POST-COVID CITY: Assessing the Role of Urban Design in Achieving Social Distance and Coping Urban Behaviour in Four Types of Neighbourhoods in Greater Cairo Region.

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Abstract:

The uprising spread of corona virous pandemic gives social distance a great concern as a new way of life in contemporary cities. Covid-19 has forced planners and scholars to question health safety of traditional neighborhoods that are perceived as main reason for the spread of covid 19. Accordingly, they suggest that the turn to modern neighborhood will contain the spread of covid-19 infection. This research aims to examine the relation between urban form and transmission of respiratory virus to highlight major lessons that can be learned for post-covid city. The research assumes that minimizing social distance to the spatial dimensions that limit to design large spaces community is a misleading. Rather, safe social distance is embedded in people coping urban behavior that can be facilitated in resilient urban forms. The research assumes that different types of urban forms create different levels of urban resilience that can facilitate different levels of coping urban behavior and mitigation of occupation density that accordingly impact the level of infection spread. To examine such assumption, the research depends on deductive method using a comparative analysis of four different types of neighborhoods. It reports, based on empirical findings, three main conclusions. Firstly, it reports that covid19 caused different levels of coping behavioral change and occupation density across different types of neighborhoods. Secondly, it observed coping ideas, such as reducing unnecessary activities, reducing activities frequency and duration, distributing activities to different times of the day, distributing activities to different locations of the community, and displacement of activities from the indoor to the outdoor. Finally, it deduced different design guides such as soft density, soft mixed use, and grid street patterns that are important for achieving urban resilience and can facilitate required coping behavior to mitigate occupation density in urban spaces and accordingly control viral infection.

Keywords:

الملخص:

أدى الانتشار الملحوظ لجائحة فيروس كورونا الى ارتفاع أهمية التباعد الاجتماعي كمدخل أساسي في صياغة الحياة العمرانية في المدن الحديثة. فقد أدت جائحة كورونا الى تساؤل العمرانيين والباحثين عن سلبيات العمران التقليدي على صحة المواطنين، حيث تم التعامل مع العمران التقليدي على انه مصدر أساسي لانتشار العدوى الفيروسية لفيروس كورونا ١٩. وبالتبعية فقد اقترح العديد من العمرانيين والباحثين ان التحول نحو نمط العمران الحديث سيكون له دور جوهري في مكافحة انتشار العدوى. يهدف البحث الى دراسة دور التصميم العمراني للمجاور السكنية في وتأثيره على انتشار الأوبئة الفيروسية. لاستخراج دورس مستفادة لصياغة مدن ما بعد الجائحة. فترض البحث ان حصر التباعد الاجتماعي في

الخصائص المادية مرتبطة بزيادة ابعاد الفراغات هو توجه قاصر، وعلى النقي يفترض البحث ان التباعد الاجتماعي الامن يكمن بالأساس في تشجيع سلوك التكييف والذي يمكن تحققه عن طريق تصميم العمران المرن. حيث يفترض البحث ان تنوع اشكال العمران يتبعه تدرج في مستوى المرونة والتي يمكنها ان تدعم سلوك التكييف العمراني عند السكان وبالتبعية تعمل كعامل وسيط لكثافة الاشغال في الفراغات العمرانية والتي بالتبعية تؤثر على انتشار العدوى. في السبيل لاختبار صحة الفرضية، يعتمد البحث على المنهج الاستقرائي حيث بالتحليل المقارن لأربعة مجاورة سكنية مختلفة في الخصائص العمرانية. وقد توصل البحث بالاعتماد على النتائج النظرية الى ثلاثة نتائج أساسية، أولهما ان جائحة كورونا أدت الى ظهور سلوك التكييف العمراني وتغير في كثافات الاشغال والذي ظهر بدرجات متفاوتة مع اختلاف النماذج العمرانية للأربعة مجاورات. ثانيا، تم استقراء العديد من أفكار سلوكيات التكييف مثل تقليل الاقبال على الأنشطة غير الضرورية، تقليل عدد مرات التردد على بعض الأنشطة، تقليل مدة تنفيذ بعض الأنشطة، توزيع زمني للأنشطة على مدار اليوم، توزيع مكاني للأنشطة على مناطق متنوعة من العمران، وتحريك بعض الأنشطة من داخل المباني الى خارج المباني. وأخيرا، تم استقراء مؤشرات تصميمة مثل التركيز على الكثافات المتوسطة والخلط الاستعمال المتوسط واستخدام أنماط الطرق الحلقية التي يمكنها ان توفر القدر اللازم من المرونة العمرانية مثل تغيير الاستعمال والامتداد والتي بالتبعية تؤدي لتوزيع الاشغال وتقليل الكثافة وتحقيق التباعد الاجتماعي الامن.

