



The IMPACT OF URBAN MOBILITY ON THE PEDESTRIAN SAFETY IN THE KINGDOM OF SAUDI ARABIA

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Abstract

The provision of safe footpaths connected to the transport network is a fundamental matter in urban mobility that contribute to walkability urban sustainability. This study intended to examine the impact of sidewalks and pedestrian crossings on the pedestrians' safety in Saudi Arabia. The study assumes that the lack of safe sidewalks and crossings has increased the risk of pedestrian's exposure to car accidents.

Field observation and Photography technique were used for data collection. National and Local regulations recommended by the Saudi Building Code (SBC) and Jeddah Streetscape and Urban Design Manual (JSUDM) are used for analysing the current condition of sidewalk and pedestrian crossings. The study results revealed a strong relationship between the lack of safe footpaths and the high rate of casualties among pedestrian in KSA. The study concludes that a wide gap exists between what was demanded by the law and what is enforced. The study's results and conclusion would increase awareness among authorities and professionals in KSA to create a realistic sense of place to protect and meet the pedestrians' need and enhance their health and safety.

Keywords: Urban mobility, pedestrian safety, accessibility, urban design, KSA

Introduction

During the last century, urban design was deeply influenced by the idea of motorized transportation, which has led to the increase of the considerable number of vehicles, urban sprawl, and global health challenges (Mumford, 1981; Gehl, 2006; WHO 2010). The consequences of the motorized concept were catastrophic by: separating the integrated urban areas, making distances longer and less walkable leading to social exclusion in cities, and increasing the rate of Road Traffic Accidents (RTAs) to become the world's fifth

leading cause of mortality and morbidity (Jacobs 1961; Holston, 1999; Gehl 2011; Krieger & Saunders, 2009; Mehta, 2013)

Fuelled by rapid population increase and economic growth, cities in KSA have also experienced a significant increase in size and population associated with the increasing number of vehicles and a high rate of RTAs since the early 1970s. (Rahman, 2016; Algadhi et al. 2012) It was reported that the lack of safe sidewalks and pedestrians' crossings have contributed to the high rate of RTAs giving KSA the rank of the world's highest number of casualties, which up to daily 17 deaths and 68 injuries (Saad, et al., 2002; AlTurki et al. 2014) The rate of road fatalities in KSA, has also witnessed an increase from 17 to 24 per 100,000 population which is very higher compared to the rates of 10 and 5 in the U.S.A. and the UK respectively. These high RTAs might be due to the fact that people walking and biking are sharing the same roads with vehicles in residential areas where sidewalks and pedestrian crossings are in poor condition. Literature suggests that the provision of safe sidewalks and pedestrian crossings is a prerequisite for pedestrians' safety and social integration (Rahman et al. 2016; Bromley et al., 2007; Cilliers & Timmermans, 2016; Gehl & Gemzøe, 2008; J. Jacobs, 1961; Lynch, 1984)

The aim of this study is, therefore, to examine the role played by sidewalks and pedestrian crossings on the pedestrians' health and safety in KSA. The study is based on the assumption that lack of safe sidewalks and crossings facilities has increased pedestrian exposure to car accidents leading to the reduction of their health and safety in KSA. It is also assumed that the provision of a safe and standard sidewalks and pedestrian crossings will increase pedestrians' health and safety by encouraging walkability, increase space connectivity, reducing the use of the private car, and consequently decreasing the rate of RTAs. The technique of field observations and photography is used as a method of data collection to demonstrate the condition of sidewalks and crossings. The Urban design principles including national and locally provided principles by Saudi Building Code (SBC) and Jeddah streetscape and Urban Design Manual (JSUDM) are used for auditing the current condition of sidewalk and pedestrian crossings. The study results revealed a strong relationship between the lack of safe footpaths and the high rate of casualties among pedestrian in KSA. The regulations provided by the SBC and the JSUDM are valuable tools and a framework within which the current condition of urban features in terms of environmental accessibility be evaluated. This study's results would increase awareness among authorities and professionals in KSA to embark on the provision of safe and accessible sidewalks and crossing to create a realistic sense of place that can protect and meet the pedestrians' need and enhance their health and safety.

