The role of public gardens in enhancing diabetic patients' health and wellbeing: the case of Kingdom of Saudi Arabia

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Abstract

Cities in the Kingdom of Saudi Arabia (KSA) have experienced rapid uncontrolled urbanism due to the absence of robust planning measures. This causes lack or ill distributions of facilities and segregation between these facilities and the residences in districts and neighbourhoods across the Kingdom. It also encouraged citizens to adopt unhealthy lifestyles which in turn aggravated their health conditions. This paper discusses the critical relationship between the unhealthy lifestyle of diabetic patients and the proximity of public gardens. A survey on 76 diabetic patients and their living conditions was carried out. A visual and mapping survey was conducted on public gardens and vacant lands around diabetics' homes. The study found that cities in the Eastern province, KSA have unhealthy urban and suburban settings in terms of the proximity and characteristics of public gardens. It is revealed that patients have unhealthier lifestyle and frequent diabetic symptoms when gardens are far away and vacant lands are nearer to their homes. This calls the need for emergent amendment of the present planning regulations for the use of vacant lands and public amenities including public gardens in Saudi cities so they would help improving the physical, psychological and spiritual health of the diabetic patients and the community.

Keywords: diabetes, public garden, health, lifestyle, wellbeing

1. Introduction

Many studies have demonstrated the positive effect of greenery on public health. These have highlighted how the availability, distance and proximity of green areas would improve the social, emotional, psychological aspects of people life. On the other hand, several studies have indicated the adverse impact of vacant lands on people health, particularly people with chronic diseases such as diabetes.

In the past couple decades, and due to urban planning errors, the KSA has experienced quick uncontrolled urbanism and this caused unhealthy built environment conditions including lack or ill distribution of facilities such as gardens and wide spread of vacant lands. This has created unhealthy physical, environmental and social conditions in the KSA's cities thus encouraged citizens to adopt unhealthy lifestyles. Consequently, these conditions have adversely affected people's health and help spreading non communicable diseases such as diabetes.

This study investigates the relationship between public gardens' proximity and indoor and outdoor environmental conditions with the health and wellbeing (i.e. feeling good and functioning well) of diabetic patients who live in the metropolitan area of Dammam-AlKhobar-AlDhahran, Eastern Province, KSA. For the purposes of the study, qualified medical practitioners determined the diabetic patients' physical, social and emotional health. A questionnaire survey and medical exams were carried out on 76 diabetics who usually visit the Teaching Hospital of the University of Dammam, AlKhobar in the Eastern province of KSA. Thus the location of public gardens

and vacant lands around the patients' home (represented by postal codes) were identified using ArcGIS software. The public gardens and vacant lands were visually assessed within the patients' neighbourhoods. The medical conditions of patients, visual survey's results and questionnaire data were all merged into one file and analysed using ANOVA test and Structural Equation Modelling (SEM) techniques. For thorough understanding of the relationship between patients' health conditions and gardens' characteristics, vacant lands were introduced as mediating variables.

The present researchers found significant links between clinical assessment tests, diabetes' symptoms with the proximity of public gardens and vacant lands. The relationship has also been examined from the perspectives of neighbourhood's density and type, the patients' age; and gender and the patients' socio-economic. The results have been reinforced and compared with the previous research highlighting the areas of overlap and variance.

2. Gardens specifications and regulations

In respect to public gardens, it is suggested that everyone should have an access to a natural green space of at least 2 hectares (2 ha= 20000 m^2) in size, no more than 300 metres (5 minutes' walk) from home; and at least one accessible 20 hectares (20 ha= 200000 m^2) site within 2000 m of home [1]. The European Environment Agency (EEA) recommended that people should have access to green space within 15 min walking distance from home [2]. Herzele and Wiedeman [3] indicated standards for urban green spaces. For neighbourhoods, the maximum distance to the park should be 400 m and the minimum size is 1 ha. For quarters, the maximum distance to the green area should be 800 m, and the minimum size is 10 ha, in which the park size is 5 ha. Burnett [4] argued that the 750 metres walking distance to facilities such as public gardens are not specifically designed regarding the needs of the older people. Also, the distance-based measures of access should be refined to include travel constraints, such as physical and psychological barriers to pedestrian movement [5].

3. Lifestyles, environmental conditions, diet and diabetes

Diabetes mellitus is the most common non-communicable disease worldwide and the fourth leading cause of death in developed countries [6]. There are, in general, two types of diabetes. In diabetes type I (T1DM), the body itself has destroyed the insulin-producing beta cells in the pancreas. On the other hand, numerous studies found that unhealthy lifestyles and lack of physical activity is the main cause of many non-communicable diseases as diabetes type II diabetes mellitus (T2DM). Lifestyles would deteriorate the medical conditions of individuals and these habit-persistent practices are imbalances between energy intake (i.e. food consumption) and expenditure (i.e. physical activity), a situation leading to obesity [7]. These lifestyles comprise of poor diet and "bad behaviours", such as smoking, alcohol consumption and lack of physical exercise. Passive entertainment exemplified by television viewing and computer games along with intake of meals; all contribute to disorders of lifestyle [7& 8]. Eckel et al. [9] have linked the lack of physical activity with diabetes. However, recent research found that physical activity is ineffective against obesity without having a healthy diet [10]. Outdoor conditions such as environmental pollution would contribute to the development of T2DM (see for example [11]) and aggravate the complications of the disease such as blindness in adults [12] and non-traumatic lower-limb amputation [13]. Outdoor polluted conditions, particularly during the heat waves, affect the number and function of sweat glands in diabetic patients which reduces the volume and rate of evaporation needed for the body to dissipate heat. This can considerably increase the risk of hyperthermia and heatstroke [14& 15].