الكلمات المفتاحية:

كوفيد ١٩، التباعد الاجتماعي، التزاحم، سلوك التكييف العمراني، أنماط المجاورات السكنية.

1. Introduction

The first few months of 2020, the whole world faced the emergence of Covid 19 pandemic. Covid19 is one of the respiratory viruses that cause infection through the air, through surfaces, and by close contact when the infected person coughs or sneezes and cause droplets that entre through the eye, nose, mouth, and breath to infect other persons who are in close contacts less than 1.5 m increase the rates of infection. The high incidence of infection of Covid-19 than other types forced all countries try to contain the spread by adopting different strategies to contain the spread of covid 19. Two strategies were asked from people the "stay home" then "social distance".

Starting with the stage of lockdown and self-isolation, World Health Organization (WHO) followed by all governments regulates to close cafes, restaurants, theatres, shopping malls, green spaces, and schools, and recommends working from home. Residents were asked to stay home and to avoid public spaces, and to avoid face to face contact as a step for containment strategies. The short lockdown failed to give continuous solution that can last; Accordingly, most governments turn to the post-lockdown stage by taking precautions of social distance and reducing rates of occupation, where residents were asked to avoid close distance with people to prevent infection and to contain the spread of Covid-10 and asked to take some precautions to reduce infection including keeping 1m distance with others, using mask, and alcohol.

In post-lockdown governments aimed to expand safe occupation to urban spaces, to keep their social, functional, and economic role in urban development and to achieve sustainability. Accordingly, a new paradigm shift in urban design is expected, that put social distance as a new way of life to prevent the spread of the virus. Covid 19 limit people rely on mass public

transportation and minimize participation in social activities and depend on virtual modes. Different suggestions are adopted in public places mainly by providing the places with sanitary facilities that help with the ongoing sterilization process, providing technical facilities that help monitor to alert and act accordingly, and providing ICT, media, and virtual communication to do most of the daily life needs including work, shopping, and education. The approach of Rather, still little concern to the role of urban form in keeping social distance and contain infection in sustainable way.

The old norms of compaction are subjected to research, a paradigm shift from old paradigm that found efficiency in the face-to-face contact to new paradigm that strive for reducing the face-to-face contact and keeping social distance aims to change people behavior to safely include, and practice activities. Planners are required to rethinking streets and public spaces for post-pandemic city and to develop new urban standards and requirements for open public spaces and neighborhoods essential for behavioral social change to social distance. A new paradigm shift focusing on the long-term impacts of COVID-19 and social distance requirements on public space and neighborhood design on discouraging social interaction and face to face contact. A paradigm shift that can change our relationship with public space and can reduce social inclusion and interaction between residents to avoid infection.

Planners are recommended to support social distance as a norm for the quality of urban form even though it may cause emergence of social segregation in front of social inclusion. Planners are facing challenge of changing paradigm of urban behavior to be safer and, also to be sustainable. This paper considers how COVID-19 might influence people habits, behavior, way of living, behavior, lifestyle, where and how people live, work, recreate, and move, and how these change behavioral patterns might in turn shape future development in term of safety and also sustainability.

1.1. Research Problem
Covid-19 pandemic has raised concern that traditional neighborhoods are increasing the spread of covid 19 due to the high level of face-to-face contact between residents. (Sy et. al. 2021, Rader B, et. al. 2020; Heliang Y, et. al. 2021). It suggests turn to modern neighborhood that have excess spread of green spaces extending throughout the urban fabric hoping to create advantage for need to social distance to achieve safer environment and reduce infection (Megahed, et al. 2000; Chang, V., 2020). A misleading perception of dense, mixed use, and small distance traditional neighborhoods as cause of viral infection could encourage planners, authorities, and developers to promote suburban sprawl for misguided reasons and to support safety over sustainability.