Urban Design Role in creating safe Accessible Environment

The goal of urban design, in theory and practice, is to deliver connections between people and their built environment, emphasizes on transport systems from footpaths to the street network (Krieger & Saunders, 2009). Theoretically, the design of an accessible street network should be able to accommodate all modes of transport in order to guarantee a well-designed mobility pattern in cities and residential areas. If followed, it would inspire the use of more efficient modes such as walking and biking, leading to an increased level of safety for all roadway users (Keippel et al., 2017). Accordingly, Urban planning principles suggest that the use of/ and access to the spaces of streets and sidewalks should be inclusive to all users regardless of age, gender, class, etc. (Carmona, et al. 2016). Universal Design and Inclusive Design are acted as a road

map to overcome the major problem of an unfriendly environment for all people, especially people with disabilities. In these designs the users are placed at the fulcrum of the design process and stress on working with people rather than for them, allowing the users to "have the ability to take control of their environments" (Hatch 1984, p. 4) Mehta (2013, p. 2) also stated that "good cities are places of social meeting creating spaces that encourage social integration in our neighborhoods."

The urban planning principles also recommend that all street network must provide for both traffic movement and people's accessibility in a manner to focus on elements such as safety, walkability, liveability, inclusivity and aesthetic of public spaces to ensure a vibrant social interaction (Gehl 2011) Designing of main roadways, intersections and accelerated lanes without providing acceptable pedestrian facilities would results into a possibility of higher casualties among pedestrians when crossing or walking on the road (Ernst M, and Shoup L., 2009; Rothman L et al. 2012). Aljoufie et al. (2012) indicate that streets are typically lined with buildings and public spaces and have to accommodate and meet the complex diversity functions of people and motor traffic fundamental role.

Design of sidewalks

Today, walkability has become a traveling concept that is adopted by many cities worldwide (Maloutas, 2017; UNESCO 2016). The general theory of walkability proposed by researchers emphasizes that walkable routes should achieve four key conditions of being: useful, safe, comfortable, and interesting (Speck 2019; Laker 2017). These conditions are not achievable in many third world countries where basic spatial qualities such as walking paths, accessibility to the public sphere, proximity, and safety are almost absent (Moulay, et al. 2017).

Design and construction of standard sidewalks are essential for promoting walkability concept and protecting all pedestrians, especially to those with disabilities who rely mostly on the pedestrian realm to travel independently within their community. Standard sidewalks can logically provide safety by separating pedestrians from adjacent motorized speeding lanes, especially in main streets where space and street furniture are allocated for social integration of people to congregate and feel of comfort.

Being located in the arid zone, KSA should also follow comfort measures such as creating shaded footpaths, local services hub, sheltered bus stop, cool air towers and sparkling water devices which are used in many cities in the world to secure the comfort of pedestrians in streets and sidewalks. Some of these measures have already been adopted in KSA cities of Mecca and Medina for Haj pilgrims and could be developed and applied in other cities (Al Abdullah 2017). The design of new sidewalks should target the general maximum gradient of 5% (1:20) or an absolute maximum gradient of 8% (1:12) and other required measures in order for the impaired people to negotiate easily.

Streetscape elements and street's fixed objects should be located at an acceptable distance of 1.5 to 4 feet from the face of the curb to protect pedestrians from passing by traffic. According to the American Disability Act of Accessibility Guideline (ADAAG 1991), a sidewalk should have the following attributes: (i) accessible walking surfaces with at least 915mm width so that wheelchair users can pass through. (ii) at least 36 inches of landings at the tops of curb ramps should be provided (United States Access Board 2011; Kirschbaum et al., 2001). Nevertheless, choice of measures for sidewalks in KSA have been left with

property owners' decision who do not follow the standards of urban design, S.B.C. and JSUD (Images 1 and 2).



Images1 & 2: Blocked sidewalks in Riyadh*

Sidewalks and Pedestrian Safety

WHO (2018) reported that nearly half (46%) of victims who were killed by traffic accidents were pedestrians, cyclists, or users of motorized two-wheelers. Mansuri et al. (2015) also reported that "more than 65% of the RTAs occurred in the residential areas where unsafe narrow sidewalks forced the pedestrians to share the speeding vehicles on the roads" (p.9). A study conducted in the United States found that pedestrian crashes were more than twice as likely to occur at locations without sidewalks than would be expected on the location with safe sidewalks (Knoblauch et al.1988). The situation is not much different in the KSA where many residential areas and roads are lacking safe sidewalks and pedestrian crossings which have contributed to the pedestrians' high rate of RTAs (Saad et al., 2002). Based on what has mentioned above, there is a close correlation found between the availability of safe sidewalks and crossing points and the safety of pedestrians. In recent years, major cities in the world have focused on the sidewalk feature as the main factor that may increase a person's inspiration and willingness to walk. Health benefits and recreation factors were also found to be encouraging walkability for achieving basic needs within the local community (Humpel, 2003; Booth et al. 2000).

