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Open gyms and physical activity in a university setting: A mixed-methods study from Varanasi, India

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Abstract

Background The prevalence of physical inactivity in India is estimated to be 34%; the highest prevalence in South Asian countries. Physical inactivity has increased the risk of non-communicable diseases among urban Indians. Built environment interventions that aim to enhance physical activity have gained popularity in recent years. The construction of outdoor gymnasiums (hereafter referred to as OGs) in green spaces is one such intervention. The installation of OGs on university campuses is a novel concept. The present study was designed to explore the usage of OGs and the perceptions of the users about OGs in a public university setting.

Methods A sequential mixed-methods study design was used to inform this two-fold study. In the first phase (Quantitative), four OGs (i.e. OG-A, OG-B, OG-C, OG-D) were observed between 6.00 am and 8.00 pm for one week per month from December 2022 to March 2023 which corresponds to winter and spring time in Varanasi, India. In the second phase (Qualitative), face-to-face, semi-structured in-depth interviews ($N=66$) with a purposive sample of (OG) users were conducted in Hindi. Descriptive statistics and thematic analysis were used to analyze quantitative and qualitative data respectively.

Results Observational data revealed that the OGs were more frequently used during spring as compared to winter. OG-C emerged as the most popular gym across the four-month period as it hosted the highest number of users ($N=3384$) followed by OG-D ($N=2380$), OG-B ($N=2004$), and OG-A ($N=792$). Another major observation was that OGs were more likely to be used by males than females. OGs were more crowded over weekends than weekdays. The thematic analysis of qualitative interview data revealed three main themes and associated sub-themes: (i) Perceived benefits associated with the use of OGs (physical and mental health benefits, proximity to nature, opportunity to socialize, safe environment, economical, ease of access for everyone); (ii) Perceived challenges associated with the use of OGs (lack of time, overcrowding, damaged equipment, laziness); (iii) Feedback for improvement of OGs (regular maintenance of gym equipment, installation of more equipment, installation of drinking water stations and restrooms).

Conclusions The emerging findings recognize OGs as viable built environment interventions that encourage people to embrace physical activity. The OGs not only contribute to the revitalization of open green spaces in university

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campuses where they are installed but also play a significant role towards the fulfilment of social responsibility of educational institutions.

Keywords Open gyms, Mixed-methods, India, Physical activity

Background

Physical activity has positive effects on health, functioning, and well-being [1–3]. For example, physical activity is associated with reduced risk of heart disease, diabetes, hypertension, and certain forms of cancer including breast and colon [1, 4, 5]. In addition, physical activity is known to delay the onset of dementia, reduces anxiety, stress, and depression, and assists in weight maintenance [1, 3, 6]. Despite these numerous health benefits, many Indians particularly the urban population fail to adhere to the recommended level of physical activity needed to maintain optimum health and well-being [7–9]. This is well reflected in the data emerging from the India's largest study on physical activity wherein 54.4% ($n = 14277$) of the sample aged ≥ 20 years were found to be inactive [8] and the urban participants (65%) were less active than their rural (50%) counterparts [8]. Moreover, the prevalence of physical inactivity in India is estimated to be 34%; the highest prevalence in South Asian countries [3], posing a severe threat to public health and economic productivity of the nation. In light of the above, the promotion of physical activity among sedentary Indians through effective interventions should be a top public health priority.

Physical activity interventions are conventionally focused on individual factors (i.e., self-efficacy, habit strength, sense of well-being) and social factors (i.e., peer support, spousal support) to increase physical activity [10–12]. However, emerging empirical evidence suggests that physical activity is affected by multiple factors including individual, social, and environmental factors [10, 13–16]. Based on the social ecological approach, the adoption of physical activity behaviors is a result of individuals' interactions with their social and physical environments [13, 17, 18].

In recent years, built environment interventions have emerged as a promising public health initiative to increase physical activity participation and maintenance. Examples include outdoor/open gymnasiums (OGs) which are physical activity infrastructures built in natural landscapes (e.g. public parks) consisting of a variety of weather-resistant exercise machines or exercise stations which assists in enhancing physical activity participation in the general public [19–21]. A systematic review suggests that OGs offer free exercise facilities for the public such as equipment that foster aerobics, balance, muscle-strengthening, muscle-flexibility [21]. The review also highlighted that OGs have been effective in reducing weight, enhancing mental health and social connectedness among users [21]. However, majority of the studies on OGs have been conducted in developed countries like Australia [20], the USA [22] and Canada [23] which may not be applicable in the context of a developing country like India. Moreover, empirical evidence on OGs in university settings is sparse.

During the last decade, the concept of "Healthy University" has gained prominence with the aim of cultivating health and wellbeing of the university population [24] through environment-level interventions [25] including university gyms. These have the potential to help university staff and students to be active and minimize feelings of isolation and lack of control among the university population [24]. Besides promoting healthy and active lifestyles, university gyms can also be viewed as a contribution towards corporate social responsibility (CSR) activities implemented by a university for the benefit of its stakeholders [26]. Indeed, it is vital that a university practices good CSR [26] by promoting ecological, environmental commitment for local and global sustainable development [27].