1.2. Research Hypothesis
Most literature put traditional neighborhoods with high residential density and reduced urban spaces as key factors for increasing covid infection. They thought that moving from traditional to new sprawled communities with increased urban spaces and reduced residential density will reduce viral infection and spread. In conflict, this research argues that this assumption rather

than be the solution for reducing infection, it could be part of increasing the viral infection. The research argues that social distance and crowd management are not a matter of spatial features of urban form, rather it's embedded in the impact that urban form could have on people coping urban behavior that in turn can encourage or discourage social distance regardless of the allowed physical spaces. The research assumes that covid19 results in varied urban behavioral change across different neighborhood types and that sprawled neighborhood is not corresponding to safer social distance, rathe it can affect people's coping not only to unsustainable behavior but also to reduce social distance that may increase viral infection.

1.3.   Research Aim
The research aims to assess the impacts of neighborhoods factors on people's coping urban behavior that could have a great encouragement or barrier for social distance, accordingly, associated with the spread of COVID-19. It compares resident's coping urban behavior in response to covid 19 across different types of neighborhoods including patterns of social activity, inclusion, and participation. This research tends to answer the following:
- How covid change urban behavior after the pandemic across different neighborhoods?
- What are adopted coping urban strategies to mitigate occupation density and overcrowding?
- How adopted coping urban strategies varies across different types of neighborhoods?
- How urban form become more resilient to facilitate coping urban behavior?

1.4.   Research Methodology
The research depends on deductive method with comparative analysis of four different types of neighborhoods to trace any significant difference in coping behavior across the four types and deduce the correlation between neighborhood patterns and coping urban behavioral change and social distance before and after the pandemic.

2.   COVID19 A NEW PARADIGM OF URBAN FORM (safety vs sustainability)
Covid 19 is an airborne disease, usually transmitted via inhalation. It is mainly transmitted through droplets and aerosols generated when an infected person coughs, sneezes, or exhales. Droplet's diameter of >20 µm are too heavy to hang in air and quickly fall on floors or surfaces 1 to 2.76 m when people are coughing or sneezing and remain active for 2 to 7 days, so it is risky for persons who touch the drops. Aerosols have diameter of <5 µm are lighter so it can hang in air and takes more than 2 m, so it is much riskier (Bazant, 2021). However, the virus transmits through aerosol from person to person or droplets of particle-based transmission over surfaces, viral infection control can be achieved through preventing person to person contact (Ong et al. 2020, Dietz et al. 2020). Infection control aims to face viral spread in two ways, the first depends on reducing air-porn infection from infected person to another through increasing social distance between people, and the second by minimizing physical contact through adopted no-touch rules between people and places (Jayaweera et al. 2020).

WHO regulates to avoid crowdedness, escaping indoor spaces and keeping safe social distance by taking some precautions including closing crowded indoor spaces i.e. mosques, churches,

café, restaurants, cinemas, and shopping malls, closing public spaces, and moving some activities to augmented schools, work, and universities (WHO, 2020). WHO recommends taking some precaution of location, proximity and time to lower risk of infection and increase safety. WHO recommends shift public indoor activities from indoor enclosed spaces to open air spaces i.e. banks, shift public activities to less crowded places further away from others. Finally, concerning public activities to shorten time with others.

Maintaining social distance became the main slogan of the state, where Covid 19 has changed the way people work, shop, and educate. Neighborhood design must be part of the response to face the spread of the virus, to respect physical and social distance in the streets, activities, and urban spaces. The correlation of urban form and covid infection are introduced in numerous studies, different scholars argued that urban form can mitigate and adopt to covid infection (Lak, A., Asl, et.al. 2020; Brizuela, N. G., et.al. 2021). Covid19 raised a challenge of variation in coping behaviors in different types of neighborhoods. Residential density, building density, land use pattern, and street network are factors of spatial configuration of urban form that differentiate modern and traditional neighborhoods.

Last decades, traditional community that considers high density, mixed use, grid street patterns was highly perceived as essential factor for sustainability by which - the city can cope with climate change to achieve energy consumption, and socially encourage interaction and sense of community. It places the day-to-day things we need to do in immediate proximity to each other and reduce required transportation and relay on short trip distances which normally happen using walkability and cyclability mode choices. It increases permeability and accessibility and mostly promotes short and direct routes that offers shorter trips and reduces travel distance, it provides different alternative passes and can be more transit friendly to the extent that they may allow greater penetration of an area by transit services. It is expected to enhance walkability and increase trips frequency by foot and reduce trip frequency by private cars, especially with lower parking area.