Therefore, safe sidewalks and pedestrian crossings are the main and important factors that encourage people to walk while can reduce or eliminate the risks pedestrians are facing on roads (McMahon et al. 2002). Countries such as the Netherlands and Denmark have already invested in providing pedestrian with safe walking routes, while other countries, including China and India, are at the beginning of their efforts to address the pedestrians' safety ((McMahon et al. 2002). To achieve the safety measures of pedestrians, it requires public and private organizations' commitment and informed decision-making to switch to the idea of compact cities that has become a traveling innovative of sustainability in the new millennium.

Compact development aims to make existing and new urban areas more self-sufficient, walkable, sustainable, and enjoyable places to live. This concept seems to be an excellent response to achieve the millennium's goal of sustainability. However, compact development is not just increased density but has a direct impact on the travel pattern and efficient transport system, connecting footpaths, reducing trip lengths, and discourage the use of private vehicles without lessening population mobility. The

compact city concept is, therefore, intended to bring about a vibrant urban environment by supporting a high-density urban settlement in which mix-use development would allow well-distributed services (Kale & Martin, 2015). This idea was also welcomed by the UK authorities manifested in the decision of the Mayor of London, Sadiq Khan, who set a target to make the city of London one of the most walkable cities in the world. He promised to raise the proportion of people walking, cycling and taking public transport journeys from currently 63 percent up to 80 percent by 2041 (Khan, 2018).

The Benefits of Sidewalks

Sidewalks are considered a hub for social integration and to some degree, functions as a mixed-gender space especially in Muslim societies where gender segregation is a must in all public sphere including work environments (Kenyon et al. 2002) However, the norm of gender separation is less enforced on streets and sidewalks where males and females can be co-present (Almahmood et al. 2017) Availability of sidewalk positively impacts the households' economy by reducing the use of private car, decline in expenses for fuel and maintenance of vehicles, also contribute into the lessening of CO₂ emissions, air pollutions leading to environmental health within cities (Atef Elhamy 2013). By encouraging physical activity, sidewalks can be helpful in reducing body weight or managing obesity-related problems, leading to a healthy life (Boston, 2015) In recent years, the increase in the level of public awareness concerning the role and benefit of walking in health and well-being, has raised the public pressure n municipalities in KSA, leading to the improvement of walkways in Riyadh, Jeddah and Abha (Bin Ayyaf 2017), (Images 3, 4 and 5).



Images 3, 4 and 5: Standard walkways in (L) Riyadh, (M) Jeddah and (R) Abha

Sidewalks Condition and Law Enforcement in KSA

The motorized oriented environment in the KSA since the late 1960s and early 1970s has contributed to the marginalizing of walkability (Ledraa, 2015). Since 1960, Riyadh the capital city of the KSA has become an example of an inaccessible environment for its sidewalks either narrow or taken over by wholesalers' goods, forcing pedestrians onto the main road putting their lives at risk of a car accident (Jamal et al. 2019), (image 6).



Images 6: blocked sidewalks in Riyadh

People block the sidewalks without any authorization as they consider them as part of their own property due to the absence of Law enforcement. This blockage of sidewalks is happening in KSA where strict laws and regulations exist to govern the urban configuration. For example, section 13-209 of the SBC reads:

No person may use any portion of any sidewalk or street right-of-way for the purpose of displaying or offering for sale wares, goods, merchandize, or other items. No person shall occupy any portion of any street, alley or sidewalk for the purpose of temporarily storing building materials without first obtaining a permit for such temporary use from the mayor and city council.

Likewise, section 4 of chapter 4 and section 6.8 chapter 14 of the JSUDM requires walkways to protect pedestrians by stating that: "the sidewalks shall be maintained in place and kept in good order for the entire length of time pedestrians may be endangered."