OGs in university settings can improve the quality of life of the university populations including students, academicians, and administrative staff as well as of the local community and society at large. With this purpose, four OGs were installed in a public university (Banaras Hindu University) where the present study has been conducted to cater to the university staff and students as well as the general public. This public university is not a gated campus and therefore members of the general community have full access to the newly constructed OGs throughout the year.

This novel university public health initiative provides an opportunity to explore the views of the university population and of the general public on the effectiveness of OGs in a university setting. Additionally, insights of students and university employees regarding university gyms are underrepresented in the literature [21, 24]. Furthermore, this study highlights the social contribution of the university towards the community members both within as well as outside the university. The study findings have the potential to inform the knowledge base for OG interventions as sustainable and effective built environmental infrastructures and subsequently assist in the design of future physical activity interventions.

Methods

A sequential mixed-methods design [28, 29] was used to guide data collection and analysis as it involved generation of numerical data and non-numerical data through observations and interviews respectively [28]. The study consisted of two phases: Phase I (Quantitative) was observation of four OGs while Phase II (Qualitative) comprised semi-structured interviews with a purposeful sample of OG users. Implementation of both quantitative and qualitative research techniques offers a thorough insight into a topic which has little prior evidence to inform future research [28–30]. Moreover, this combined approach could uncover findings that might be missed through utilizing only a single technique [28, 29]. Both the phases of this study received ethical approval from the Institutional Ethical Committee of Institute of Medical Sciences, Banaras Hindu University (Dean/EC/7201).

The four OGs analyzed in this manuscript are built in open areas within the Banaras Hindu University, Varanasi, India (Fig. 1). Varanasi enjoys the title of being the world's oldest city and is also known as the spiritual capital of India attracting both national and international tourists. Banaras Hindu University is the largest residential public university in Asia with 66 hostels for students (41 for boys, 21 for girls and 4 for international students) and approximately 1500 residential quarters for teaching as well as non-teaching staff. The university is open to the public throughout the year as it hosts two super-speciality government hospitals and several tourist attractions including the Birla Temple, and Bharat Kala Bhavan (i.e., Museum). As per university records, the campus recorded an average footfall of 55,000 per day in 2023.

The first OG, OG-A (Fig. 2) is placed within Mahila Mahavidyalaya (MMV), an exclusive campus for female students within the university campus, where entry of male students is restricted. OG-A comprises of 10 machines which can be used by 17 individuals at the same time (Table 1). Out of these 10 machines, five are for stretching (e.g. Rowing machine), whereas the others are for strengthening muscles (e.g. Horse rider) or for aerobics (e.g. Elliptical machine). The second OG, OG-B (Fig. 3) is situated adjacent to the International Hostels and comprises of nine machines which allow 16 users to simultaneously practice the same three forms of physical activity as highlighted in OG-A. The third OG, OG-C (Fig. 4) is located at the intersection of two Men's Hostels. It includes 10 machines of which two machines seek to strengthen muscles (e.g. Aero rider), five machines are for stretching (e.g. Shoulder wheel), and three machines are for aerobic exercise (e.g. Air walker). These facilities

