants rate the frequency of this support on a scale ranging from 1 (none) to 5 (very often) and higher scores indicate greater support [32]. To calculate the total social support score for an individual, we added together the support values from the 11 positive support queries and the inverse values for the 2 negative support queries. Additionally, participants were asked: *With what frequency, in the last three months, has a family member or a friend accompanied me to the Recreovía?* and responded using a scale ranging from 1 (never) to 5 (very often).

Lastly, for social network analysis, participants completed a social network questionnaire (Appendix 1), where they nominated up to five people whom they usually interact with in the Recreovía or at the park. For each nominated person, we gathered the relationship to the older adult, approximate age, whether they met in the program and whether they did physical activity together.

Qualitative component

The qualitative component used in-depth interviews to explore the perception of participants and instructors regarding the program's impact on their daily life. We conducted video-call interviews with an experienced interviewer following a semi structured guide (Appendix 2) including direct and indirect open questions that were tailored to each group. All meetings were recorded and transcribed verbatim. From the qualitative sample, we invited a group of older adults to participate in the interviews through a logic of maximum variation sampling to ensure inclusion in both settings, sexes, and roles (participants and instructors) [33]. Additionally, we used a snowball sampling strategy to recruit older adults and their companions in both indoor and outdoor settings, allowing for the inclusion of participants with varied social connections and perspectives. To include experiences from participants before and during pandemic restrictions, we invited a man and a woman from each setting who had longest attended Recreovía up to saturation. A total of 8 interviews were conducted including the program manager, 2 Recreovía instructors, and 5 older adult users (3 women, 2 men) of the Recreovía program, who accepted participation.

Data analysis

Quantitative component

We conducted a descriptive analysis of the selected variables and pairwise comparisons by settings of the Recreovía (indoor vs. outdoor) and schedule (weekday outdoor vs. Sunday outdoor). Results present Pearson chi-squared tests, Wilcoxon rank sum tests and Fisher's exact tests depending on the nature and distribution of each variable. Additionally, the internal consistency of each questionnaire in each domain was calculated through Cronbach's alpha coefficient. These analyses were conducted using the statistical computing package RStudio [34].

We analyzed the social networks that emerged among the participants of Recreovía, based on the people they interacted with in the three different settings: indoor,

weekday outdoor, and Sunday outdoor. We created three separate directed networks for each setting, which consisted of nodes and edges. Each node represented a participant and the edge between nodes indicated the direction of the nomination as being friends, relatives, or neighbors. We described the relationship between the age difference of older adults and their companions for each network. This analysis was conducted using the NetworkX library from Python [35].

In social network analysis, assortativity (dissortativity) refers to the tendency to connect with others who share similar (different) characteristics [36]. We assessed assortativity between being older or younger than 60 by calculating the assortativity coefficient [25] from the NetworkX library in Python. This coefficient in the context of the study informs whether participants tend to establish connections based on age (older adults or other ages), revealing whether there is a preference for connection between nodes with similar category (coefficient close to 1), different (coefficient close to − 1), or if there is no tendency to connect based on age category (coefficient close to 0) [25].

Qualitative component

We conducted a codebook thematic analysis in two coding cycles with multiple coders [37, 38]. The first coding cycle was deductive and identified topic summaries guided by WHO domains of quality of life (physical, psychological, social relationships, and environment) [39]. The second coding cycle was inductive to identify sub-topics within each quality of life domain as well as to refine codes. Moreover, we selected the participant quotes that best reflected each topic. To establish inter-coder agreement, the coding team employed three separate comparing and verification sessions including debriefing and member checking techniques at the end of each coding cycle [33]. The final hierarchical codebook included in this paper contains 10 codes organized into six main codes: physical health, psychological domain, level of independence, social relationships, relationship with the environment, and spiritual domain. The qualitative analysis was conducted using NVivo software (QSR International 193 Pty Ltd. Version 12 Pro).

Integration

We adopted a bidirectional framework [40] using the selected healthy-aging-related outcomes (quality of life, mental health, and social relationships) to bring together the results. Thus, quantitative and qualitative data were analyzed separately and then merged for interpretation according to the healthy-aging outcomes. The integration process involved constructing a comparison matrix where the horizontal axis represented the healthy-aging domains, providing the analytical framework, while the vertical axis included all relevant findings from both quantitative and qualitative components. We assessed the relationships between these findings based on three criteria: 1) convergence; when quantitative and qualitative findings aligned, reinforcing each other; 2) divergence: when results differed or contrasted, highlighting discrepancies between the two data sources; 3) complementarity: when quantitative and qualitative findings provided distinct but interrelated insights, offering a more comprehensive understanding of the outcome. This approach enabled a systematic synthesis of the data. Finally, results were discussed and consolidated by the team of authors to drive final interpretation.