Section 4.1 chapter 9 of the S.B.C. also emphasizes making routes within the site accessible:

pedestrians' access routes to begin from public transportation stops, parking, passenger loading zones, public streets, and sidewalks to the accessible building entrance to be served. The regulations indicated that: upon the completion of construction activity, the owner or his agent shall immediately remove walkways' debris and other obstructions and leave such public property in as good a condition as it was before such work was commenced.

Furthermore, section 6.2 chapter 14 of the JSUDM stated that:

A walkway shall be provided for pedestrian travel in front of every construction and demolition site unless the authority having jurisdiction authorizes the sidewalk to be fenced or closed. The same section emphasizes that: Walkways shall be of sufficient width to accommodate the pedestrian traffic, but in no case shall they be less than 1.2 meters in width. Some sidewalks in KSA's cities were found standard in few streets only (image 7).



Image 7: A standard sidewalk in Riyadh

This implies that the authorities have the vision and resources to provide similar standard sidewalks in all areas including secondary streets and residential zones, to replace the sidewalks that are narrow and blocked by many barriers. Except for the main street, most

of sidewalks in the KSA cities remain useless for being narrow, inconsistent in height levels and often blocked by the architectural and human-produced barriers. (Images 8, 9, and 10).

The JSUDM has also specified that:

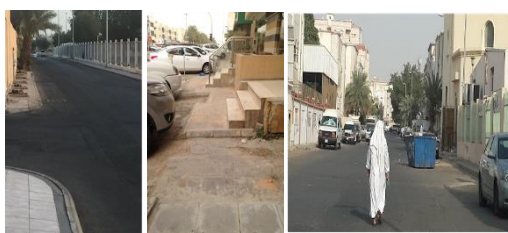
A continuous sidewalk is required on both sides of all streets. Sidewalks shall be unobstructed to allow easy flow on busy streets while including street furniture. All



Images 8, 9, and 10: Narrow, blocked and inconsistency sidewalks

pedestrian accessibility shall be made directly from the sidewalk. However, the height inconsistency of sidewalks in KSA's streets seem to be a common feature of the KSA cities (images 11, 12 and 13).

The same guideline recommends the dimensions of sidewalks as follows:



Images 11, 12 and 13: Blocked and inconsistency sidewalks in Jeddah

Sidewalks shall be no less than 2 meters in width and shall be unobstructed from lampposts, utilities, landscaping, etc. with a minimum of one and a half (1.5) meters clear width or the actual width of the sidewalk.

The JSUDM's manual recommended a minimum of two (2) meters in width for sidewalks in residential streets. For commercial streets, the width of the sidewalks shall be five (5) meters to accommodate greater pedestrian traffic and outdoor dining. However, sidewalks shall have a minimum width of three (3) meters as implemented in developed countries.

Adequate rules and regulations are provided by the JSUDM and the SBC to govern sidewalk installations but were not enforced on the ground, leaving people with a big challenge to walk safely. Lack of enforcement of law and regulations has resulted in unsafe sidewalks as most of them in Jeddah and Riyadh were either blocked permanently by a built wall or temporary by parked vehicles (images 14, 15, and 16).



Images 14, 15, and 16: Narrow sidewalks blocked by wall and parked cars in Jeddah

Afshan (2012) reported that Jeddah was being transformed into a pedestrian-friendly city through a massive project that aims to construct sidewalks and walkways across the cities' neighborhoods. This claim is proved to be false as many sidewalks in residential areas of Riyadh and Jeddah visited by the author were inaccessible and unsafe. Established walkways in KSA, however, are used for leisure walking only as they were not connected to the urban spaces and services. These initiatives imply that the provision of sidewalks are feasible in KSA, and it is possible to be delivered in all urban sphere giving pedestrians a chance to perform their daily activities safely.

The condition of pedestrian crossings in KSA

A pedestrian crossing is pointing at any location where the sidewalk and roadway are met to provide pedestrians with an easy and safe crossing of the motorist's path of travel. Like sidewalk, lack or substandard pedestrian crossing poses considerable accessibility challenges and life threat for both fit pedestrian and people with impairments alike. For example, motorists in KSA are required by law to give priority to pedestrians at signalized intersections, however, vehicles sometimes start turning while pedestrians are still crossing. Literature has also identified problems such as missing curb ramps, long crossing distance, short signals timing, and poorly maintained pedestrian crossings in KSA that are adversely affect pedestrian health and safety (Owen et al., 2014; Sammer et al., 2012).