Lately, in post-lockdown stage, traditional community is mostly perceived as an essential causal relation of insufficient social distance and increasing crowdedness, could have direct causal relationship with the spatial properties of crowding. Accordingly, conceived as basic factors for increasing risk of viral infection and affecting the spread of an epidemic, as it increases contact between people. Scholars consider the greater the population density, the greater the risk of infection (Lak, A., Asl, et.al. 2020; Sy et. al. 2021; Hu H, et. al., 2013; Wu T, et. al., 2016; Rader B, et. al., 2020). They sought that reducing density will lead to sufficient social distance in cities, which outbreaks the growth of disease transmission (Lak, A., et.al. 2020; Jabareen, Y. et. al., 2021). They thought that reducing mix of commercial activities with residential activities will prevent the formation of crowds in neighborhoods and can make urban form more resilient to pandemics (Lak, A., Asl, et.al. 2020). They thought that the smaller the distance, the more convenient the connection between city parts, the larger the scale of the population flow, the easier the spread of pandemic across regions, and that reducing connectivity by imposing treed pattern can reduce viral infection.

A misleading physical engagement of overcrowding with traditional urban form as major cause for viral infection. They argue that traditional urban forms are main causes of overcrowd by reducing social distance beyond the safe limit, on the other hand, by minimizing coping behavior. This argument needs to be reconsidered, furthermore, it is still unclear to what extent population density, mixed use, and street permeability affects infection rate.

3. Social Distance, Coping Behavior And Occupation Strategies:

Urban form plays an important role in shaping people urban activities and participation to urban life (Ghonimi I., 2020). This role can be influenced by hard situations like Covid 19 that challenge people daily life activities. People fear of infection makes them minimize daily life activities and control their participation to urban life. On the other side, the social and economic negative impacts of lockdown make people aims to reconsider coping their life behavior to maintaining safe daily life activities and make life come back to normal state. Accordingly, this could highlight the role of resilient urban form in facilitating coping urban behavior to maintain safe social distance and to avoid over-crowdedness to control the chances of viral spread.

3.1. Social Distance vs Over-crowdedness.

Most medical organizations recommend keeping safe distance between people by reducing overcrowded to limit the spread of viral diseases like COVID-19 (Goniewicz, et al. 2021).

3.1.1. Meaning of social distance and over-crowding:

Social distance is the physical distance maintained between individuals in social contexts, it is a practice of maintaining safe physical distance from others. Most medical organizations recommend staying at least 1 to 2 m away from others to be safe from infection, and to achieve containment of the spread of covid-19 (WoW, 2020). In contrast, over-crowdedness refers to the number of users exceeding the available allowed occupants (Blake, et al. 2007), where save physical distance are not achieved, that could increase intensity and duration of risk for viral spread. For the purposes of prevention of airborne disease transmission, HUD defines overcrowding as less than 15.3 square meters of living area per person (Seidlein, et al. 2020). Urban crowding is a matter of people urban behavior that obeys people's intentions, attitude, willing, and interest to exist in urban spaces.

3.1.2. Measuring social distance and overcrowding:

Assessing safe social distance and overcrowding is important to meet safety and sustainability requirements. Spatial analysis can be used based on Circles Packing Method to deduce and compare the achieved social distance and occupation density in different cases as in figure (1). In the other hand occupation density and overcrowding index can be measured by dividing the number of actual recorded persons to the number of allowed persons within safe social distance in certain area. The greater value than one indicates that people are not in safe social distance.
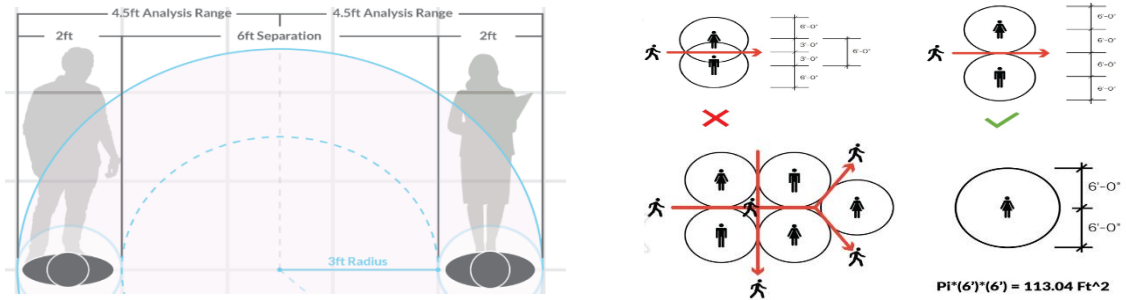
Figure (1): measuring social distance in urban spaces.