Results

Quantitative component

Descriptive analysis

The Recreovía participants had similar sociodemographic characteristics (Table 1) in both the indoor and outdoor settings. A total of 90 older adults were included with a mean age of 64.13 ± 4.51 years in the indoor setting and 64.42 ± 5.91 years in the outdoor setting. Most of the sample was female, comprising 90.3% in the indoor setting and 86.44% in the outdoor setting (Table 1). Around 50% of the participants reported secondary school as their highest formal educational level achieved and nearly 60% recounted a medium level of socioeconomic status. Most older adults (75.56%) had been attending the Recreovía for at least 12 months and nearly all of them (97.78%) reported health and wellbeing as the main reasons to attend the program.

Regarding the overall quality of life score, there were no statistically significant differences between participants of the indoor setting activities (77.42 ± 20.26) and outdoor setting activities (69.70 ± 20.13) (Table 2). Participants of Sunday outdoor setting activities had higher mean scores for the psychological (81.25 ± 9.72, $p = 0.008$), social relationships (67.56 ± 18.05, $p = 0.004$) and relationship with the environment (67.75 ± 13.58, $p = 0.019$) domains when compared to participants of the weekday outdoor setting activities. In all cases, the scores were ≥ 60, so the result is related to a good/satisfactory quality of life in the respective domains. The internal consistency for the QoL-WHO questionnaire was questionable for the overall domain (Cronbach's alpha coefficient; $\alpha = 0.62$), acceptable for the physical health ($\alpha = 0.70$), psychological ($\alpha = 0.70$), and environment domains ($\alpha = 0.73$), and was poor for the domain of social relationships ($\alpha = 0.57$).

Regarding mental health outcomes, participants were asked whether they used Recreovía participation to prevent mental health symptoms during the March 2020

Table 1 Sociodemographic characteristics of older adults (≥ 55 years old) who participate in the Recreovía

Variable	Outdoor setting							Indoor setting		
	Overall outdoor ***N*** **= 59**		**Weekday** ***N*** **= 31**		**Sunday** ***N*** **= 28**		***p-value***[a]	**Facebook live and Movement route** ***N*** **= 31**		***p*-value**[b]
Age (Mean ± SD)	59	64.42 ± 5.91	31	64.26 ± 6.90	28	64.61 ± 4.69	0.465[c]	31	64.13 ± 4.51	0.802[c]
Sex (%)										
Female	51	86.44	30	96.77	21	75.0	0.022[d]	28	90.3	0.742[d]
Male	8	13.56	1	3.23	7	25.0		3	9.7	
Highest level of education (%)										
No formal education/primary	12	20.34	8	25.81	4	14.29	0.480[e]	4	12.90	0.574[e]
Secondary	31	52.54	16	51.61	15	53.57		16	51.61	
Post-secondary	16	27.12	7	22.58	9	32.14		11	35.48	
Household Socioeconomic Status (%)[f]										
Low (1–2)	16	27.12	12	38.71	4	14.29	0.035[e]	15	48.39	0.044[e]
Middle (3–4)	43	72.88	19	61.29	24	85.71		16	51.61	
How long have you attended the Recreovía? (%)										
≤ 6 months	14	23.73	10	32.26	4	14.29	0.105[e]	3	9.68	0.003[d]
6–12 months	0	0.00	0	0.00	0	0.00		5	16.13	
≥ 12 months	45	76.27	21	67.74	24	85.71		23	74.19	
Reasons to attend the Recreovía (%)										
Health and wellbeing	59	100.00	31	100.00	28	100.00	N/A	29	93.55	0.116[d]
Spend time with relatives or families	0	0.00	0	0.00	0	0.00		0	0.00	
Recreation and leisure	0	0.00	0	0.00	0	0.00		2	6.45	

[a] *p*-value Weekday vs Sunday Park

[b] *p*-value outdoor vs. indoor

[c] Wilcoxon rank sum test

[d] Fisher's exact test

[e] Pearson Chi-squared test

[f] An official six-level measurement that includes external characteristics of housing

Table 2 Healthy aging outcomes of older adults (≥ 55 years old) who participate in the Recreovía