The most common installations use by Pedestrians to crossroads are zebra crossings or pedestrian mid-block refuge islands in the centre of the road. Creating a well-designed pedestrian crossing would involve an accurate design plan of a variety of components and information, including signs, signals, and road markings; turning radius; crossing times; refuge islands; slip lanes; curb ramps; sightlines; traffic patterns; and the onset of signals phases. A plan that vigilantly considers each of these components is considered in the right path for the creation of an efficient pedestrian crossing. Equally significant, however, is the manner in which these components are combined.

Ministry of Transport (2011, p.65) stated that "design of pedestrian facilities like walkways, bridges, and pedestrian crossing with islands in the middle of the road shall help to reduce the high percentage of victims among pedestrians." However, like sidewalks, there was no enforcement for a pedestrian crossing in the KSA's cities, and pedestrians are caught between the lack of safe routes of crossings on the one hand and the speeding inconsiderate drivers on the other. WHO (2011) reported that most RTAs happen to

pedestrians while they are crossing streets or roads which were lacking any safe pedestrian crossing points. Even when roads have been provided with basic pedestrian facilities, the growing needs of impaired people were often neglected. For example, most of the main streets and roads in the KSA are too wide to be crossed safely by impaired people due to the limited crossing times even if there is pedestrian activated signals exist. Increasing the time span to allow impaired pedestrians to complete their crossing is, therefore, an important factor for safety crossing which was also neglected (Garder. 2004).

Apart from signalled crossroads at the main junctions, there is a range of controlled and uncontrolled measures that are used in developed and developing countries to provide pedestrians with a safe crossing which is missing in the KSA's roads. These measures not only almost absent in many KSA's cities, but the road marking of a pedestrian crossing in the signalled crossroads is also too worn to be seen (Images 17 and 18).



Images 17 &18: Faded road marking at crossroads

While underpasses are not considered in the KSA, flyover footbridge with multiple stairs are provided which are too high to be used by people with a health problem, elderly and pregnant women (Image 19).

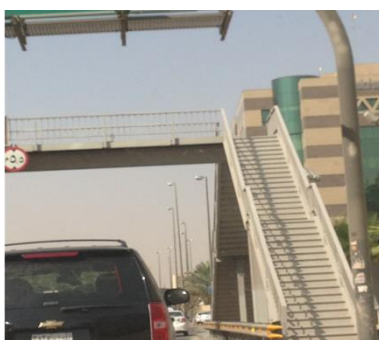


Image 19: Too high footbridge for pedestrian to climb in Riyadh

Nevertheless, some healthy pedestrians are reluctant to use the flyover bridges as they find it easy to recklessly and dangerously cross the busy thoroughfare due to the lack of designated road crossing option. It would be helpful if zebra crossings and pedestrians' bridges be provided at standard intervals and height to give the pedestrians a chance to choose based on their health condition.

Results

The study revealed that standard footpaths would increase space connectivity, reduce the private car's use, and consequently decrease the rate of RTAs. This study shows that most of the sidewalks and pedestrian

crossings in the KSA cities were unsafe and did not adhere to the urban design principles' standards. The result based on this study's finding revealed that there is a significant correlation between the lack of safe standard pedestrian routes and the rate of mortality and injuries of pedestrians. The results might increase awareness among authorities and professionals to create safe sidewalks and crossings to make a better sense of place in towns and cities of KSA. that can protect and meet the pedestrians' need and enhance their health and safety. The study results revealed that standard footpaths would increase space connectivity, reduce the private car's use, and consequently decrease the rate of RTAs.

Discussion

The KSA streets are naturally bordered on either side by sidewalks presumably to facilitate walking and protect pedestrians. Many of the necessary regulations have been provided by the SBC and JSSUD at national and local levels to deliver safe and standard sidewalks and road crossing installations for pedestrians. However, the study's result based on a review of the literature and the author's field observation shows that footpaths were poorly designed, which made them far from being safe to be used by pedestrians in KSA cities. This lack of safety was due to the rarely considered factors influencing walking behaviour, including the perception of crime, traffic safety, and self-efficacy, by decision-makers during the designing of pedestrians' routes. The consequences of such negligence were inadequately designed paths to be used safely by pedestrians. Moreover, sidewalks were also being blocked by architectural or human-caused barriers, and unsafe crossings have averted them from performing their primary function of accommodating and protecting pedestrians.