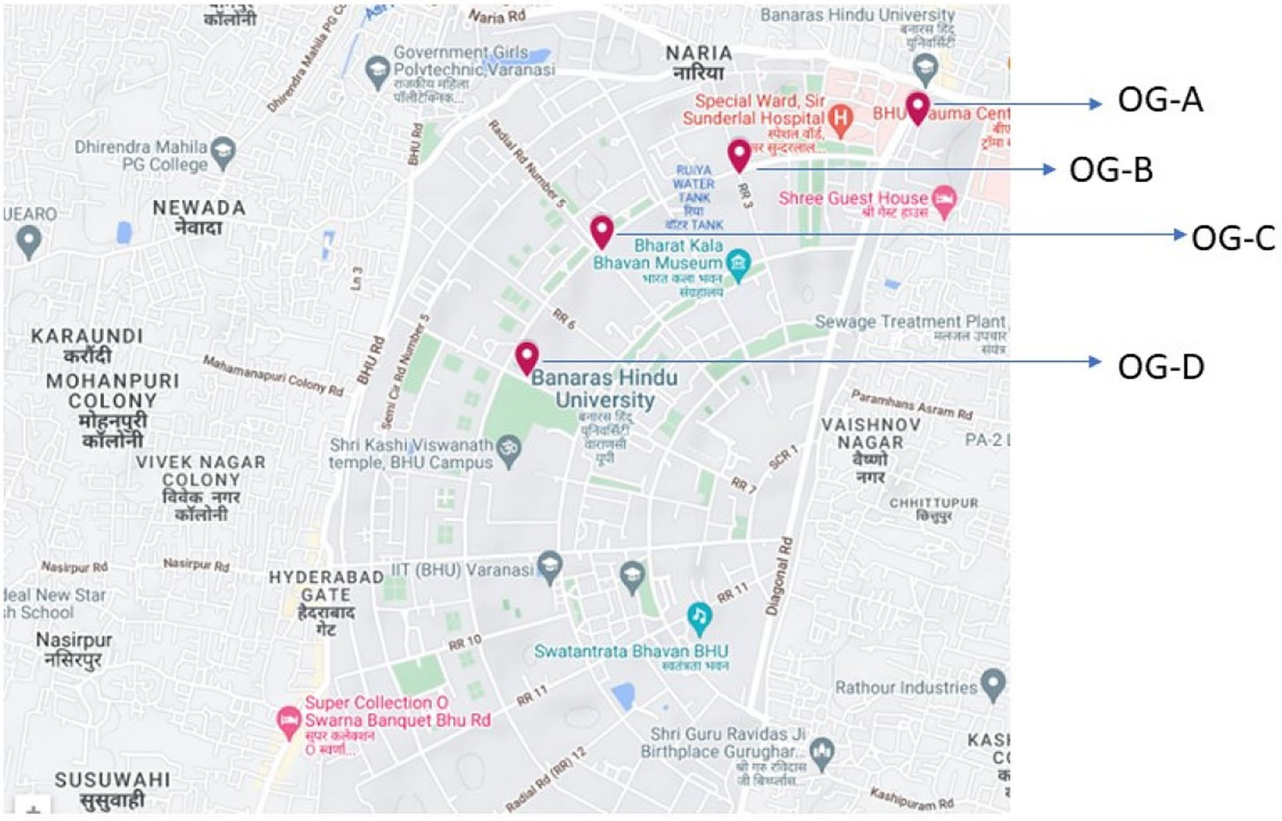

Fig. 1 The four OGs in Banaras Hindu University

Fig. 2 OG-A

Fig. 3 OG-B

at OG-C can be used by 18 individuals at one time. The fourth OG, OG-D (Fig. 5) is adjacent to the University Student Health Centre and comprises of nine machines (e.g. Double cross walker – aerobics; Back shoulder press – muscular; Monkey bar equipment -stretching) that permit 19 individuals to train at one time. Except OG-A, which can only be accessed by female students and female staff, all other OGs are accessible to users from within the

Table 1 Type and number of machines in four OGs

Name of the machine (Type – Muscular/Aerobics/Stretching)	Full name	Brand	OG-A	OG-B	OG-C	OG-D
Air walker (Aerobics)	GS 147 Air Walker	Grand Slam	1	1	1	0
Double cross walker (Aerobics)	GS 161 Double Cross Walker	Grand Slam	1	1	1	1
Elliptical machine (Aerobics)	GS 160 Elliptical Exerciser	Grand Slam	1	0	0	0
Triple twister (Aerobics)	GS 162 Twister	Grand Slam	1	0	1	1
Weight assisted chest press (Muscular)	GS 107 Chest Press	Grand Slam	0	1	0	1
Sit-up-station (Stretching)	GS 146 Sit Up Twister Arm Wheel	Grand Slam	0	1	1	0
Weight assisted shoulder press (Muscular)	GS 111 Shoulder Press	Grand Slam	0	1	0	0
Leg press (Stretching)	GS 127 Leg Press	Grand Slam	1	1	1	1
Rowing machine (Stretching)	GS Rowing Machine	Grand Slam	1	0	0	0
Shoulder wheel (Stretching)	GS 159 Arm Wheel (Shoulder Wheel)	Grand Slam	1	0	1	0
Horse rider/Air swing (Muscular)	GS 166 Horse Ride Station Air Swing	Grand Slam	1	0	1	0
Push chair/Chest press (Stretching)	GS 137 Pull Chair Push Chair	Grand Slam	1	1	1	0
Pull chair/Shoulder press (Stretching)	GS 104 Double Pull Chair	Grand Slam	1	1	1	0
Scaling ladder (Aerobics)	GS 135 Monkey Bar	Grand Slam	0	1	0	0
Single pendulum / Aero rider (Muscular)	GS 163 Air Swing	Grand Slam	0	0	1	0
Leg rise tower (Stretching)	GS 125 Dips Chin Ups Pull Ups	Grand Slam	0	0	0	1
Monkey bar equipment (Stretching)	GS 135 Monkey Bar	Grand Slam	0	0	0	1
Strength training (Muscular)	GS 126 Smith Machine	Grand Slam	0	0	0	1
Seated arm machine (Muscular)	GS 105 Seated Chest Press	Grand Slam	0	0	0	1
Back shoulder press (Muscular)	GS 111 Shoulder Press	Grand Slam	0	0	0	1
Total			**10**	**9**	**10**	**9**

Fig. 4 OG-C

Fig. 5 OG-D

university campus as well as to the general public irrespective of gender. Except OG-A which is located in a gated female only campus, the remaining three OGs are built on Semi Circle Road 4 (i.e., SCR4) and are separated by sports ground. The OGs are accessible to the outside population (i.e. civilians residing outside the university campus). Several outsiders from the surrounding areas visit the campus on a daily basis for walking and running in the university playgrounds whereas university students pass by the OGs while commuting between their hostels and lecture theatres, thus making them more likely to use the OGs facilities.