3.1. Greenery and health and physical activity

Parks and playgrounds not only provide places where people can engage in physical activity such as walking, but they also can serve as attractive destinations that can persuade people to walk to reach them [16]. Urban green space offers more than opportunities for physical activity; it offers a chance for engagement with and observation of nature, as well as opportunities for social interaction, thus enhancing individuals' sense of well-being [17]. Green spaces however need to be accessible, of sufficient size, and connected to residential areas.

The previous research found that children with more access to parks and recreational facilities are more active than children with less access, and most results for adults are similar [18]. Giles-Corti et al. [19] outlined the importance of attractiveness and size of open space in encouraging physical activity. A series of studies in Perth, Australia found that parks were more likely to encourage physical activity if they were perceived aesthetically pleasing (minor traffic, sidewalks, trees, retail shops) [20]. Parks often serve as sites of physical activity, which is associated with enhanced health and reduced risk for all-cause mortality and many chronic diseases [21]. Park access is significantly related to the development of obesity [22]. In addition, psychological well-being is empirically linked to urban parks and green space [23]. A large number of studies demonstrated linkages between parks' proximity and physical activity [22, 24]. White at el. [25] suggested that individuals who live in urban areas with greater amounts of green space are happier and significantly showing lower mental distress than those who live in areas with less green space.

People with a greener environment within between a 1 km or 3 km radius around their homes have better self-perceived health than people living in an area with less greenery. The relation between green space and health is stronger for people with a lower socioeconomic status (SES) as compared with people with a high SES, and is stronger for youth and elderly compared with adults [26].

Reklaitiene at el. [27] examined links between gender to the usability of the public parks and proximity of these parks. The results confirmed an association between use of the green space, residential proximity, and depressive symptoms and poor to very poor perceived general health among women only. Van den Berg, Maas,Verheij, & Groenewegen [28] showed that respondents with more green space near their homes were less affected by a stressful life event than those with low green space access, suggesting that green space buffers stress. Eckel et al. [9] have linked the lack of physical activity with diabetes.

A park experience has been shown to reduce stress [29]. Park visits can rejuvenate residents, enhance contemplation, and provide a sense of peace and tranquillity [30]. Barton and Pretty [31] for example, conducted a meta-analysis of UK studies, showing that there were significant impacts of green exercise on several measures of mood and self-esteem. Another meta-analysis [32] found linkages between various measures of psychological health and urban green space.

Louv [33] contended that children who lack access to urban green space suffer from a wide range of behavioural problems. The lack of park access has been also linked to mortality. Vulnerable people who tied to locality, elderly people, children, young parents, unemployed people and immobile people may experience a decline to regular daily activity e.g. walking and cycling. This would result in increased obesity and risk of diabetes and cardiovascular diseases [34].

3.2 Impediments to the physical activity

Impediments to physical activity are these that obstruct people from doing their physical activity within their neighbourhoods and cities. In this sense, Clayden et al. [35] argued that segregation of open spaces and residences by streets has made these spaces less accessible and more dangerous for pedestrian movement, and this in turn negatively affects the liveability and general health of residential areas. Subsequently,

vulnerable people who tied to locality, elderly people, children, young parents, unemployed people and immobile people may experience a decline to regular daily activity e.g. walking and cycling [21].

On the other hand, vacant land constitutes a significant economic, environmental, and social problem for many cities, and affects the health and safety of residents. Garvin [36] conducted a survey in Philadelphia, Pennsylvania, USA and the participants in the survey described a neighbourhood physical environment as dominated by decaying abandoned homes and overgrown vacant lots. Vacant land affects community well-being by overshadowing positive aspects of the community, contributing to fractures between neighbours, attracting crime, and making residents fearful [36]. Vacant land was described by respondents as impacting physical health through injury, the build-up of trash, and attraction of rodents, as well as mental health through anxiety and stigma [36]. Living in a rundown unkempt environment has been shown to be related to wellbeing and improvements to vacant sites in the local neighbourhood has been shown to be related to a range of health-related indicators such as reduced stress and levels of vandalism.

The Saudi government has recently applied low tax rate on vacant lands to promote owners to build on their vacant lands. The same tax rate however, is imposed on vacant lands wherever the location is i.e. city, urban or suburban areas. Also, it seems the tax policy seems ineffective as owners found ways to avoid the tax such as transferring the ownership or part of it to close relatives.

3.3. Impediments to the physical exercise in the KSA

In KSA, impediments to the physical exercise would include the following: the living (i.e. physical, social and environmental) conditions, and the proximity of amenities and vacant lands from people's homes.