Accessibility of footpaths in KSA, is often seen as a "you have to" rather than a required element of the planning, design, and construction processes. This approach is restrictive by overlooking the many socio-economic benefits that accessible environments bring to a community. In the condition of high rate of casualties among pedestrians, convincing people to avoid the use of cars and resort to use more friendly transportation modes such as walking or biking needs broad efforts by authorities. The authorities should try to reduce the dreadful loss of pedestrians' lives by diverting the emphasis from facilitating vehicular road towards an approach to deal with pedestrians' safety to encourage walkability and biking transportation.

Securing the safety of pedestrians demanding the transformation of walkability into tangible and applicable strategies directed by authorities' complete systemic actions. In KSA, For example, many city municipalities embarked on constructing walkways to encourage walking. The construction of isolated walkways in many KSA's cities implies that the provision of safe, connected sidewalks in residential areas is also feasible. While authorities and professionals have the know-how and clear planning policy in place, however, there is no idea why they failed to apply such an idea in their cities' residential areas to create standard pedestrians sidewalks. There is no doubt that the availability and connectivity of sidewalks in the residential areas couples with safe crossing points can guarantee the relation and integration of urban spaces and places while ensuring the continuity of such policies in the future. It would be helpful if the professionals and authorities to view the urban realm as a system in which all parts are functioning in association to achieve the goal of people's comfort and safety. A narrow focus on any piecemeal and isolated development would be less effective than taking an integrated approach of multiple factors involved in pedestrian safety. In other words, collaboration among professional of various government, NGOs, agencies and sectors is a cornerstone of

any prospect plan's success that can assure the balance between modes of transport and guarantee the convenience and safety of pedestrians.

Achieving the goal of making the routes safer and walkable is possible by educating people and drivers on road safety, enforcing traffic regulations on sidewalks and pedestrian crossings, and engineering to enhance roads and streets to accommodate both vehicles and pedestrian. The results of this research would also help in the adoption of inclusive methodologies and universal design for creating an accessible built environment for all. This is the prerequisite step towards the ultimate goal of social inclusion leading to a cohesive, integrated diverse society in which preservation of health and safety and promotion of socio-economic activities are equally guaranteed for all.

Conclusions

This article aimed to examine the functional role of sidewalk and road crossings on the pedestrians' health and safety in the KSA cities. This study revealed that pedestrians suffer high casualties despite many national and local regulations to provide them with safe and standard sidewalks and pedestrian crossings. However, law and regulations were not enforced or materialized on the ground and tend to be ink on paper. It can therefore, conclude that reliance on the written statement of law and regulations or even expect to see these regulations be implemented on the ground tends to become simplistic and perhaps irrelevant in practice. Lack of enforcement might be due to the lack of potency on the authorities' side and their employees. The relevant query then becomes not necessarily whether we should focus on the provision of law and regulations rather the quality and potency, and commitment of the authorities' to implement what stated in the law. Therefore, With enhanced walkability condition, decision makers are better prepared to choose a suitable decision to urge walking in a safe and friendly environment for transportation, recreational, and utilitarian purposes. Achieving these targets is possible for city authorities by enforcing the relevant regulations and improving the current conditions of the sidewalks, crossing points, and urban spaces. The outcomes would reduce pedestrians' loss of lives by encouraging them to walk instead of using their private vehicles.

***All photographs were taken by the author in 2020.**

References:

- Afshan, A. (2012,18 August). Can we make Jeddah pedestrian-friendly? Arab News, p3.
- Algadhi, S.; Mufti, R. (2002). Malick, D. Estimating the Total Number of Vehicles Active on the Road in Saudi Arabia. *J. King Abdulaziz Univ. Eng. Sci.* 2002, 14, 3–28.
- Algadhi, S.; Mufti, R.; Malick, D. (2002). Estimating the Total Number of Vehicles Active on the Road in Saudi Arabia. *J. King Abdulaziz Univ. Eng. Sci.*, 14, 3–28.
- Aljoufie, M.; Zuidgeest, M.; Brussel, M.; Maarseveen, M.V. (2012). Spatial-temporal analysis of urban growth and transportation in Jeddah City, Saudi Arabia. *Cities* 2012, 31, 57–68.
- Almahmood, M.; Scharnhorst, E.; Carstensen, T.A.; Jorgensen, G.; Schulze, O. (2017). Mapping the gendered city: Investigating the socio-cultural influence on the practice of walking and the