Phase I: Observation

In this phase, four researchers (BY: OG-A; NR: OG-B; AP: OG-C; UP: OG-D) observed the four OGs between 6.00 am and 8.00 pm for seven days in the third week of each month starting from December 2022 to March 2023 which corresponds to winter and spring time in Varanasi. There are significant differences between winter and spring in Varanasi wherein mean maximum and minimum temperatures in winter (December and January) are 22 °C and 10 °C respectively whereas in spring these values rise to around 31 °C (High) and 15 °C (Low). During the third week of each month, all the four OGs were observed during four time slots: Slot 1–6.30 am – 8.30 am; Slot 2–11.00 am – 1.00 pm; Slot 3–3.00 pm – 5.00 pm; Slot 4 – 6.30 pm – 8.30 pm. These four slots were predetermined during the training session undertaken by the four observers. The first author (LV) offered a ten-day training program to the four observers which involved observing and recording the data, manual counting through tally counting method and recording the data on spreadsheets. During the course of the training, the observers noted that peak hours for OG usage occurred in the morning and noon, while students and staff visiting the university playgrounds also used the OG facilities in the evening and night. In the light of these observations, all the four observers collected data during allotted time slots by being physically present at the OGs and counting the numbers of OG users during that period without disturbing their exercise schedule. Collected information was recorded on inventory daily at the end of each time slot (four times a day). Mean scores of the users over the weekdays (i.e., total number of users from Monday to Friday / 5) and weekend (i.e., total number of users on Saturday and Sunday/ 2) were calculated using Excel program to observe the trends of weekday and weekend for both males and females.

Phase II: Interviews

Following Phase I, purposive sampling was employed to recruit participants for Phase II: Interviews. To be eligible, participants had to be more than 18 years old,

exercise at one of the four OGs, and be current residents of Varanasi city. Children and adolescents under the age of 18 years as well as individuals with a history of injuries were excluded from the study. NR approached the participants in person during their visit to the OG for exercise and requested them to participate in the inquiry. If the participant showed interest, then he/she was provided with a plain language statement and consent before the commencement of the interview. Participation was voluntary and no compensation was offered to the research participants for their contribution.

Four open-ended questions (Table 2) were designed to capture participants' perceptions about OG and its utility. The questions were pilot tested with five participants (3 students, 1 staff member and 1 outsider) to verify the readability of the questions. Hitherto, researchers have recommended the use of 2–5 participants for pilot interviews in the context of qualitative research [31–34] thus validating the execution of five pilot interviews in the present study. No amendments were made and subsequently the pilot data was merged with the final interview data set. NR, a trained qualitative researcher conducted face-to-face interviews (lasting 14–21 min) in Hindi at the field site (i.e., OGs) between August and October 2023. Field notes were taken by UP and the conversations were audio recorded with consent. At the 66th interview, data saturation was achieved and therefore no further interviews were conducted.

All interviews were transcribed verbatim by UP and translated to English by AP. Translated transcripts were further checked by the Interviewer (NR) for accuracy. The inductive thematic analysis and interpretation were executed in six steps as informed by Braun and Clarke [35]. The first step involved repeated reading of the anonymized transcripts to gain familiarity with the raw data. Based on this step, the NVivo 14.0 software program was used to produce preliminary codes from the raw data for each transcript (See Supplementary File). In the third step, the preliminary codes were collated to form potential themes while the fourth step involved reviewing and refinement of the potential themes. In the fifth step, distinct definitions and narrative description for each theme were produced. Finally, the themes were linked to the excerpts from the interviewees, allowing for a comprehensive examination of the interviewee accounts [35–37]. Selected quotes from the participants describing the themes are presented in the Results section.

Table 2 List of open-ended questions

1. How do you perceive this newly constructed OG?
2. What benefits did you get from using the OG?
3. Discuss the challenges you face while using the OG?
4. Would you like to give any feedback about the OG.

All transcripts were primarily coded by NR while AP analyzed 50% of the transcripts to increase reliability and minimize any possible bias arising from personal interpretation of raw data. Any dispute between the two coders (NR, AP) was resolved through discussion and consultation with the senior author (LV). The research team comprised three Masters students of Family and Community Sciences (AP, UP, BY), one senior researcher (LV) specializing in Extension Education and Communication and a postdoctoral fellow (NR) with expertise in qualitative health research.

Results

Phase I: Observation

The observation data revealed that OG-B, OG-C and OG-D witnessed the highest number of users in the early morning slot of 6.30 to 8.30 am in the month of March whereas OG-A was an exception as it witnessed maximum users during the 11.00 to 1.00 slot in March (Table 3). This could be attributed to the fact that OG-A was located near the student canteen and therefore it attracted several female students during the lunch break. Overall, the maximum number of users was observed in the month of March in OG-C. OG-C also emerged as the most popular gym across the four-month period as it hosted the highest number of users ($N = 3384$) followed by OG-D ($N = 2380$), OG-B ($N = 2004$), and OG-A ($N = 792$). The lowest number of users were observed in the month of December in OG-A (Table 4).

Another major observation was that OGs were more likely to be used by males than females (Fig. 6). For example, OG-B hosted only 16% and 12% of female users over weekdays and weekends respectively. It is evident from the mean score of OG users that OGs were more frequently used over the weekend than on weekdays by both male and female users (Fig. 6).