Variable		Outdoor setting						*p-value*[a]	Indoor setting		*p-value*[b]
		Overall outdoor *N* = 59		Weekday *N* = 31		Sunday *N* = 28			Facebook live and Movement route *N* = 31		
Quality of life (0–100) (Mean ± SD)											
Overall		59	69.70 ± 20.13	31	67.34 ± 18.45	28	72.32 ± 21.88	0.233[c]	31	77.42 ± 20.26	0.456[c]
Physical health		59	73.06 ± 13.66	31	71.08 ± 14.96	28	75.26 ± 11.94	0.269[c]	31	67.05 ± 16.87	0.145[c]
Psychological		59	76.34 ± 12.72	31	71.91 ± 13.61	28	81.25 ± 9.72	0.008[c]	31	75.40 ± 16.61	0.963[c]
Social relationship		59	60.73 ± 17.24	31	54.57 ± 14.08	28	67.56 ± 18.05	0.004[c]	31	66.40 ± 18.94	0.069[c]
Relationship with the environment		59	63.82 ± 12.72	31	60.28 ± 10.92	28	67.75 ± 13.58	0.019[c]	31	67.64 ± 17.54	0.301[c]
Mental health (%)											
Do you participate in the Recreovía to feel better during the COVID- 19 pandemic? (%)	**Yes**	51	86.44	30	96.77	21	75.00	0.022[d]	30	96.77	0.156[d]
	No	8	13.56	1	3.23	7	25.00		1	3.23	
SRQ common mental disorders score (Mean ± SD)		59	2.76 ± 3.31	31	2.42 ± 3.30	28	3.14 ± 3.34	0.348[c]	28	4.30 ± 5.00	0.255[c]
SRQ Anxiety symptoms (%)											
No symptoms (0)		20	33.90	12	38.71	8	28.57	0.754[d]	9	29.03	0.441[d]
Low symptoms (1–2)		20	33.90	9	29.03	11	39.29		13	41.94	
Middle symptoms (3–4)		10	16.95	6	19.36	4	14.28		2	6.45	
High symptoms (≥ 5)		9	15.25	4	12.90	5	17.86		7	22.58	
SRQ Depression symptoms (%)											
No symptoms (0)		25	42.37	15	48.39	10	35.71	0.753[d]	14	45.16	0.148[d]
Low symptoms (1–3)		24	40.68	12	38.71	12	42.86		8	25.81	
Middle symptoms (4–6)		7	11.87	3	9.68	4	14.29		3	9.68	
High symptoms (≥ 7)		3	5.08	1	3.22	2	7.14		6	19.35	
Social relationships (Mean ± SD)											
Score for social support for exercise behavior[e]		59	36.03 ± 7.79	31	35.32 ± 8.57	28	36.28 ± 6.90	0.368[c]	31	38.45 ± 10.90	0.461[c]
With what frequency, in the last three months, has a family member or a friend accompanied me to the Recreovía? (%)											
Never (1)		24	40.68	12	38.71	12	42.86	0.450[d]	15	48.39	0.544[d]
Rarely (2)		9	15.25	3	9.68	6	21.43		2	6.45	
Occasionally (3)		6	10.17	5	16.13	1	3.57		5	16.13	
Often (4)		18	30.51	10	32.26	8	28.57		7	22.58	
Very often (5)		2	3.39	1	3.22	1	3.57		2	6.45	

[a] *p*-value Weekday vs. Sunday Park

[b] *p*-value overall outdoor vs. indoor setting

[c] Wilcoxon rank sum test

[d] Fisher's exact test

[e] Sallis Social support of exercise scale [22]