In KSA, there are a number of housing arrangements such as: gated compounds; terraced housing, villas, blocks of flats, or mixed development. With respect to the unhealthy built environment and individuals' habits in KSA, the following issues are noticed:

- rapid growth of Saudi cities and the absences of healthy and sustainable planning code;
- Residential districts in KSA can be also classified in accordance to the social class. The facilities, finishing quality, level of furnishing and cleanliness varies from one district to another [37];
- These suffer from irregular location of the amenities such as; gardens, parks, leisure and recreation within the neighbourhoods, quarters, and districts [37];
- The gated compounds are usually well fenced and guarded and have facilities that are different in number and quality according to the compound class and also many are inaccessible to the neighbours. So this largely reduces permeability and accessibility of neighbours' access to the compounds' services and facilities and enforces segregation in the urban fabric [38];
- The extreme hot, dry inland and humid weather in coastal cities create environmental conditions that affect the type and timing of people's activities. Thus, Saudis tend to engage in unhealthy activities: such as irregular sleeping patterns (e.g. afternoon nap, sleeping late), evening or late night trips to local malls and shopping arcades or sitting for long hours in coffee shops, late night's heavy meals [38]. These activities replace outdoor activities, such as children's playgrounds and walking children to school. In major cities across the KSA, it was found that the majority of Saudi adolescents spent more than 2 hours watching TV, and around half of them do not meet the daily physical activity requirements;
- Poor living conditions add to these problems and adversely affect the health of all citizens, particularly those with diabetes. Such living conditions make it

difficult for diabetics to enjoy walking around their neighbourhoods due to the extreme hot, dry and humid weather conditions and high level of air pollution within cities [39];

- In Jeddah, problems of poor quality public spaces within modern residential areas seem to beset the public realm. The Jeddah municipality attempted to tackle the lack of public space in this district by acquiring some residual/marginal undeveloped land lots in one of the Jeddah's districts. These land lots are located in heavy traffic and noise area. Also, some of garden lots have rigid edges, poor finish, unpleasant spatial character, blind areas and dark places and are surrounded by ideal apartments blocks gives the central park a monotonous visual appearance;
- The municipality of Al-Khobar has recently realized that there is a lack of public gardens and announced the creation of seven public gardens. However, they are small in size and dislocated within the neighborhood.

In respect to vacant lands, the Kingdom of Saudi Arabia has over 17 million square hectares of white/ vacant lands including planned and unplanned units. The total area of used and vacant lands in the Eastern Province is 186,836 *VS.* 200,859 sq. ha [40]. AlMoyan [41] found that the vacant lands have high gains of solar energy. According to their locations within the neighbourhood, they affect the air movement and ventilation rate of the open spaces of neighbourhoods.

4. The research methodology and objectives

The literature review above has indicated the importance of physical activities to the human health and wellbeing. It also pointed out possible environmental and physical impediments to the exercise of these activities. With respect to this valuable contribution, this research aims at exploring the strength of relationship between the health conditions of diabetics with the proximity of gardens in the Eastern Province of KSA, and the following objectives are pursued:

- To investigate how strong is the relationship between the medical condition, physiology of the disease reported symptoms and perception of their living conditions in relation to:
  - the number, distribution and sizes of gardens;
  - The number, distribution and sizes of vacant land lots; and
- To find out the role that vacant lands play in affecting the relationship between public gardens with the medical conditions of patients.

Consent to carry out the study was first obtained from the University of Dammam's ethics committee. The fieldwork was carried out in late 2013 and drew upon a sample of diabetics who usually visit the medical clinic at the teaching hospital of the University of Dammam, Al-Khobar. This list of patients includes T1DM and T2DM male and female adults, age 15-70 years and resident in metropolitan area of Alkhober- AlDammam-AlDhahran cities, Eastern province, KSA. Seventy-six diabetic patients participated in the study.

They completed a questionnaire requesting information on their living conditions, home and neighbourhood and lifestyle activity since the onset of the disease. The medical staff then conducted a physical examination of the participants to test their blood pressure and Body Mass Index (BMI). These tests also recorded their Fasting Blood Glucose (FBG), levels of HBA1C (i.e. Glycated Haemoglobin in blood), Micro albumin urea, Lipid HDL (i.e. High-density Lipoprotein or good cholesterol), Lipid LDL level (i.e. Low-density Lipoprotein or bad cholesterol), and Lipid TG (i.e. Triglyceride) (see the definitions of medical tests in table 2).

Table 2: the definitions of medical tests and the measurement level for each patient

Name of the medical test	**What it is?**	**Medical test levels**

BPsystolic	It is to test the pressure measured when the heart is contacting(ejecting blood)	Low BP =less than 110 mm Hg Normal= 110-140 mm Hg Abnormal =above 140 mm Hg
BPdiasystolic	It is to test the pressure when the heart is relaxing and filling with blood	low= Less than 65 mm Hg Normal= 65-90 mm Hg Abnormal= Above 90 mm Hg
Fasting Blood Glucose (FBG)	It is a blood test done to measure the amount of glucose present in the blood after an eight-hour fast	Normal=120 mg/dL and less Diabetic (Low risk)= 121-150 mg/dL Diabetic (High risk)= 151-180 mg/dL Diabetic (Very high risk)= above 180 mg/dL
Glycated Haemoglobin (HBA1C)	It is a form of hemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods of time	Normal= 4-5.6 mmol/mol At risk= 5.7-6.4 mmol/mol Diabetic= above 6.5 mmol/mol
Lipid HDL level	This is to test high-density lipoprotein cholesterol, also called "good" cholesterol	Desirable= more than 60 mg /dL Low risk =46-60 mg/dL Borderline= 35-45 mg /dL High risk =less than 35 mg /dL
Micro albumin urea	Microalbumin urine test determines the presence of the albumin in urine.	Negative =Normal Positive =abnormal

The postal addresses of the patients' homes were obtained from the patient's completed questionnaires and medical files. During 2014, hot diabetes spots map was created using ARCGIS 10.2.1 software available at the University of the West of England, UK. The following layers were added to the map:

- A public gardens layer that comprises 98 lots
- A vacant land layer was added and this comprises 1556 lots; and
- A Saudi household average size layer i.e. number of family members in the household which was obtained from online ArcGIS layers.