Phase II: Interviews

Sixty-six participants (35 females; 31 males) participated in the interviews whose mean age was 29.15 years (ranging from 19 years to 69 years). Out of the total, 36 participants were students, 27 were outsiders (i.e., neither working nor studying at the university) and the remaining three participants recognized themselves as university staff. Three major themes and the associated sub-themes were identified through thematic analyses of the 66 interviews associated with the use of OGs: (i) Perceived benefits associated with the use of OGs (physical and mental health benefits, proximity to nature, opportunity to socialize, safe environment, economical, and easy access); (ii) Perceived challenges associated with the use of OGs (lack of time, overcrowding, damaged equipment, laziness); (iii) Feedback on improvement of OGs (regular maintenance of gym equipment, installation of more

Table 3 Slot-wise distribution of users across the four OGs

	OG-A				OG-B				OG-C				OG-D			
	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
DECEMBER	26	28	22	35	132	114	111	166	387	89	108	169	131	166	158	129
JANUARY	44	52	25	52	157	89	120	177	330	125	96	101	65	114	136	215
FEBRUARY	52	69	63	54	156	84	60	169	309	204	162	80	133	135	161	262
MARCH	65	78	71	56	185	57	56	171	514	260	225	225	231	23	106	215

S1- SLOT-1: 6.30 am -8.30 am; S2 – SLOT-2: 11.00 am – 1.00 pm; S3 – SLOT-3: 3.00 pm – 5.00 pm; S4 – SLOT-4: 6.30 pm – 8.30 pm

equipment, installation of drinking water stations and restrooms). These themes and sub-themes are described below, and illustrative quotes are presented in Table 5.

Theme 1 – Perceived benefits associated with the use of OGs

Physical and mental health benefits (63/66, 95%)

Unanimously, all the participants discussed the physical and mental health benefits of exercising in the OGs. After using the OG, the participants felt invigorated throughout the day and reported being more productive at work or university. Physical health benefits like weight loss, controlled blood sugar levels, reduced bone pain, relief from flatulence and constipation were frequently cited by the participants.

> *"If the stamina of the body increases then the confidence automatically increases." (P59, F, 22 years, Student).*
>
> *".....I remain active throughout the day and at the same time my husband is also fine, much better than before, there is a lot of improvement in his sugar level." (P64, M, 31 years, Outsider).*
>
> *"After coming here, I got relief from depression, started feeling light, fresh and active throughout the day...It also helped in reducing fatigue & bone pain." (P60, F, 42 years, Outsider).*

Proximity to nature (54/66, 82%)

The participants appreciated the ambience of the OGs. They reported that the OGs brought them closer to nature which was practically impossible in a closed gym environment or home environment. Since the OGs were located within the university campus, the OGs were surrounded by trees and at the same time were far away from the hustle and bustle of the city.

> *"I come to this open gym to enjoy the open environment and cool breeze, which gives me mental satisfaction and energy to a great extent..." (P63, M, 53 years, Staff).*
>
> *"Nowadays, there are a lot of indoor activities in our environment, so I come here with my children to spend some fun time and enjoy the fresh air." (P46, F, 32 years, Outsider).*

Opportunity to socialize (47/66, 71%)

The interviewees mentioned that the OGs gave them the opportunity to interact with peers, make new friends along with active participation in physical activity.

Table 4 Mean usage of the four OGs by months and time slots

	OGs				Months				Time Slots			
	OG-A	OG-B	OG-C	OG-D	DECEMBER	JANUARY	FEBRUARY	MARCH	S1	S2	S3	S4
Mean	49.50	125.25	211.50	148.75	123.18	118.62	134.56	158.62	182.31	105.43	105.00	142.25
SD	17.83	45.45	123.53	61.13	87.52	76.15	76.77	123.86	138.84	63.11	55.10	71.38

"It is a good place to meet friends and spend time together and at the same time also get some exercise." (P46, F, 32 years, Outsider).

"For us, an open gym is a very good means of maintaining our health and recreation for children. Coming here gives them the opportunity to play and talk with other children, which is not possible at home." (P42, M, 35 years, Outsider).

Safe environment (46/66, 70%)

Majority of the OG users noted that they felt safe while exercising on the newly installed OGs as they were located within the university campus. However, few female students raised safety concerns in the presence of male OG users. They further discussed that they avoided using the OGs during late evening and night.

"Since it is located on campus, girls feel safe to exercise here." (P54, M, 29 years, Outsider).

Although it is safe, some girls are afraid of coming here late in the evening or early in the morning, fearing that boys might harass them...."(P9, F, 25 years, Student).

"According to me, it doesn't seem a bit safe for girls." (P22, F, 22 years, Student).

Economical (42/66, 64%)

Besides admiring the green ambience of the OGs, the interviewees also acknowledged the fact that the OGs could be used free of charge. The interviewees noted that this attracted many members of the student community as well as individuals belonging to low and middle socioeconomic strata to the OGs because they were unable to afford the fees of other gyms located outside the university campus.

"Open gyms are very useful for those who cannot afford to pay. Now even poor people can come here and exercise as it is free of cost." (P15, M, 27 years, Student).

" When someone goes to a gym outside, he will have to pay a fee and here you can do it whenever you want and that too for free!!" (P3, M, 23 years, Outsider).