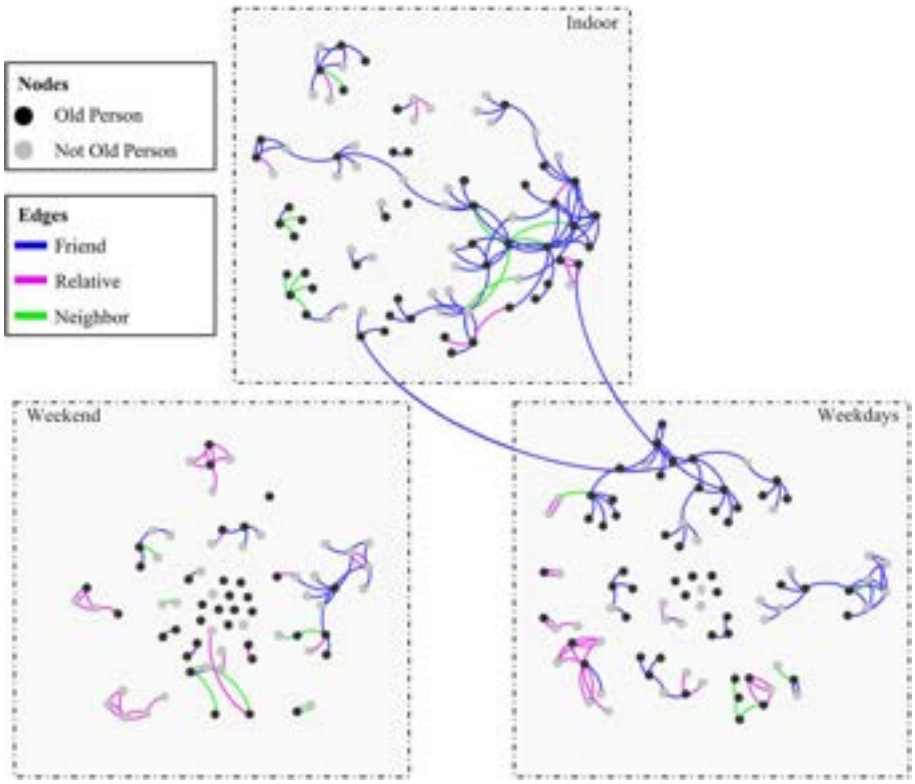

Fig. 1 Social network analysis

quarantine. A higher proportion of indoor participants (96.77%) reported using the program for this purpose compared to outdoor participants (86.44%), though this difference was not statistically significant. Within the outdoor group, weekday users were significantly more likely to report using the program for mental health benefits (96.77%) compared to Sunday users (75.00%) (p = 0.022).

In relation to the SRQ, in all cases the score for common mental disorders was less than 7, which indicates the absence of significant emotional pain among participants. Concerning anxiety symptoms, most of the indoor and outdoor participants reported no or low symptoms (70.97% for indoor participants and 67.8% for outdoor participants). Likewise, within the outdoor setting, most of the weekday (38.71%) participants reported no symptoms and most of the Sunday participants reported low symptoms (39.29%), but this difference was not statistically significant (p = 0.754). In relation to depression symptoms most of the participants, both in the indoor (70.97%) and outdoor (83.05%) settings, reported no or low symptoms. Among the outdoor setting participants, most of the weekday (48.39%) and Sunday (42.86%) users reported no or low symptoms but this difference was not statistically significant (p = 0.753). There were no statistically significant differences between outdoor and indoor settings related to mental health outcomes.

In terms of social relationships with the Sallis Social Support for Exercise Scale, there were no statistically significant differences between outdoor and indoor settings. The mean score for the indoor participants was 38.45 (± 10.90) and 36.03 (± 7.79) for the outdoor participants. In the outdoor setting, the mean score for Sunday participants was 36.28 (± 6.90) and 35.32 (± 8.57) for Weekday participants, but this difference was not statistically significant. The internal consistency for the Sallis social Support for Exercise Scale was good (Cronbach's alpha coefficient; $\alpha = 0.8$).

Moreover, most of the participants for both the indoor and outdoor participants reported that in the last 3 months a family member or friend never (48.29% and 40.68%, respectively) or often (22.58% and 30.51%, respectively) accompanied them to the Recreovía. These differences were not statistically significant.

Social network analysis

We modeled the three networks according to the previously defined settings: indoor, weekday outdoor, and Sunday outdoor (Fig. 1). The indoor setting network had 92 participants, who were connected by 110 edges

representing family, friendship, or neighbor relationships. The weekday outdoor setting network had 75 participants, who were connected by 64 edges representing family, friendship, or neighbor relationships. The Sunday outdoor setting network had 95 participants, who were connected by 99 edges representing family, friendship, or neighbor relationships. In addition, we identified two connections from the Sunday outdoor setting to the indoor setting and one connection from the indoor setting to the Sunday outdoor setting.

We found that participants who reported social interactions in the Recreovía predominantly engaged in intergenerational relationships, involving both older adults and individuals of other age groups. In the Sunday outdoor setting, 51.6% of connections were between older adults and other age groups, 31.3% were between non-older adults, and the remaining 17.2% were between older adults. For the weekday outdoor setting, 45.5% of connections were between older adults and other age groups, 22.2% were between non-older adults, and 32.3% were between older adults. Finally, in the indoor setting, 42.7% of connections were between older adults and other age groups, 6.4% were between non-older adults, and 50.9% were between older adults.

The assortativity coefficient in the Sunday outdoor setting network was approximately 0.02, in the weekday outdoor setting it was 0.08, and in the indoor setting it was 0.04. The assortativity results, which are close to 0 across all three settings, suggest there is no significant tendency for participants to interact based on age category, whether older or younger. Furthermore, the observation that 43% to 52% of connections occur between older adults and individuals of other age groups aligns with these findings, indicating that participants share experiences and build connections regardless of age category.

Qualitative component

The interviews revealed that the Recreovía, as a physical activity program, can be related with healthy aging for its influence in the quality of life domains of physical health, psychological, level of independence, social relationships, relationship with the environment, and spirituality.

