

Research Article

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Well-Being and Green Infrastructure in Saudi Arabia-The Resident's Perspective

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ABSTRACT

This study investigated the impacts of green infrastructure (GI) on the physical, mental, and social well-being of residents in Dhahran, Eastern Province, Saudi Arabia. An online questionnaire was administered to 690 participants with data analysis conducted using SPSS. The findings revealed moderately positive relationships between green infrastructure and physical ($r_s = 0.430$), mental ($r_s = 0.418$), and social ($r_s = 0.472$) well-being. Key well-being benefits recognized by participants included improved air quality, increased physical activity, and enhanced relaxation. The frequency of greenspace usage, however, was found to be modest. This study underscores the significance of addressing barriers such as accessibility, amenities, maintenance, and extreme climate, to maximize the potential benefits of green infrastructure. This research offers evidence from a relatively under-researched Middle Eastern context and recommendations for further research, employing longitudinal and experimental designs are made.

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Introduction

Green infrastructure (GI) encompasses a network of natural and semi-natural elements integrated within urban environments, such as parks, gardens, green roofs, and urban forests. This infrastructure serves multifaceted purposes, ranging from environmental conservation to enhancing public health and well-being [1,2]. Defined as an interconnected network of greenspace that conserves natural ecosystems and benefits human populations, green infrastructure contributes significantly to urban sustainability by mitigating climate change impacts, reducing pollution, supporting biodiversity, and fostering community well-being [3,4].

The importance of green infrastructure in promoting urban livability and quality of life has garnered increasing attention worldwide. Research demonstrates that access to green spaces correlates positively with physical and mental health outcomes, social cohesion, and overall satisfaction with one's living environment [5]. Research by Ward Thompson et al. found that spending time in green spaces can lower blood pressure and reduce stress [6]. Moreover, green infrastructure offers economic benefits by enhancing property values and attracting investments [5].

In the context of Saudi Arabia, particularly in Dhahran, Eastern Province, where rapid urbanization and industrialization have been prominent features, the role of green infrastructure in urban development becomes crucial. Dhahran, a strategic center for the Saudi oil sector, has experienced significant growth over the decades, leading to environmental challenges and concerns regarding residents' well-being [7,8].

Against this backdrop, this research aimed to investigate the impacts of local green infrastructure on the physical, mental, and social well-being of residents in this province of Saudi Arabia. Specifically, the study sought to explore residents' perceptions and utilization of existing green infrastructure in the area. It also examines the relationship between residents self-reported wellbeing and access to green spaces and awareness of the Saudi Arabia Vision 2030 and the associated Quality of Life Program. Alongside this, barriers, and opportunities for enhancing green infrastructure and its associated benefits in the city are explored.

Materials and Methods

This research employed a cross-sectional quantitative approach utilizing an online questionnaire survey to investigate the impacts of green infrastructure on the physical, mental, and social well-being of residents in Dhahran, Eastern Province, Saudi Arabia.

Convenience sampling was employed to recruit participants from diverse neighbourhoods across Dhahran. An online questionnaire was distributed via email, social media platforms, and local community forums. This questionnaire was utilised to assess residents' perceptions of, and behaviours linked to, green infrastructure and its impact on well-being.

The questionnaire was comprised of 29 questions, addressing the utilisation of green infrastructure benefits, including a sense of wellbeing as well as barriers to access and opportunities for green space. Participants answered questions on a 5-point Likert scale, which were then classified from a very high level of agreement to a very low level of agreement.

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) software. Descriptive statistics were employed to summarize participants' demographic characteristics. Spearman's rho correlations were conducted to assess the relationships between perceived benefits of green infrastructure and residents' well-being indicators.

Results

Demographics

There were 690 respondents to the survey all from the Dharan area. There were 40.1% male and 59.9% female respondents drawn from a range of age groups, with the largest groups being those aged 55 years and above (29.4%), followed by 45-54 (27.7%) and 35-44 (22%). The majority of respondents were Saudi Arabian (94.8%). A significant proportion of respondents (62.3%) held a bachelor's degree, and the respondents represented a diverse workforce including private sector employees (30.1%), government employees (21.7%) and retirees (29.7%). There were varying lengths of residency, with the majority of respondents having lived in the Dharan area for more than 10 years (85.5%).

Reported Wellbeing of Respondents at Time of Survey

Respondents were asked about their current perceived physical, mental and social wellbeing as part of the survey, in order to provide some further context around their perceptions of the impact of local green space. The majority of participants rated their overall physical well-being as 'average' (34.5%) or 'good' (34.6%) from a five-point scale. Overall mental wellbeing was rated as average (31%) or good (37.7%) with 11.8% of respondents described their mental wellbeing as poor or very poor. The majority of participants rated their own overall current social well-being as average (29.7%) or good (41.2%).

Green Infrastructure and Physical Wellbeing

A large percentage of participants believed green infrastructure improved their physical well-being (68.8%) and may thought that green infrastructure was very important in improving the overall physical well-being of the population in general (76.4%).