- meaning of walkscapes among young Saudi adults in Riyadh. *J. Urban Design*, 22, 229–248.
- Al Turki Y.A. (2013). How can Saudi Arabia use the Decade of Action for Road Safety to catalyse road traffic injury prevention policy and interventions? *Int J Inj Contr Saf Promot.* 2014;21:397–402. [PubMed] [Google Scholar]
- Atef Elhamy K., M. (2013). Encouraging walkability in G.C.C. cities: Smart urban solutions. *Smart Sustain. Built Environ.* 2, 288–310.
- Bin Ayyaf, A. (2015). Enhance the human dimension in municipal work, Riyadh as a case]. Riyadh, Saudi Arabia: Tarah International.
- Booth, M.L.; Owen, N.; Bauman, A.; Clavisi, O.; Leslie, E. (2000). Social-cognitive and perceived environment influences associated with physical activity in older Australians. *Prev. Med.* 2000, 31, 15–22.
- Boston, G. (2008). The Many Benefits of Walking 30 Minutes a Day. Conference, Cape Town, South Africa, 29 September–3 October 2008; pp. 51–57.
- Bragg, J., Kolobov, A., and Weld, D.S. (2014). Parallel Task Routing for Crowdsourcing. *Proc. Of HCOMP 14.*
- Bromley, R.D.F., Matthews, D.L., and Thomas, C.J. (2007). City centre accessibility for wheelchair users: The consumer perspective and the planning implications. *Cities* 24:3, 229–241.
- Carmona, M., Magalhães, C. de, & Hammond, L. (Eds.) (2008). *Public Space: The Management Dimension.* London, New York; Routledge .
- Cilliers, E. J., & Timmermans, W. (2016). Transforming spaces into lively public open places: case studies of practical interventions. *Journal of Urban Design*, 1–14. Available at: <https://doi.org/10.1080/13574809.2016.1234336>
- Ernst M, Shoup L. (2009). *Dangerous by design: solving the epidemic of preventable pedestrian deaths and making great neighbourhoods.* Washington, D.C., Transportation for America, 2009.
- Garder PE. (2004). The impact of speed and other variables on pedestrian safety in Maine. *Accident Analysis & Prevention*, 2004, 36: 533–542.
- Gehl, J., & Gemzøe, L. (2008). *New City Spaces* (3 edition) Copenhagen: Danish Architectural Press.
- Gehl, J. (2011). *Life between buildings: using public space.* Washington, DC: Island Press. Available at: <http://public.eblib.com/choice/publicfullrecord.aspx?p=3317590>
- Gehl, J. (2006). *Life between buildings, using public space* (6. edition) Copenhagen: Danish Architectural Press.
- Hatch, R., 1984. *The Scope of Social Architecture.* New York: Van Nostrand Reinhold.
- Holston, J. (1999). The Modernist City and the Death of the Street. In S. M. Low (Ed.), *Theorizing the city, the new urban anthropology reader* (pp. 245–276) Rutgers University Press.
- Humpel, N. (2003). Environmental factors associated with adults' participation in physical activity A review. *Am. J. Public Health*, 2003, 93, 1552–1558.
- Jacobs, J. (1961). *The death and life of great American cities.* New York, NY: Random House.
- Jamal, A., Rahman, M. T., Al-Ahmadi, H. M. and Mansoor, U. (2019). The Dilemma of Road Safety in the Eastern Province of Saudi Arabia: Consequences and Prevention Strategies. *International Journal of Environmental Research and Public Health.*