3.2. Coping Urban Behavior and Occupation Strategies:

Coping urban behavior aims to maintain the continuity of social, economic, and functional role of urban spaces in people inclusion, interaction, and participation safely in daily life activities. In confront with covid 19, different coping behavior and occupation strategies are adopted to keep social distance, reduce crowdedness, and reduce exposure risk in urban spaces. It aims to keep safe social distance as a challenge of crowd management to face the spread of covid infection.

3.2.1. Meaning of coping behavior and occupation strategies:

Coping is defined as a change in behavior during or after a difficult situation to maintain physical and mental safety. It is a set of actions taken to deal with stressful or threatening situations (Srivastava, et al. 2014). Different coping strategies are recorded in literatures that aims to redistribute occupation in term of time, location, and function based on change of the shape, time, and place of activities to keep occupation density and distribution in safe social distance in urban spaces.

TABLE 1: Deduced coping urban behavior strategies in urban spaces.

Coping Strategies	WHO	CDC	UN	NACTO 2020	Varma 2020	Frearson 2020	Pena 2012	Euronews 2020
Reduce occupation rates		*	*					
Increase urban spaces rates								*
Increase social distance	*	*						
Change mode choices to safer one		*						
Reduce occupation frequency		*						
Reduce duration of occupation	*							

Distribute occupation to different times	*	*					
Distribute occupation to different locations	*	*				*	
Displace activities from indoor to outdoor	*		*	*	*	*		*
Extendable urban space			*			*	*
Convertible of urban space			*		*	*	*
Multifunctional urban space			*				*

The Centers for Disease Control and Prevention (CDC, 2020), World Health Organization (WHO, 2020), United Nations Human Settlements Programme (UN, 2020), and National Association of City Transportation Officials (NATCO 2020) have issued guidelines for the control, prevention, and evaluation of COVID-19 that are summarized in the following points:

• Reduce occupation density in urban spaces: It refers to number of occupants per area within safe social distance. It probes the limit people are willing to reduce existence in urban spaces. It can be achieved in four ways: first displace activities from physical to virtual based on ICT, second displace activities from urban spaces, 2nd places of work, education, and shopping places to 1st place of home, third reduce unnecessary optional and social occupation, minimize necessary occupation, finally increasing urban spaces and pavement.

• Change mode choice of occupation to safer modes. It probes the degree to which residents willing to use certain modes than others with certain duration at certain times of the day. By using equality alternative different safe modes, increase alternatives to give great variety.

• Reduce the frequency of occupation. It can be classified as High, Medium, and Low-frequent occupation. It probes the degree to which residents are forced to repeat certain behavior by certain modes at certain times of the day.

• Reduce the duration of occupation. It can be classified as Short, Medium, and Long-stay occupation. It probes the degree residents forced to spend more time to do certain behavior by certain modes at certain times of the day. Increasing the duration of contact with infected persons will increase the risk of infection.

• Distribute occupation to different times of the day and the week. It can be classified as early-morning, mid-day, late-night occupation. It probes the degree residents can occupy urban spaces at different times of the day morning, afternoon, and evening.

• Distribute occupation to different locations: It refers to the ability of occupation at different locations of the community. It can be indoor or outdoor, and central or linear. It probes the degree residents occupy urban spaces at different places.

3.2.2. Measuring coping behavior and occupation strategies:

Assessing how Covid cause coping urban activities behavioral change helps to predict how to avoid urban crowdedness, achieve safe social distance and meet sustainability requirements. Coping behavior concerns the change in typical way of behaving with urban spaces and with other, it concerns change in people's intentions, attitude, willing, and interest to exist in urban spaces, what they are more likely and willing to act. Different investigation and measuring tools are required to give clear conclusion for social behavioral change. It depends on spatial measure, questionnaire and ethnographic observation of coping behavior including mode choices, frequency, duration, and type of doing that activity. Quantification of coping of urban activities is essential for assessing its role in covid infection, and control pandemic (Hackl, J., et.al. 2019). Patterns of urban activities can be measured using the following parameters (Ghonimi 2021):

• The variable "purpose of activity" refers to the different types of reasons for doing physical activities including necessary activities e.g. work, education, shopping; optional activities e.g. sport, and recreation; and social activities e.g. meeting friends, family, and neighbors.