Google Earth and Saudi locator (http://www.locator.com.sa/locator/Default_E.aspx) were used to identify the public gardens and vacant lands nearby the diabetic patients' homes (see figure 1& 2). Public gardens, and vacant lands were modelled in ArcGIS map within a walking distance of 1200 m of the patient's home. Service area was calculated from the diabetic patients (i.e. centroid postal code). This was done on 400, 800 and 1200 m intervals. The distances between patients' homes to the nearest public garden with vacant lands within 1200 m were calculated using OD Cost Matrix Analysis. The areas of the vacant lands were also calculated. The ARGIS results then were exported to a SPSS file that comprises information of the physical examination of the diabetic patients, questionnaire survey results and the visual survey output concerning vacant lands and public gardens.

Figure 1: the location of public gardens and vcant lands within 1200 m from the patients' homes (represented by red dots)

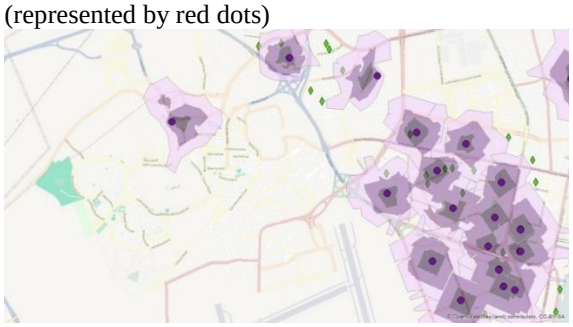


Figure 2: the calculation of service area from the diabetic patients' homes on 400, 800 and 1200 m intervals

The basic data analysis calculated the mean and percentages. ANOVA and Regression tests were used to examine possible

significant correlations. Thus, the clinical assessment of the patients' physiological health, the patients' own self-evaluations of their homes and neighbourhoods living condition, and the vacant lands information were correlated. SEM examines the effect of an independent variable on a dependent variable and this is through a number of co-variables. For ANOVA and Regression tests, only relationships having a significance value (i.e. $P < 0.05$) are reported on. For SEM only networks that have a continuous significant path between independent, co-variables and dependent variables are reported. The levels of significance considered are as follows: $P < 0.05$ as the common level: $P < 0.01$ as the moderate level and $P < 0.001$ as the high level. Any positive correlation means that two or more variables change in the same direction and in the same proportion, and vice versa.

5. The results

5.1. Physical, social and emotional health

The survey found that 88% of the participants have diabetic HBA1C levels above 6.5, 32% of the diabetics have a positive level of micro albumin urea and 66% of them are overweight or obese. It also found 17% have a FBG level of above 200 mml and 47% of the patients have borderline or high risk HDL. The most frequent diabetes manifestations experienced are: extreme fatigue and related tiredness, tension and stress, and blurred vision, and inability to control their nervous system. Whereas the least experienced symptoms are: loss of sensation, cardiatric problems, loneliness and isolation; and blood pressure problems.

Living conditions

In terms of diet: 48% - 59% rarely or never drink fizzy drinks or eat junk food meals. Approximately 77% said that they often or always eat fruits and vegetables. When asked about their home and social lives, more than half of them (57%) said they never or rarely engage in morning exercises. Approximately 25% rarely or never walk for more than 30 minutes a day and only 48% said they walk for 30 minutes. As much as 67% said that they frequently participate in religious activities and 59% said they frequently get involved in social activity *VS* 41% who rarely or never involved in social activities. 72% of the respondents said that they often or always watch TV or work in the office.

Home and neighbourhood conditions

Patients were asked about their indoor and outdoor conditions. Half of the patients said that they frequently suffered from lack of sunlight entry to the house. More than third of them said that frequently suffered from unpleasant outside views, and low level of ventilation in the house. Nearly quarter of them said that they frequently suffered from: annoying flow of air in the house, lack of hygiene/ cleansing in the neighbourhood, traffic noise, noise from neighbours, and difficulty of wandering around in the neighbourhood. Around 20% said that they frequently experienced from uncomfortable temperature and poor air quality in the house, poor finishing of the house, the house organization and size, and disgusting odours in the neighbourhood.

The proximity of gardens and vacant lands

84% of the patients have garden lots less than 2401 sq. m within 1200 m from their homes. In terms of number of garden lots within 1200 m from home, 34% of the patients do not have any garden lot, 43% of the patients have one garden lot, and 23% have 2 garden lots. With regards to vacant lands, 75% of patients have vacant land lots are within 800 m from their homes, 64% of patients have vacant land lots are within less than 400 m from their homes. 82% of patients have vacant land lots with less than 2401 sq. m within 1200 m from their homes. 18% of the patients have 1-20 vacant land lots within 1200 m from their homes and nearly half of the patients (i.e. 57%) have more than 20 vacant land lots within 1200 m from their homes.

With regards to vacant lands, 75% of patients have vacant land lots are within 800 m from their homes, 64% of patients have vacant lands within less than 400 m from their homes. 82% of patients have vacant

land lots with 2400 sq. and. m within 1200 m from their homes. 18% of the patients have 1-20 vacant land lots within 1200 m from their homes and nearly half of the patients (i.e. 57%) have more than 20 vacant land lots within 1200 m from their homes.