Physical health domain

Participants mentioned that physical activity influences the well-being of the body and optimal functioning of the organism. They expressed seeing physical activity as a lifestyle rather than as an isolated practice, which provides them with well-being and personal pride. They highlighted that the Recreovía made it possible to maintain and reinforce physical activity routines during the COVID- 19 pandemic.

Instructors also recognized the preventive role of physical activity among older adults:

> *"Losing movement in an older person is basically condemning them to sedentarism, obesity, and non-transmissible morbidity. For that, I say at all precision the everlasting youth secret is exercise, maintaining and developing muscles with physical activity"*

Additional participant quotes within this domain are presented in Table 3.

Levels of independence domain: The Recreovía makes it easier for the participants to discover that they are independent beings, who can fend for themselves, moving from one place to another, performing routine and physical activities without the help of third parties. Participants highlighted the value of independent mobility. For example, a participant declared:

> *"That satisfaction (for independence) and that joy is always achieved in your daily activities, not only at work or study, in all aspects of life that are presented to you."*

Through regular participation in the Recreovía, participants realized they could move around on their own and performing routine and physical activities without assistance from others.

> *"It brings joy and peace of mind to be able to move from one place to another, to feel that your joints are functioning well, that you're maintaining them—your balance, your mobility—and that you feel good. I believe we need to listen to our bodies through physical activity."*

Relationship with the environment domain

The interviews revealed that the physical and social environment plays a key role in participants' quality of life. Participants emphasized that settings like the Recreovía encourage both physical activity and social interaction. Reflecting on the pandemic-related quarantine, many highlighted the importance of continuing physical activity at home, even though they preferred outdoor environments. One participant shared:

> *"That was a long period of confinement, and nothing you can do at home makes up for being used to going out, feeling the sun, the air, and seeing people."*

Additionally, participants recognized that the characteristics of public spaces—such as safety, accessibility, and atmosphere—are important for enabling older adults to engage in physical activity. A selection of quotes illustrating these findings is presented in Table 3.

Table 3 Integration of quantitative and qualitative results according to healthy aging outcomes

Healthy aging outcomes	Quantitative component		Qualitative component			Integration of findings	
	Quantitative measure	Quantitative result	Qualitative topics	Description	Quote	Merged interpretation	Conclusions
Quality of life	**QoL Survey—subscale Physical health**[a]	In all the cases, the scores were ≥ 60, related to good/satisfactory quality of life. There were no statistically significant differences in the physical health domain in indoor (67.05 ± 16.87) vs. outdoor (73.06 ± 13.66) settings ($p = 0.145$)	Physical health	Physical activity was conveyed as a lifestyle which provides older adults with well-being and personal pride	"For each movement that I do is one less pill, one less medicine. For each lap that I take or for each step that I do daily when I do my activities."/"I think that the most important thing in feeding the Spirit is breathing, physical activity, water and a good sleep."(Participant, 75 years-old)	Convergent	Regardless of the setting (outdoor vs. indoor), the Recreovía program contributes to improving the physical health of older adults, which implies greater well-being, personal pride, and a sense of independence
			Level of independence	The Recreovía is paramount in helping the participants to acknowledge that they are independent beings, who can fend for themselves, performing routine and physical activities without the help of third parties	"It gives joy and tranquility to be able to move from one side to the other, that the joints are fine, that we maintain balance, mobility and feeling good. I think that by doing physical activity we should listen to our body." (Participant, 62 years-old)		
	QoL Survey—subscale Relationship with the environment[a]	Scores were ≥ 60 in both cases with higher quality of life in the environment domain on Sunday (67.75 ± 13.58) vs. weekdays (60.28 ± 10.92) ($p = 0.019$)	Relationship with the environment	They mentioned the positive impact of the Recreovía and other environments that encourage physical activity and allow enjoying public spaces	"I have been doing physical activities for 12 years, I started going to Recreovía and later I liked jogging outdoors. I have been finding a taste for more things along the way, walks, getting to know parks, wetlands and climbing the hills." (Participant, 62 years-old)	Convergent	Environments that favor outdoor physical activity generate greater satisfaction in older adults, such as Sundays
		Scores were ≥ 60 in both cases. There were no statistically significant differences in quality of life in the environment domain in indoor (67.64 ± 17.54) vs. outdoor (63.82 ± 12.72) settings ($p = 0.301$)		In relation to the pandemics' quarantine, the participants mentioned the negative impact of not being outdoor physical activity	"I couldn't stand the time locked up anymore, it affects a lot when one is used to going out. I was at home, and I exercised, but it never made up for the open field where I am used to being, so I was affected in my spaces." (Participant, 75 years-old)	Complementary	Although during the pandemic participants may feel safer doing physical activity indoors, it is still important to enjoy and engage in outdoor physical activity