Ease of access for everyone (38/66, 58%)

Another benefit of using the newly constructed OGs discussed by the participants was its accessibility (i.e., it was open for all including university staff, students and general public) as noted by the participants. Besides accessibility, the participants also mentioned that there were no

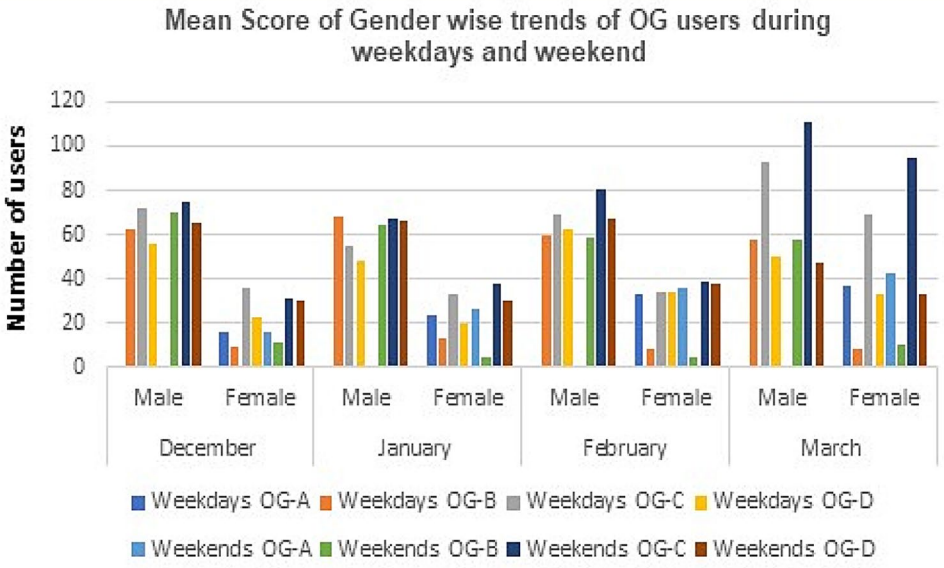

Fig. 6 Mean score of gender wise trends of OG users during weekdays and weekend

time restrictions for accessing the OGs making it convenient for the users.

> *"According to me this is a very good initiative taken by the University as it is open for all. Anybody can avail this facility as per their convenience. There are no restrictions." (P48, M, 36 years, Outsider).*
> *"The best thing about this place is that it is open throughout the day and for everyone." (P41, M, 39 years, Staff).*
> *"In an open gym, we can go anytime. I can do exercise as per my schedule." (P35, F, 19 years, Student).*

Theme 2 – Perceived challenges associated with the use of OGs

Lack of time (61/66, 92%)

Most of the male and female participants perceived lack of time as a major barrier to exercising in the OGs. This lack of time was attributed to hectic academic schedule in case of students while immense workload at office and burden of household chores were often mentioned by outsiders and university staff.

> *"For me the biggest hurdle is time constraints. If there is any household or personal work in the evening then there is a problem…Morning where is the time, I have to go to the office. So, it is quite difficult to take out time for exercise."(P45, M, 45 years, Outsider).*

Overcrowding (34/66, 52%)

The interviewees often cited overcrowding as a major barrier to exercising at the OG. They further noted that OGs witnessed excessive crowds mostly during the peak hours (i.e., evening) as most of the machines were occupied.

> *"It is mostly crowded in the evening and then there are a lot of problems with exercising. Perhaps the number of equipment should be increased so that everyone gets a chance to exercise." (P40, F, 33 years, Outsider).*
> *"I can only think of one obstacle which is overcrowding. When there is a crowd then the trouble starts as the specific equipment required is not available for exercising. All the machines are engaged." (P11, M, 23 years, Student).*

Damaged equipment (30/66, 45%)

Another hindrance to working out at the OG was damaged machines as highlighted during the interviews. The participants lamented that a few machines were not functional and therefore they could not be used as illustrated by the following quote:

> *"Few machines are broken or damaged hence there is some hindrance in using them." (P41, M, 39 years, Staff).*

Laziness (28/66, 42%)

Several interviewees noted that they felt 'lazy' and did not feel motivated to use the OG facilities on a regular basis.