5.2. The visual survey results

Twelve public gardens and ten vacant lands in low income, middle and upper middle class neighbourhoods were visually surveyed. In respect to the public gardens, the survey indicates the following points:

- In one of the middle and upper middle class areas, the public garden lots are very near to each other;
- Some gardens are located in a marginal area of the neighborhood;
- Most of the gardens (i.e. 9 out of 12) do not have facilities for teenagers, adults and elderly people. For elderly people, the size of the garden and unsafe settings, differences in levels does not allow safe exercises and even safe walking;
- The quality of construction materials used is acceptable, although they have rigid and sharp edges and constitute a safety hazard;
- The gardens are regularly maintained and cleaned by the municipality but the level of maintenance and cleanliness is below the acceptable standard;
- Some gardens have no gates, fences, ramps, or shaded areas (e.g. pergolas);
- Some of the gardens have low level of visual appearance in terms of attractiveness and have blind and dark areas;
- In low income areas, the visual appearance of the surrounding blocks is monotonous and bad;
- Most of the gardens segregated from residences by streets without safe crossings; and
- Consequently, there is no attractive green, shaded (apart of casted shadows from the buildings) and safe street corridors that lead to these public gardens.

The vacant lands surveyed were found to be filthy and highly polluted and they are used for dumping rubbish, construction waste and wrecked or decommissioned vehicle. They are occupied by illegally parked cars and lorries. Some have temporary car parking canopies that belong to the nearby houses, and portable trailers that are occupied by low income foreign labour.

5.3. Lifestyle, gardens, and vacant lands

The SEM is used to test clinical assessment tests, self-reported home and neighborhood environmental conditions with the public gardens and vacant lands information (table 1). So for each SEM diagram (see Figure 3 as an example), the study investigated the effect of garden distance, number or size (as an independent variable) on the medical condition of the patient (as a dependent variable).

The mediating variables are self-reported home conditions, neighborhood conditions, and vacant lands information. Only significant results (i.e. $P < 0.05$) are reported below. The results showed that when the district became increasingly urban, there is frequent complaint about the difficulty of wandering around in the neighborhood and this is associated with higher reported blood pressure problems (table 1).

The shorter distances to the nearest garden and the larger area of vacant lot within 1200 m from home are associated with frequent watching TV or working in the office. The shortest distance to the nearest garden and the larger area of the vacant lots within 1200 m from home, are associated with higher level of micro albumin urea and higher HBA1C level. This would be explained that the existence of large size of vacant lands near home would impede diabetic individuals from visiting the neighborhood's garden. So diabetics would spend more time at home doing unhealthy activities such as watching TV.

Longer distance to the public garden from home is associated with diabetics' frequent complaint of the house organization and size and this is linked to frequent complaint of (table 3):

- lack of stability at home;
- pressing social engagements; and

- lack of family coherence.

5.4. The role of urban context, age and gender

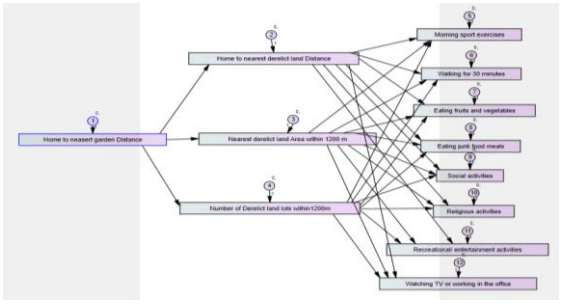
The ANOVA results found positive links between the densities of the neighbourhood represented by the number of family members per household with Fasting Plasma Glucose (FBG). For example, FBG level is higher for patients living in high density neighbourhoods. In high density area, there are more gardens within 1200 m, and patients infrequently watch TV or work in the office. Gardens are nearer to homes in high density areas whereas vacant lands are away in these areas. The bigger number of garden lots is associated with frequent social, religious and recreational activities. The number of vacant land lots within 1200 m is higher in urban areas than suburban areas whereas the number of garden lots is higher in suburban areas than urban areas.

The data is categorized into categories thus tested using ANOVA test. In terms of age and for younger group i.e. 20- 40 years old, the study found that a smaller garden area is associated with the patients' frequent need to sleep. Also for the same group the fewer number of garden lots within 1200 m from home is associated with a higher level of BP Systolic. For middle adulthood group (i.e. 41-60), the longer distance to the public garden is associated with a higher level of BP Diasystolic and frequent uncomfortable feeling of the house organization and its size.

For males, the constant feeling of the need to sleep and frequent feeling of being overloaded are associated with smaller public garden areas which are within 1200 m from home. They frequently complain of the poor finishing of the house and uncomfortable feeling concerning the house organization and size when smaller number of public garden lots within 1200 m from home. Female patients have a higher level of BPsystolic when there is a fewer number of public garden lots within 1200 m nearby patients' homes.

In terms of the vacant lands, shorter distance to the vacant lands, for group aged 20 to 40, is associated with frequent complain of disgusting odours. The HDL level for group aged 41-60 is higher when the vacant land is nearer and the number of vacant land lots is greater. Females feel more loss of sensation particularly in the foot limbs when the vacant land is nearer to home.

For urban neighbourhoods, the ANOVA test showed that when the garden is away from home, patients frequently watch TV or work in the office and repeatedly complain of the house organization and its size.