Table 3 (continued)

Healthy aging outcomes	Quantitative component		Qualitative component			Integration of findings	
	Quantitative measure	Quantitative result	Qualitative topics	Description	Quote	Merged interpretation	Conclusions
Mental health	**SRQ**[b]	In all cases, the SRQ scores were less than 7, which shows that the participants do not present emotional pain. Indoor (4.30 ± 5.00) vs. outdoor (2.76 ± 3.31) settings had no statistically significant differences ($p = 0.255$)	Psychological domain	The positive impact of physical activity on identity, self-esteem, emotions, and mental health was underscored	"That thing (physical activity) kind of keeps you psychologically and mentally, it feeds you. There will always be someone who criticizes and makes fun of you, but if your mind is up high and you're doing what you like, the rest pass by." (Participant, 75 years-old)	Convergent	Regardless of the configuration of physical activity, participants agree that physical activity promotes mental health and psychological well-being
Social relationships	**Social support scale**[c]	There were no statistically significant differences in score for social support for exercise behavior in the indoor (40.77 ±11.94) vs. outdoor (38.44 ±8.64) settings ($p = 0.486$)	Social relationships	The participants described the social relationships with peers, instructors, and family that they have formed from their regular practice of physical activity. The participants have weaved friendship relationships with peers that cover not only issues related to physical activity but also other leisure activities	"We had a group called little mermaids, who also met in other places to drink red wine, chat, have lunch, to build friendship, because we weren't even of the same religion, nor of the same job." (Participant, 60 years-old)	Complementary	Regardless of the configuration of physical activity, participants report having social relationships with families, friends and new people who support practice of physical activity
	Social network analysis	There was no statistical evidence of a tendency to associate with any particular age group in the 3 scenarios. Nearly 52% to 43% of the connections were found to be between the participants aged over 60 and those under 60	Social relationships	The participants reported that Recreovía promotes intergenerational relationships in which they can interchange lessons, care, and support	"They (in the Recreovía program) are inclusive; they do not restrict the activities only for adults, or only for children, no! The family gets integrated many times. Sometimes I get to exercise with my grandchildren"(Participant, 60 years-old)/"Well, apart from going to the park, I go out with my friends. I really like to share with my friends -who are older than me-. I like to be able to help them with activities of strengthening their joints safely where we can share and be safe."(Participant, 62 years-old)	Convergent	Environments that favor outdoor physical activity such as Sunday can promote the intergenerational relationship between participants and age-related support

[a] World Health Organization Quality of Life Questionnaire (WHOQOL) [18]

[b] Self-reporting Questionnaire (SRQ) [21]

[c] Sallis social support for exercise scale [22]

Psychological domain

participants underscored the positive impact of physical activity on identity, self-esteem, emotions, and mental health. Mainly, the participants mentioned that Recreovía strengthens their life satisfaction because of the influence it has on their self-esteem and motivation. To illustrate these results, a participant stated:

> *"It motivates me a lot those days when I have to go to the park with the teachers whom everybody knows well. Because you have that integration and share it every time, and takes it every day when one participates to become a very upright person."*

An additional quote illustrating these findings is presented in Table 3.

Social relationship domain

participants described the social relationships with peers, instructors, and family that they have formed in the context of their attendance to the Recreovía. The participants have weaved friendship relationships with peers that cover not only issues related to physical activity but also leisure issues where they are in extra-sports places. A participant described this in the following quote:

> *"You meet a girl [slang for women of the same age], and then you meet the other one, you do exercises one day, and then one of you suddenly becomes like a few friends, like we share, like at school."*

They have also forged friendly relationships with instructors that allow a better enjoyment of the Recreovía activities and positively impacts the commitment of the participants to attend the program. The methods of the instructors strengthen family support and make relationships with relatives has a fundamental role in terms of motivation and accompaniment of the older adults in Recreovía. An additional quote illustrating these findings is presented in Table 3.

Spiritual domain

Participants mentioned various aspects of their personal spiritual or religious beliefs that were influenced by physical activity and contributed to their overall quality of life. Both participants and instructors expressed that engaging in physical activity served as a way to nurture the spirit.

One participant shared:

> *"I think the most important things for feeding the spirit are breathing, physical activity, drinking water, and sleeping well"*

Another added:

> *"I definitely believe physical activity is the best remedy for the body, the mind, and the soul. We exercise in the park following all safety protocols. Nothing has been taken away from the classes—they're still the same. The only difference is that we're no longer crowded in front of the stage."*

Integration

The integration of quantitative and qualitative data allowed us to understand the potential impact of Recreovía program in each of the healthy-aging-related outcomes for the studied population. Table 3 presents in detail the common topics of the qualitative and quantitative components where findings were convergent, divergent, or complementary.