However, despite this association with positive physical wellbeing, a large number of the respondents (46.2%) reported visiting green spaces only rarely, with only 31.6% of the participants visiting green spaces at least once a week, and 17.1% of the participants visiting green spaces several times a week. The results show a significant positive relationship between physical wellbeing and green infrastructure (based on spearman's rho correlation coefficient of 0.430** at a significance level of < 0.001).

Green Infrastructure and Mental Wellbeing

The majority of respondents (76.1%) believed that spending time in green spaces positively affected their mental well-being: with only a very small percentage of respondents (0.6%) strongly disagreeing with this positive affect. However, despite this affirmation, a large number of respondents (40.6%), were only rarely engaging with green spaces to help improve their mental well-being, despite the perceived importance of this connection. The results showed a significant positive relationship between Green Infrastructure and peoples mental well-being (based on the calculated Spearman's rho correlation coefficient of 0.418** at a significance level of < 0.001).

Green Infrastructure and Social Wellbeing

60.9% of participants strongly agreed that green infrastructure helped to promote social wellbeing, including interactions and community engagement. The majority of participants (62.0%) thought that green infrastructure was very important for fostering social engagement, with 43.5% observing positive social interactions in green spaces. The results show a significant positive relationship between green infrastructure and people's social well-being (based on the Spearman's rho correlation coefficient of 0.472 at a significance level of < 0.001).

Saudi Arabia Vision 2030 and the Quality-of-Life Programme

73.6% of respondents were familiar with the green infrastructure goals outlined in the Saudi Arabia Vision 2030, and the associated Quality of Life Programme. which showed a good level of awareness and is a sign that these plans had been communicated to the public [Figure-1].

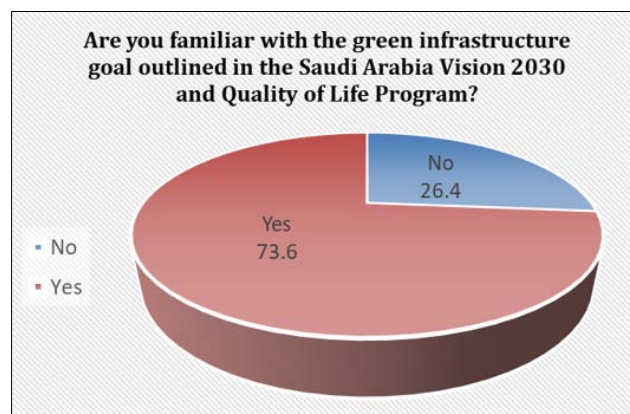


Figure 1: Familiarity with Saudi Vision 2030 Green Infrastructure Goal

The vast majority of respondents (64.2%) strongly agreed that the green infrastructure goal will have a positive impact on the well-being of Dhahran or Eastern Province residents [Figure-2].

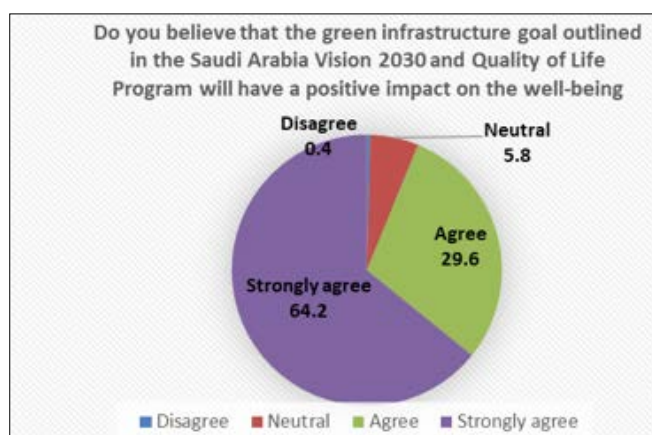


Figure 2: Perceived Impact of Saudi Vision 2030 Green Infrastructure Goals on Well-Being

With respect to progress against the Green Infrastructure goals, findings reflect an overall sense of optimism, with some room for improvement, See table 1:

Table 1: Evaluation of the Current Progress in Terms of Developing Green Infrastructure in Dhahran and the Eastern Province

		n	%
How would you rate the current progress of green infrastructure development in Dhahran or Eastern Province in line with Saudi Arabia Vision 2030 and Quality of Life Programme?	Very poor	16	2.3
	Poor	58	8.4
	Average	185	26.8
	Good	263	38.1
	Excellent	168	24.3
	Total	690	100.0

Recognised Effects of Green Infrastructure on Health and Wellbeing

In terms of the key/top benefits of Green Infrastructure, the top-ranking result was the improvement in air quality this could bring (39.6%) followed by physical activity and stress reduction, see table 2 below:

Table 2: Perceived Benefits of Green Infrastructure for Physical, Mental, and Social Well-being in Dhahran or the Eastern Province

		n	%
In your opinion, which is the top benefit of green infrastructure for physical, mental and social well-being in Dhahran or Eastern Province?	Improved air quality	273	39.6
	Enhanced opportunities for physical activity	201	29.1
	Stress reduction and relaxation	112	16.2
	Increased access to nature and green spaces	69	10.0
	All of the above	27	3.9
	Other	5	.7
	I do not believe green infrastructure has benefits for well-being	3	.4
	Total	690	100.0

The survey also asked about barriers to accessing green space and whilst the majority felt there were no barriers, a significant proportion (38%) of respondents did feel there were barriers. The most commonly mentioned barriers include hot weather, maintenance issues, lack of green spaces in some neighbourhoods, urban planning issues, and long distances to reach green areas.