Figures 3: the SEM diagrams showing the relationships between public gardens with medical conditions and physical activities of patients. The vacant lands act as mediating variables *(note: the diagram shows the standard regression weights only)*

Table 1: SEM links between variables (i.e. neighbourhoods, physical activity, and diabetics' conditions) showing the positive and negative regression weights. *Odd associations are in Italic* (Significance level <0.05, sample size=76)

Independent *(A)*	**Mediating variable (B)**	**Dependent (C)**	**Estimate 1 (A *Vs.* B)**	**Estimate2 (B *Vs.* C)**	**Overall Estimate (A, B *and* C)**	**Sig. (A *Vs.* B)**	**Sig. (B *Vs.* C)**
Neighbourhood type (i.e. urban, suburban)	Difficulty of wandering around in the	Blood pressure problems	-0.616	0.251	-0.365	0.041	0.040

	neighbourhood						
Home to nearest garden distance	Vacant land Area	Watching TV or working in the office	-0.388	0.197	-0.191	0.037	0.038
Home to nearest garden distance	Vacant land Area	Micro albumin urea	-0.398	0.028	-0.37	0.034	000
		HBA1C	-0.385	0.124	-0.261	0.038	000
Home to nearest garden distance	The house organization is uncomfortable and its size is small	Lack of stability at home	.458	.230	0.688	000	.015
		Pressing social engagements	.458	.485	0.943	000	000
		Lack of family coherence	.458	.509	0.967	000	000

The smaller size of garden is linked with the patients frequent complain of uncomfortable temperature in the house and feeling the need to sleep. For suburban neighbourhoods, the distant garden lots are associated with frequent complain of noise from neighbours from neighbours and feel the need to sleep. The smaller number of garden lots is associated with frequent conflicts and the charged atmosphere at home and need to sleep.

6. Discussion: identifying possible detrimental to diabetics' health

The research findings below should be interpreted, with regards to KSA's harsh and polluted environmental conditions, lack/dislocation of amenities in neighbourhoods and districts, and poor street conditions and these have been briefly highlighted in subsection 3.3. These conditions would enforce citizens to practise unhealthy lifestyles.

The study found that most of the patients have alarming level of diabetic HbA1C and two thirds of them are obese. The most frequent diabetes symptoms that they suffer from are stress, tiredness, blurred vision and inability to control their nervous system. Around half of them frequently drink fizzy drinks and eat junk food meals and they rarely engaged in physical activity. More than one third of them rarely participate in social activities. Around a quarter of them rarely walk for more 30 minutes.

The visual survey on public gardens showed that they have a serious problem concerning the lack of fitness facilities for all age groups and they are inaccessible due to the poorly maintained streets and lack of safe streets' crossings and shaded and thermally comfortable urban corridors. Some gardens and surrounding blocks have poor visual appearance. The GIS investigation showed a shortage of gardens in terms of size, proximity and number. Actually, it indicated that some patients do not have any gardens nearby their homes and more than half of the patients have large number of vacant land lots near their homes. As indicated above, the Saudi municipalities have attempted to tackle the shortage of public gardens by providing new gardens. However, the problem is not about increasing the number of public gardens but about their proximity, size, accessibility, configuration, design quality, safety level, etc.

On the other hand, vacant lands proximity, area and number have negative impact on these activities. Thus, when there are larger vacant lands near patients' homes, more patients watch TV. When there are more vacant lands lots, patients feel high levels of micro albumin urea and HBA1C level and reported lipid problem. The results showed that the [Age] groups are sensitive to the existence of vacant land near their homes in different ways. For instance, the younger group complained from disgusting odours in the neighbourhood whereas the older group have higher level of lipid HDL when vacant lands are nearer. The shorter distance to vacant land lots is associated with the

patients frequent feeling of frequent loss of sensation particularly in the foot limbs.

The area type i.e. the urban area also seems to discourage patients from wandering around. The lack of walkability and physical activity is linked with reported blood pressure problems [see for example 9 for similar observation].

In respect to the public gardens, a significant link was found between the patient's high (i.e. unhealthy) level of BP systolic and unavailability and shortage of public gardens near home. The longer distances and smaller sizes of gardens are linked with patient's frequent feeling that the house organization and size are uncomfortable and constant need to sleep.

The results showed that urban areas under investigation do not encourage patients to wander around. The lack of walkability and physical activity is linked with reported blood pressure problems [see Eckel et al. 9]. The lower number of garden lots is associated with infrequent social, religious and recreational activities. The SEM results showed positive impact of gardens on patients' health. However, this relationship is affected negatively by vacant land size and number. Thus, when there are larger vacant lands near patients' homes, more patients watch TV. When there are more vacant lands lots, patients feel high levels of micro albumin urea and HBA1C level and reported lipid problem. The longer distance to the garden is associated with the patient's frequent complain of home organization and size, and this –in turn- is associated with social problems at home.

The study found that the relationship between gardens and patients' health and activities is controlled by neighbourhood's type (i.e. urban, suburban), age and gender. For instance, the higher number of garden lots would encourage elderly people to regularly wal. In regards to gender, males suffer frequently feeling the need to sleep and feeling overloaded when there are smaller public garden areas near home. Males perform more frequently recreational/ entertainment activities and complain less frequently of indoor conditions when there is larger number of public garden lots near home.

The statistical analysis indicated significant links between medical conditions of patients and urban conditions. For example, a positive link was found between FBG and the neighbourhood's density, the highest level of FBG however found for patients who live in mid density neighbourhoods. The results showed that the (Age) groups are sensitive to the existence of vacant land near their homes in different ways. For instance, the younger group complained from disgusting odours in the neighbourhood whereas the older group have higher level of lipid HDL when vacant lands are nearer.