Regarding the quality of life, in the physical health domain the results were convergent and in the relationship with the environment subdomain the results were convergent and complementary supporting that the Recreovía program improved physical health and well-being, especially in environments that favor outdoor physical activity. Regarding mental health, the result was convergent, illustrating the positive impact of facilitating physical activity on the mental health of older adults, independent of the configuration (indoor vs. outdoor). Finally, regarding social relationships the results were complementary for Sallis' social support for exercise scale and convergent with the social network analysis where the Recreovía program promotes contact with different people from varying age groups who support physical activity in older adults.

Discussion

This study describes healthy-aging-related outcomes using a mixed methods approach to analyze the quality of life, mental health, and social relationships among older people who attended the Recreovía, a community-based physical activity program in Bogotá, during COVID- 19 pandemic. Participants highlighted that engaging in the Recreovía was an important factor associated with their quality of life, in fact, some reported having joined the Recreovía to prevent mental symptoms during the quarantine in March of 2020. Our results showed that most Recreovía participants have low symptoms of anxiety and depression and partake in intergenerational relationships. Overall, the results indicate that older adults find it valuable to engage in a community-based physical activity program that takes place in both indoor and outdoor settings, as it offers them the opportunity to maintain physical, mental, and social health and activity on a regular basis. These results are relevant in the context of Latin

America, where mental health symptoms, social determinants of health (e.g., isolation, socioeconomic status, education), and physical activity are more pronounced risk factors affecting cognition and functional ability, and thus, healthy aging [41].

In line with the healthy aging literature, our results support the importance of promoting public strategies that address multiple aging risks simultaneously, thereby fostering social networks and healthy, active lifestyles [42]. This study contributes to understanding how community-based physical activity programs promote healthy aging in low LMICs. Previous literature has reported that physical activity positively impacts the aging process through at least three mechanisms. First, improving mobility, cognition, and independent functioning, [8, 43]. Second, preventing conditions that hinder healthy aging including falls, osteoporosis, sarcopenia, and controlling non-communicable diseases [8]. Third, participating in community-based physical activity has been associated with quality of life and positive psychological outcomes, which maintain the ability to learn and make decisions [43]. As a novel result, this study identified that community-based physical activity also benefits social engagement among older adults, enhancing their ability to maintain relationships and contribute to society. This adds to the evidence on how community-based physical activity interventions contribute to creating age-friendly communities that interact and maintain the functional ability that enables well-being in older age [6]. Therefore, integrating such programs into public health strategies could play a crucial role in promoting healthy aging and fostering inclusive communities.

Social connections have repeatedly been considered an important feature of healthy aging [44], and intergenerational programs have shown to be effective instruments to counteract social isolation and to increase older adults' social engagement [45, 46]. Social support from intergenerational relationships can provide a sense of belonging, purpose, and emotional fulfillment, which can reduce stress and anxiety levels in older adults [47]. Our study is the first to identify intergenerational relationships as a healthy aging outcome related to community-based physical activity participation. The social network analysis in this study shows that the Recreovía can be a space that promotes intergenerational interactions. In both the weekday and Sunday outdoor settings, relationships between older adults and those under 60 years of age predominated. Although connections between older adults are higher in indoor settings, connections between older adults and those under 60 still represent approximately 40% of all connections. The intergenerational connections among Recreovía participants in various settings support findings from other contexts regarding the population's interest in projects that promote intergenerational relationships, which offer diverse benefits to each community [14, 48]. Moreover, a growing number of studies have explored potential pathways mediating the relationship between neighborhood environments and health outcomes, yielding varied results across factors such as physical activity, social integration, and support [49]. For instance, Zhang et al. (2021) identified social networks as a significant mediator in the link between transportation terminals and self-rated health [50]. These insights underscore the importance of fostering intergenerational connections and supportive neighborhood environments to enhance overall community well-being.

The most relevant risk factors for healthy aging (cognition and functional ability) in Latin America are related to social and health disparities, unlike in other regions where classical risk factors such as age and sex play a more substantial role [41]. Therefore, the results of this study offer important recommendations to meet the needs of older adults and develop context-relevant healthy aging strategies that consider the interactions of multiple risk factors (e.g., mental health symptoms, isolation, physical activity). Implementing these strategies can help address the unique challenges faced by older adults in Latin America, promoting a more equitable and supportive environment for healthy aging.