Discussion

The positive correlations between green infrastructure and well-being among Dhahran residents aligns with studies undertaken by Lee and Maheswaran, 2010; Coutts and Hahn, 2015 and Jabbar et al., 2021, reinforcing the notion that access to green spaces contributes to better health outcomes [5,9,10]. The acknowledgment of the health benefits by participants in this study echoes the growing public awareness of the impact of green infrastructure documented in literature by Barton and Rogerson,

2017 and Chen et al., 2021, and indicates a broader societal recognition of the importance of green infrastructure [11,12].

However, despite this awareness, there is a discrepancy between the perceived importance of green spaces and the relatively low frequency of visits. This highlights a gap between knowledge of the benefits and people's behavior, which is consistent with findings from other urban contexts [13]. This suggests that while residents are recognizing the value of green infrastructure, barriers, such as accessibility or competing priorities for example, may be hindering their utilization. Addressing these barriers is essential to realizing the full potential of green spaces as a health-promoting resource. In particular, whilst integrating green infrastructure into urban planning can serve as an effective population-level intervention in terms of enhancing physical activity and related health indicators, for optimal benefits to be achieved, work is required to address inequalities in green space availability and its utilization across social groups [14,15]. Improving the availability and accessibility of greenspace could be enhanced by applying concepts such as the "15-minute city" [13,16,17].

This study supports the notion that urban green spaces cultivate social ties among neighbours [18]. This echoes other studies, with social engagement and community building being frequently cited motivations for urban greening projects [19]. Urban green spaces provide venues for casual social encounters and organised group activities that strengthen social bonds [20]. By providing communal open space, green infrastructure also facilitates the incidental interactions vital for community cohesion [19,21]. This reinforces the idea that contact with nature is essential to good social health and quality of life [11,12,22]. Whilst creating green spaces may offer a promising population health strategy for enhancing social well-being, again, an inclusive, participatory approach is needed to maximise these benefits [19].

According to Michie et al., behaviour is impacted by three fundamental components: capacity, opportunity, and motivation (COM-B model, 2021) [23]. The positive correlations between green infrastructure and physical, mental, and social well-being found in this study, all indicate that green infrastructure is seen by residents as a positive to their wellbeing. Providing accessible green space helps support individuals' capacity to participate in health-promoting activities and can also facilitates opportunity by offering suitable locations for physical exercise, social engagement, and reflection. In particular, aesthetically pleasing green surroundings can enhance individuals' drive and motivation to participate in health-promoting activities such as physical exercise, recreational pursuits, and community-based initiatives. Overcoming barriers to access is challenging though. Consideration of design that considers provision of green space that works in extreme hot weather is a challenge. Residents also mentioned issues of maintenance of these areas, where will the funding for long term maintenance come from? The residents also mentioned the lack of green spaces in some neighbourhoods, linking to the need to consider existing urban spaces alongside new developments to ensure green space is accessible within a short distance of all, with a planning system that supports this.

Conclusion

Urban greening initiatives are gaining traction in the United Arabs region, with efforts underway in Kuwait and Qatar, and across Saudi Arabia [14,24]. Climate considerations in this region, including high temperatures, highlight the need for tailored greenspace design, requiring contextualised solutions [15,25].

Relevant guidelines such as the Saudi Green Building Code provide a starting point for such work and this research provides some initial evidence regarding the impacts of green infrastructure on residents, specifically in Dhahran [26].

The findings align with previous studies evidencing the multifaceted benefits of nature contact and green spaces with respect to health and well-being [11,25,27]. The participants recognising the benefits of green infrastructure with respect to physical activity, health, mental stability, and social connections. However, some disparities emerged between perceptions of these benefits and frequency of greenspace usage, suggesting that potential barriers exist to the latter.

Recommendations

Further investigation into the mechanisms linking nature exposure to health outcomes is needed to deepen our understanding of the pathways through which green infrastructure influences well-being and in particular, further longitudinal causality studies are vital for establishing links between green space exposure and health indicators. This study highlighted not only the self-reported benefits but certain barriers to accessing green space, highlighting the need for efforts to expand urban green space to ensure equitable access, including for example, more consideration of transportation links, diversity in programme planning and involving communities at planning stage.

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Data Availability Statement

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflicts of Interest

The authors declare no conflicts of interest.

Ethics Declarations

The authors declare no competing interests.

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