7. Concluding remarks: What (must) be done and how

This study showed the positive impact of physical and spiritual activities of diabetic patients on their health status. The above relationship however is hampered by the unhealthy outdoor living conditions that patients living.

Venerable groups of the society as diabetics are in an emergence need for the community care and attention. So, to trigger the positive social, spiritual, psychological and health-wise role of public gardens, the following actions are recommended on the following levels:

- Local communities in urban and suburban areas should be involved in decision making concerning the design and planning of community centers that comprise integrated services as mosque, gym, nursery, community hall, public library, public garden, etc. So these would effectively respond to the needs of all group users including vulnerable groups with chronic diseases as diabetics.
- In respect to vacant lands, higher taxes on vacant lands should be applied in relation to the location of the land lots and owners should be granted a planning permission valid for a set period of time. Authorities should not permit the transfer of ownership within the planning period as

this would be used by the owners to avoid tax.

- Authorities should apply legislations that systematically and comprehensively sort out the problem of public gardens in cities. Public gardens with certain physical qualities should be provided.
- The Saudi standards of design of public gardens should be reviewed taking into account number, distribution in high and low density areas and types of users such as elderly people and diabetics and the hot harsh weather of the KSA. So, public gardens should be large in size, within a walking distance from homes and can be easily accessed by via shaded, well ventilated and safe urban corridors. Level of design, construction, maintenance and cleanliness of public gardens should be according to robust building and landscaping standards that match the international standards. Visual appearance of the garden and surrounding blocks, and safety in use are important issues to consider as well.
- Municipalities should assess the design of existing or new gardens and planning solutions for vacant lands using tools such as Health Impact Assessment (HIA). This should be in collaboration with the local communities in urban& suburban areas to enable reaching robust healthy planning solutions that correspond to the needs of all group users including vulnerable groups as elderly and diabetics.

In the KSA, there are a number of urban contexts such as residential compounds, academic campuses, residential neighbourhoods, mixed type (i.e. commercial and residential or industrial and residential) neighbourhoods etc. So, future research should examine the unique relationship between the proximity and functions of public gardens with their urban contexts and how the proximity of community services to the residences would encourage citizens adopting healthy lifestyles.

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References

1. *Natural England organization. 'Nature Nearby', Accessible Natural Greenspace Guidance. 2010. http://www.ukmaburbanforum.co.uk/documents/other/nature_nearby.pdf (Accessed 27 March 2016)*
2. *Barbosa, O., et al. Who benefits from access to green space? A case study from Sheffield, UK. Landscape and Urban Planning journal, 2007 November; 83 (2-3), 187–195.*
3. *Herzele, A. V., Wiedemann, T. A monitoring tool for the provision of accessible and attractive urban green spaces. Landscape and Urban Planning journal, 2003 April; Volume 63 (2), Issue 2, 15, 109–126.*
4. *Burnett, A. In the right place accessibility, local services and older. Help the Aged, 2005, London, United Kingdom.*
5. *Brown, B.B., Werner, C.M., Amburgey, J.W., Szalay, C. Walkable route perceptions and physical features: converging evidence for en route walking experiences. Environ. Behav; 2007, 39 (1), 34–61.*
6. *International Diabetes federation. IDF DIABETES ATLAS 2012. www.idf.org/sites/default/files/5E_IDFAtlasPoster_2012_EN.pdf (Accessed 18 May 2013)*
7. *Ebbeling C. B., Pawlak, D. B., and Ludwig, D. S. Childhood obesity: public-health crisis, common sense cure. The Lancet, 2002; 360 (9331), 473-482, dx.doi.org/10.1016/S0140-6736(02)09678-2 (accessed 13 April 2012)*
8. *Peckhan C. Fetal and child development, In Marinker M.,*

Peckham M. (eds.). Clinical futures, 1998., BMJ Books.

9. *Eckel RH, York DA, Rössner S, et al. Obesity, a Worldwide Epidemic Related to Heart Disease and Stroke: Executive Summary, AHA Conference Proceedings Prevention Conference VII. Circulation 2004; 110: 2968-2975.*
10. *Malhotra, A., Noakes, T., Phinney, S. It is time to bust the myth of physical inactivity and obesity: you cannot outrun a bad diet (Editorial). Br. J. Sports Med., 2015 April; 1-2, http://dx.doi.org/10.1136/bjsports-2015-094911*
11. *Kelishadi R, Mirghaffari N, Poursafa P, Gidding SS. Lifestyle and environmental factors associated with inflammation, oxidative stress and insulin resistance in children. Atherosclerosis 2009; 203(1), 311-9. dx.doi.org/10.1016/j.atherosclerosis.2008.06.022 (accessed 10 February 2013)*
12. *Jeppesen P, Bek T. The occurrence and causes of registered blindness in diabetes patients in Arhus County, Denmark, Acta Ophthalmol. Scand. 2004; 82 (5): 526–530.*
13. *Chaturvedi N, Stevens LK, Fuller JH., Lee ET, Lu M. Risk factors, ethnic differences and mortality associated with lower-extremity gangrene and amputation in diabetes: The WHO Multinational Study of Vascular Disease in Diabetes, Diabetologia 2001, 2001 Sep;44 Suppl 2:S65-71.*
14. *Martinez M L, Devenport J, Saussy J. @Drug Associated Heat Stroke, Southern Medical Journal 2002; 95 (8), 799-803.*
15. *WMO. Heat waves and health: guidance on warning system development. 2010, (114 pages). www.wmo.int/pages/prog/wcp/ccl/opags/documents/HeatWavesandHealthGuidance_26July2010.pdf (accessed 10 April 2012)*
16. *Bedimo-Rung, A. L., Mowen, A. J., & Cohen, D. A. The significance of parks to physical activity and public health: A conceptual model. American Journal of Preventive Medicine, 2005; 28 (252), 159-168*
17. *Greenspace Scotland. HIA of Green space: A Guide. Greenspace Scotland, Stirling. 2008.*
18. *Diez Roux, A. V., Evenson, K. R., McGinn, A. P., Brown, D. G., Moore, L., Brines, S., et al. Availability of recreational resources and physical activity in adults. American Journal of Public Health, 2007 March, 97 (3), 493–499.*
19. *Giles-Corti, B., Broomhall, M. H., Knuiman, M., Collins, C., Douglas, K., Ng, K., et al. Increasing walking: How important is distance to attractiveness and size of public open space? American Journal of Preventative Medicine, 2005 February; 28 (2), Supplement 2, 169–176*
20. *Giles-Corti, B., Macintyre, S., Clarkson, J. P., Pikora, T., & Donovan, R. J. Environmental and lifestyle factors associated with overweight and obesity in Perth, Australia. American Journal of Health Promotion, 2003 Sep-Oct;18(1):93-102.*
21. *Barton, J., & Pretty, J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. Environmental Science and Technology, 2010 March; 44(10), 3947–3955*
22. *Wolch, Jennifer R., Byrne, Jason, Newell, Joshua P. Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 2014 May; 125 (2014) 234–244.*
23. *Ernstson, H. The social production of ecosystem services: A framework for studying environmental justice and ecological complexity in urbanized landscapes. Landscape and Urban Planning, 2013 January; 109(1), 7–17*