Table 5 Themes associated with the use of OGs

THEMES	SUB-THEMES	QUOTES
Perceived benefits associated with the use of OG	Physical and mental health benefits	*"My body has become very flexible. I have become much fitter and happier than before."* (P55, M, 28 years, Outsider) *"Ever since I have been using OG, I have seen a lot of benefits in myself like a clean stomach, good sleep, sugar maintenance and living a good life even without medicine."* (P44, M, 39 years, Outsider) *"After coming here, I started feeling very good about myself. After exercising I can go back and study comfortably with a fresh mood and then come here again the next day."* (P53, F, 24 years, Outsider)
	Proximity to nature	*"……there are plants and fresh oxygen, I had not seen such a good open gym before."* (P56,M, 28 years, Student) *"Open gym is useful for everyone, and you can say that it is a medium to connect with nature."* (P20, F, 23 years, Student)
	Opportunity to socialize	*"Along with ourselves, children also get exercise, and we also get a chance to spend time together. And here one also gets a family atmosphere like children, old women, everyone feels very good."* (P45, M, 45 years, Outsider) *"……also, one gets time to mingle with other people."* (P44, M, 39 years, Outsider)
	Safe environment	*"I think there should be separate equipment for girls."* (P51, F, 25 years, Student) *"Girls face difficulties when open gyms are crowded, and they feel insecure otherwise it is very safe."* (P16, M, 28 years, Student)
	Economical	*"It is free, so it is a very good initiative taken by the University for middle class families like us."* (P48, M, 36 years, Outsider)
	Ease of access for everyone	*"……anyone can come here and do exercise……."* (P37, M, 31 years, Outsider) *There is no restriction on timing and people from outside can also come and exercise here…… There is no issue, and you do not have to follow any kind of rules or regulations."* (P16, M, 28 years, Student)
Perceived challenges associated with the use of OGs	Lack of time	*"Due to studies, I am not able to get time to come here daily, classes keep going on continuously…."* (P14, M, 25 years, Student)
	Overcrowding	*"When boys from outside come here who are not even students then the machines are not available otherwise there is no problem of any kind."* (P19, M, 24 years, Student)
	Damaged equipment	*"Some machines have defects so it would be better if they are maintained from time to time."* (P7, F, 23 years, Student)
	Laziness	*"After office I am so tired that I just don't like going anywhere. Perhaps, laziness is the biggest barrier to not coming here on a regular basis. However, I try to come on holidays."* (P37, M, 31 years, Outsider)
Feedback on improvement of OGs	Regular maintenance of gym equipment	*"…and it is very important to take care of the equipment from time to time."* (P58, F, 31 years, Outsider) *""Only a little repair of equipment is needed like greasing because the equipment does not move smoothly…."* (P62, F, 32 years, Outsider) *"If the equipment installed here gets repaired from time to time, then there will be no challenges in using it."* (P12, F, 23 years, Student)
	Installation of more equipment	*"There should be some more equipment…….heavy machines like dumbbells and others should be there."* (P55, M, 29 years, Outsider) *"……there is no problem as such, but it would have been better if the machine was a little heavier."*(P57, M, 27 years, Outsider)
	Installation of drinking water stations and restrooms	*"…drinking water facility should be there."* (P4, M, 38 years, Outsider)

"The biggest obstacle is laziness. Sometimes I just feel lazy to come here. I don't like coming here but this is not good as it breaks the routine. If you leave a gap of 2–3 days, it will not be beneficial. " (P2, M, 23 years, Outsider).

"I don't come here every day because I am a bit lazy." (P8, F, 21 years, Student).

Theme 3 – Feedback on improvement of OGs

Regular maintenance of gym equipment (25/66, 38%): The gym users often stressed on regular maintenance (e.g. lubrication) of the machines installed in the OGs to prevent deterioration over time. Some users also highlighted that few machines were not functioning properly because of rusting.

"Maintenance of the equipment is very important in an open gym, if maintenance is not done on a regular basis, then after rains the equipment will get rusted." (P10, M, 23 years, Student).

"....there are some machines here which need repair." (P61, F, 42 years, Outsider).

Installation of more equipment (24/66, 36%)

In the light of overcrowding at the OGs, the participants recommended the installation of more machines so that everyone gets a chance to engage in physical activity.

"Quite often there is a huge crowd here, so some more equipment should be installed so that we do not face problems in exercising." (P36, M, 47 years, Staff).

"The number of machines should be increased so that everyone gets a chance to exercise." (P58, F, 31 years, Outsider).

Installation of drinking water station and restrooms (22/66, 33%)

The participants also talked about building drinking water and sanitary facilities in the OGs.

"There is no obstacle as such. Sometimes I just feel thirsty so there should be a provision of drinking water." (P17, F, 21 years, Student).

Discussion

While most open gymnasium literature has focused on developed economies, the present inquiry has focused on OGs in a public university setting in a developing economy. Key findings were that OGs were more frequently used during spring as compared to winter. OGs hosted a greater number of male users than female users. OGs were more crowded over weekends than weekdays. The OG users reported a number of advantages of exercising at the OGs which included physical and mental health benefits, social connectedness, affordability and ease of access. At the same time, the users talked about the various barriers in using the OGs like laziness, time constraints, overcrowding, and damaged machines. Lastly, the gym users shared some suggestions for betterment of the OGs which included regular maintenance of machines and installation of more machines to combat overcrowding. These findings acknowledge OGs as a viable built environment intervention that supports people to embrace physical activity.

Our observational data revealed that more males compared to females participated in different forms of exercise in the OGs. Comparable gender differences in leisure-time physical activity have been noted in the past [8, 38, 39]. During March (i.e., spring) the OGs reported a higher occupancy rate as compared to the winter months of December and January. This low occupancy in winter could be ascribed to unfavorable weather (i.e., cold winds) as well as a week-long winter break for the students and faculty. Similar variations in OG occupancy were detected between summer and winter months in a Chile-based study of four public OGs [40]. Typically, our OGs saw a higher occupancy over the weekends and morning hours. Parallel observations were reported from Xihu Park in China [41].