- JSUDM (2008). *Jeddah Streetscape & Urban Design Manual*, Kingdom of Saudi Arabia, Jeddah Municipality.
- Kale, B., & Martin, P. (2015). *Comprehensive complete streets planning approach*. Washington, D. C.: Transportation Research Board Annual Meeting 2015, Paper # 15-1177.
- Keippel, A., Henderson, M. A., Golbeck, A. L., Gallup, T., Duin, D. K., Hayes, S., Ciemins, E. L. (2017). Healthy by design: Using a gender focus to influence complete streets policy. *Women's Health Issues*, 27, S22–S28.
- Kenyon, S., Lyons, G. and J. Rafferty (2002). "Transport and Social Exclusion: Investigating the Possibility of Promoting Inclusion Through Virtual Mobility," *Journal of Transport Geography*, 2002
- Khan, S. (2018). London set to become the world's most walkable city. Available at: <https://www.london.gov.uk/press-releases/mayoral/mayor-launches-londons-first-ever-walking-plan>
- Kirschbaum, J.B., Axelson, P.W., Longmuir, P.E., Mispagel, K.M., Stein, J.A., and Yamada, D.A. (2001). *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide*, Chapter 7.
- Knoblauch RL, et al. Investigation of exposure-based pedestrian accident areas: crosswalks, sidewalks, local streets, and major arterials. Washington, D.C., Federal Highway Administration, 1988.
- Krieger, A., & Saunders, W. S. (Eds.) (2009). *Urban Design*. Minneapolis: Univ Of Minnesota Press.
- Laker, L. (2017). Where is the World's Most Walkable City? Available at: <https://www.theguardian.com/cities/2017/sep/12/walkable-city-worlds-most-new-york-melbourne-fes-el-bali>
- Ledraa, T. (2015). Evaluating walkability at the neighbourhood and street levels in Riyadh using GIS and environment audit tools. *Emirates Journal for Engineering Research*, 20(2), 1–13.
- Lynch, K. (1984). *Good City Form* (Reprint edition) Cambridge, Massachusetts: The M.I.T. Press.
- Maloutas, T. (2017). Travelling concepts and universal particularisms: A reappraisal of gentrification's global reach. *European Urban and Regional Studies*,
- Mansuri FA, Al-Zalabani AH, Zalat MM, Qabshawi RI (2015). Road safety and road traffic accidents in Saudi Arabia. A systematic review of existing evidence. In: *Saudi Med J*. 36(4): 418–424.
- McMahon P. J. et al. (2002). An analysis of factors contributing to “walking along roadway” crashes: Research study and guidelines for sidewalks and walkways. Chapel Hill, University of North Carolina Highway Safety Research Center.
- Mehta, V. (2013). *The street, a quintessential social public space*. New York: Routledge.
- Ministry of transport (2011) *Development of the National Transportation Strategy (NTS)*, final report. Kingdom of Saudi Arabia.
- Moulay, A., Ujang, N., & Said, I. (2017). Legibility of neighbourhood parks as a predictor for enhanced social interaction towards social sustainability. *Cities*, 61, 58–64. <https://doi.org/10.1016/j.cities.2016.11.007>
- Mumford, L. (1981) *The Highway and the City*. Westport, Conn: Praeger.
- Owen, A., and Levinson, D. (2014) *Access Across America: Transit 2014*, U.S.A., Center for Transportation Studies, University of Minnesota.
- Rahman, M.T. (2016) Detection of land use/land cover changes and urban sprawl in Al-Khobar, Saudi Arabia: *Arabia. Nat. Hazards*, 2016, 84, 1807–1830.

- Rothman L, Howard AW, Camden A, et al (2012) Pedestrian crossing location influences injury severity in urban areas *Injury Prevention*. 18:365-370.
- Saad AH, Al Gadhi SA, Mufti RK, Malick DF. (2002). Estimating the Total Number of Vehicles Active on the Road in Saudi Arabia. *Journal of King Abdul Aziz University Engineering Science*. 14:3–28. Available at: www.kau.edu.sa/AccessPage.aspx?Site_ID=320&Ing=EN&SYS
- Sammer, G., Uhlmann, T., Unbehaun, W., et al. (2012). Identification of Mobility-Impaired Persons and Analysis of Their Travel Behavior and Needs. *Transportation Research Record: Journal of the Transportation Research Board* 2320:1, 46–54.
- Saudi Building Code (2018). Administrative, Architectural and structural Requirements. Ministry of Municipality and Roral areas, Riyadh, Municipality. Available at: <http://sbc.gov.sa>
- Speck J. (2019) *Walkable City Rules: 101 Steps to Making Better Places*, Washington, Island Press.
- UNESCO. (2016). *Culture: urban future: global report on culture for sustainable urban development*. Paris, France: UNESCO Publishing.
- United States Access Board. (2011). *Proposed Accessibility Regulations for Pedestrian Facilities in the Public Right-of-Way*.
- World Health Organization (2010) Global Health Observatory (GHO) data. *World Health Statistics*. Available at: www.who.int/gho/publications/world_health_statistics/en.
- World Health Organization (2018) *Global status report on road safety*. 17 June 2018 Report, available at: <https://www.who.int/publications/i/item/9789241565684>.