24. *Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. Inequality in the built environment underlies key health disparities in physical activity and obesity. Pediatrics, 2006 February; 117 (2), 417–424.*
25. *White Mathew P., Alcock, Ian, Wheeler Benedict W., and Depledge, Michael H. Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data. Psychological Science Journal, 2013 July, 24(6) 920–928*
26. *Maas, J., Verheij, R. A., Groenewegen, P. P., de Vries, S., and Spreeuwenberg, P. Green space, urbanity, and health: how strong is the relation? Journal of Epidemiology & Community Health. 2006 Jul; 60(7): 587–592. doi: 10.1136/jech.2005.043125*
27. *Reklaitiene, R., Grazuleviciene, R., Dedele, A. et al. The relationship of green space, depressive symptoms and perceived general health in urban population. Scand. J. Public Health 2014 Nov;42(7):669-76. http://dx.doi.org.ezp.uod.edu.sa/10.1177/1403494814544494 (Published Online First: 12 August)*
28. *Van den Berg, A.E.; Maas, J.; Verheij, R.A.; Groenewegen, P.P. Green space as a buffer between stressful life events and health. Soc. Sci. Med. April 2010, 70, 1203–1210.*
29. *Ulrich, R.S. Natural versus urban scenes some psychophysiological effects. Environ. Behav. 1981 September, 13, 523–556.*
30. *Song, Y., Gee, G. C., Fan, Y., & Takeuchi, D. T. Do physical neighborhood characteristics matter in predicting traffic stress and health outcomes? Transportation Research, Part F: Traffic Psychology and Behavior. 2007 March, 10, 164–176.*
31. *Barton, J., & Pretty, J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. Environmental Science and Technology, 2010 March, 44(10), 3947–3955.*
32. *Lee, A., & Maheswaran, R. The health benefits of urban green spaces: A review of the evidence. Journal of Public Health, 2011 Jun, 33(2), 212–222.*
33. *Louv, R. Last child in the woods: Saving our children from nature-deficit disorder. Main edition. 2005. Chapel Hill, NC: Algonquin Books.*
34. *Barton, H. and Grant, M. Urban planning for healthy cities: A review of the progress of the European Healthy Cities Programme, Journal of Urban Health, Bulletin of the New York Academy of Medicine, 2011. http://dx.doi.org/10.1007/s11524-011-9649-3*
35. *Clayden, A., Mckoy, K. & Wild, A. Improving residential liveability in the UK: Home zones and alternative approaches. Journal of Urban Design, 2007 January, 11 (1), 55-71.*
36. *Garvin E, Branas C, Keddem S, Sellman J, Cannuscio C. 2013. More than just an eyesore: local insights and solutions on vacant land and urban health. J Urban Health. 2013 Jun; 90(3): 412-26. doi: 10.1007/s11524-012-9782-7*
37. *Sidawi, B., Alhariri, M. T. & Albaker W. I. Creating a Healthy Built Environment for Diabetic Patients: The case study of the Eastern Province of the Kingdom of Saudi Arabia, Global Journal of Health Science, 2014, 6(4); 136-147.*
38. *Sidawi, B. and Alharriri, M. T. The importance of healthy and sustainable built environments for vulnerable groups of population. Built Environment Journal, 2015 July, 12 (2), 31-48*
39. *Sidawi, B., Deakin, M. and Al-Harriri M. The place-based impact of built environments: Diabetes, living conditions, homes and neighbourhoods. Indoor and Built Environment. 2015 May, 25 (3), 495-508.*

40. *Riyadh- ARAB news, Most vacant lands are in Makkah, Riyadh. 2014. http://www.arabnews.com/news/597321*
41. *AlMoyan, J. S. D The climate of Industrial district of Jubal (Applied Climatology study). 2011. University of Dammam. KSA*

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