The study participants discussed a range of benefits of using OGs. Positive physiological and psychological well-being were one of the most commonly discussed benefits of exercising in the OGs. The participants also reported that they enjoyed exercising in the natural environment. These views complement previous evidence on urban green spaces which suggest that physical activity undertaken in green environments provides more physical and mental health benefits when compared to indoor exercise [42–46].

Another frequently mentioned benefit of training in the OGs was socialization. This corresponds with the findings from a systematic review [21] which highlighted the emergence of the social connectedness theme in four studies. Our OG users also noted that OGs were affordable and accessible to everyone because they were not chargeable like private gyms and were open throughout the day. These views were strongly backed by both qualitative as well as survey data from Canada [23] and Australia [47] respectively. However, the situation in China is a bit different where stadiums and gymnasiums located in Chinese universities provide either free (e.g. outdoor basketball court) or paid services (e.g. tennis court) to the public [48]. Although most of the gym users felt safe and secure while exercising in the OGs, few users,

particularly female users, raised some security concerns regarding training in the presence of male users and during late evening and night. Similar concerns were highlighted by Fernández-Rodríguez and colleagues in their systematic review on characteristics and patterns of use of outdoor gyms [49]. Perhaps, universities could consider enhancing the security (e.g. placement of a female security guard at the OG) of OGs to maximise the use of OG facilities by females during evening and night, thus reducing gender disparity.

Besides sharing the benefits, the interviewees also discussed the challenges encountered by them while using the OGs. Due to overcrowding, our participants were unable to use the facilities of the OGs, a barrier also cited by Australian [50] and Polish [51] outdoor gym users. Echoing the views of Polish users [51], our study participants also lamented about damaged machines and poor maintenance of the OG facilities which hindered physical activity training in the OGs. In the same vein, the maintenance of gym machines was a cause of concern for Chinese universities also [48, 52]. In addition to these environmental barriers, two intrapersonal barriers such as time constraints and laziness were cited during the interviews. Likewise, American [53] and Brazilian adults [54] also complained about lack of time and lack of motivation to participate in recreational physical activity.

To overcome these challenges, the present study participants suggested some areas of improvement to facilitate optimum utilization of OGs. One of the recommendations was the regular maintenance of the gym machines. Again, this is consistent with both local [55] and international evidence [23]. Another suggestion was to install more machines to combat overcrowding. Similarly, Australian users endorsed installation of more outdoor exercise equipment [47]. Finally, the interviewees highlighted the need to install restrooms and drinking fountains on the OG premises. Comparable views were reported during semi-structured interviews conducted with Brazilian older adults [56]. Adequate funding is required to overcome these challenges as well as improve the operations of the OG facilities. Perhaps, universities can either seek funding from the government agencies or generate social capital through Public-Private-Partnership [52]. Additionally, higher educational institutions can also secure funds through university enterprises cooperation including charging fees for sport equipment promotion, securing corporate sponsorship, and transferring naming rights [52].

Strengths of this research article include the use of mixed-methods study design and exploration of the contribution of university-based OGs in health promotion. The positive feedback of the users regarding the OGs in our study potentially ensures transferability to other university settings in the Global South. There are a few limitations which warrant consideration. First, the present data is specific to urban India. Subsequently, this data may not be generalizable to the rural Indian population. Second, gym users could have provided socially laudable responses but again this was minimal as they explicitly discussed the poor maintenance of the exercise machines. Third, the OGs were only observed over winter and spring. In order to gain a more comprehensive view about OG occupancy, the OGs have to be observed throughout the year covering all four seasons. Fourth, the findings of this study could be limited by observer bias. However, the use of multiple observers and the use of interviews helped in minimizing any potential observer bias.

Conclusions

This mixed-methods study contributed to the limited evidence exploring the use of OGs as well as the perceptions of OG users. Overall, this research suggests that creating active environments in a university setting has been successful as users share a number of physical and mental health benefits of using OGs. Considering the rising burden of non-communicable diseases in India, OGs provide a feasible option for enhancing physical activity among sedentary Indians and in future should be scaled up to promote health and wellbeing of both university and general populations across India and in other low and middle-income countries. Besides revitalizing open green spaces in university settings, OGs also facilitate universities in fulfilling their social responsibilities.

Abbreviations

OGs Outdoor Gymnasiums
CSR Corporate Social Responsibility

Supplementary Information

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Supplementary Material 1

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Author contributions

LV and NR conceived the study and its original design. UP, AP, BY, and NR collected the data. LV, UP, AP, BY, and NR analyzed the data. NR drafted the initial form and all revisions of this manuscript. LV, UP, AP, BY, and NR reviewed and approved the final manuscript.

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Data availability
The datasets generated and analyzed during the current study are not publicly available due to University and Ethical Guidelines but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was approved by the Institutional Ethical Committee at the Institute of Medical Sciences, Banaras Hindu University (Dean/EC/7201). The procedures performed were in accordance with the ethical standards of the committee. Organizational consent (Phase I) and written informed consent (Phase II) were obtained from the University and all the respondents respectively before commencement of the study.

Consent for publication
The consent forms were signed on the understanding that data from the study would be used in future publications.

Competing interests
The authors declare no competing interests.

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