First, raising awareness on physical activity, outdoor environments, and intergenerational relationships as aspects that can enable physical, and cognitive functioning is key to building adequate healthy aging policy and services. Second, community-based and age-friendly physical activity programs can play an important role in fostering the social networking of older adults, specially, intergenerational relationships which provide opportunities for cognitive stimulation and learning [47]. Additionally, investing in neighborhood infrastructure based on evidence can enhance health, alleviate health inequalities, and enhance the overall quality of life whilst aging. Strengthening efforts in knowledge translation can effectively incorporate this research into policymaking and community interventions [49]. Third, resilient community-based programs that can adapt to extraordinary moments can help people adapt and maintain the functional abilities that enable wellbeing and good quality of life. Future studies should consider a mixed-methods approach to further understand the benefits of the emerging intergenerational relationships in physical activity programs.

Strengths and limitations

In this study, it is important to highlight the limited sample size, which constrains the generalizability of results to a city-wide level. Additionally, it's crucial to note that

the study took place during the COVID- 19 pandemic, making the findings particularly relevant in the context of crisis scenarios. This information contributes to the development of improved strategies for healthy aging. Nevertheless, the results of our study offer valuable insights into healthy aging within a LMIC setting. Moreover, given the cross-sectional nature of the study, causality is not assessed. However, the comprehensive mixed methods design enables a more thorough analysis within the confines of the cross-sectional framework.

Conclusions

Outdoor spaces that encourage physical activity and allow free socialization could play an important role in maintaining the independent functioning, mental health, and quality of life of older adults. Community-based physical activity may not only benefit the well-being of older adults but also enhance their social engagement, enabling them to maintain relationships and play a meaningful role in society. Furthermore, such initiatives can foster intergenerational connections, reduce social isolation, and create more inclusive communities. By prioritizing the development and support of these spaces and programs, policymakers and community leaders can significantly contribute to the overall health and well-being of the aging population.

Abbreviations

LMICs	Low- and Middle-Income Countries
WHO	World Health Organization
QoL	Quality of Life
WHOQOL	World Health Organization Quality of Life Questionnaire
SRQ	Self-reporting Questionnaire
IDRD	Instituto Distrital de Recreación y Deporte (District Institute for Sports and Recreation, Bogotá, Colombia)
NVivo	Qualitative data analysis software by QSR International
DANE	Departamento Administrativo Nacional de Estadística (National Administrative Department of Statistics, Colombia)
COVID- 19	Coronavirus Disease 2019
Cronbach's α	Cronbach's Alpha (measure of reliability)

Supplementary Information

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Supplementary Material 1: Social Network Questionnaire (English translation from Spanish).

Supplementary Material 2: Interview Guide (English translation from Spanish).

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Authors' contributions

N.WG. led the quantitative and contributed to qualitative data analysis, data triangulation, tables 1 and 2 and led drafting of the manuscript. S.A.G. contributed to the data collection, conceptualization, methodology, validation, and drafting of the original manuscript. M.A.R. contributed to the conceptualization, methodology, validation, Table 2 and drafting of the original manuscript. O.L.S. and D.A. contributed to the conceptualization, quantitative and qualitative data analysis, drafting and critical revision of the manuscript. S.SF. led data collection and qualitative analysis, supported the integration and interpretation of mental health instruments, and contributed to drafting the manuscript. L.PP. contributed to the quantitative data analysis, reliability assessment, Table 2 and drafting of the manuscript. M.B. led the social network analysis, Fig. 1, including its interpretation, and drafting of the original manuscript. J.S.AP. led the quantitative data analysis and contributed to drafting the results and discussion sections. N.O. led the collection and analysis of qualitative data, supported data triangulation, and contributed to drafting the results and discussion sections. G.V. contributed to the conceptualization and analysis of the social network data, Fig. 1 and supported the writing and interpretation of results. D.S. contributed to the literature review, drafting of the manuscript, and critical revision of the final submission. All authors reviewed the manuscript.

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Data availability

The datasets used and/or analyzed during the current study may be available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was granted from the Research Ethics Committee of the Universidad de los Andes (No. 1250—October 21 st, 2020). This Committee is governed by Resolution 8430 of October 4 th, 1993, issued by the Colombian Ministry of Health, which establishes the scientific, technical, and administrative standards for health research adhering to the principles of the World Medical Assembly outlined in the Declaration of Helsinki of 1964, last revised in 2000 as well as the Code of Federal Regulations, Title 45, Part 46, for the protection of human subjects, from the Department of Health and Human Services of the National Institutes of Health of the United States (June 18 th, 1991). All study participants provided written informed consent prior to participating in this study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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