• The variable "Modes of urban activities" refer to the way urban activities can happen including virtual, augmented, and personal modes.

• The variable "Frequency of urban Activities" refers to the times that certain activity could happen per day, it includes high, medium, and low-frequency activities.

• The variable "Duration of urban Activities" refers to the time residents are spending in each activity per day including short-stay, medium-stay, and long-stay activity. It measures residents willing to spend more time do activity in urban space at certain times of day.

• Social intended active vs unintended passive inclusion:

o "Active intended activity" refers to planned social inclusion for intended purposes by invitation which are limited without the proper interest to attract residents.

o "Passive subsidiary activity for other activities" refers to social inclusion as accidental, unplanned, and causal encounter subsidiary and passive to other activities.

o "Passive byproduct of movement" refers to social inclusion as accidental, unplanned, and causal social encounter as byproduct of movement.

Covid 19 is expected to make deep behavioral changes in the patterns and modes of urban daily-life activities in urban space. It can impose new activities, can diminish some activities, can minimize the frequency of some activities, can reduce duration of some activities, can distribute occupation to different times of the day, can change the way people used to act some activities and can move some activities from the indoor to the outdoor and can displace activities to virtual using internet facilities to substitute physical activities. Accordingly, it could have a great encouragement or barrier to achieve safe social distance and meet sustainability.

TABLE 2: summarized variable for measuring coping behavioural urban patterns.

Urban activities coping behavior		Recommendation to enhance coping behavior
Reduce occupation. Reduce unnecessary occupation	Mode of activities (Personal, augmented, and virtual)	Change modes to virtual modes. Reduce physical inclusion to urban spaces.
	Mode of activities (1st place, 2nd place, 3rd place)	Move activities to home. Reduce frequency of prerequisite occupation.
	Mode of activity (necessary, optional, and social)	Reduce unnecessary activities, minimize optional and social activities, limit necessary activities.
	Extendibility of urban spaces.	Increase urban spaces and width of sidewalks
Mode choice of Physical occupation	Passive and active modes (intended and unintended)	
	Provide equitable modes.	Limited users (shift to personal
	Planned intended inclusion for socializing, walking, cycling)	
	Unplanned (By-product, and Subsidiary of other activity)	Shift to intended active and minimize unintended passive
	(Alone, with friends, with family, with neighbor)	
	Exclude old, exclude young, exclude female	
Frequency of Physical activities	Frequency of physical (personal) activities (High-frequency, Medium-frequency, and Low-frequency)	Reduce the frequency of doing physical activities. Limit to low frequent trips.
Duration of Physical activities	Duration of physical (personal) activities (Short-stay, Medium-stay, and Long-stay) activities.	Reduce the duration of doing physical activities. Limit to short-stay activities.
Time of Physical activities	Time of doing physical (personal) activities. (Morning, After non, Night) activities.	Distribute activities to different times of the day and the week.
Location of Physical activities	Location of doing physical (personal) activities. (Indoor – outdoor) / (central location, linear locations)	Distribute activities to different places of the community. Move activities from the indoor to the outdoor.

4.   The Case Study Of Four Categories Of Neighborhoods In Gcr

The aim is to trace any significant differences in coping urban behavior in responses to Covid 19 across different categories of neighborhoods. The relationship between neighborhood design and coping urban behavioral change in response to covid 19 will be examined to develop design guidelines to minimize the spread of covid 19. Four types of neighborhoods are selected to present different design pattern in Greater Cairo Region, the central early developed, the early planned, the flourish of new settlements to the west and the east, and the private gated communities.

4.1.   Case Study Selection

Four types of neighborhoods were selected to present different categories of neighborhoods in Greater Cairo Region. Khalfawy in Shoubra is selected to represent early developed neighborhoods, Heliopolis is selected to present early planned neighborhoods, EL-Nargis in New Cairo is selected to present new planned neighborhoods, and P11 in Madinaty is selected to present the contemporary planned neighborhood as in Figure 2.
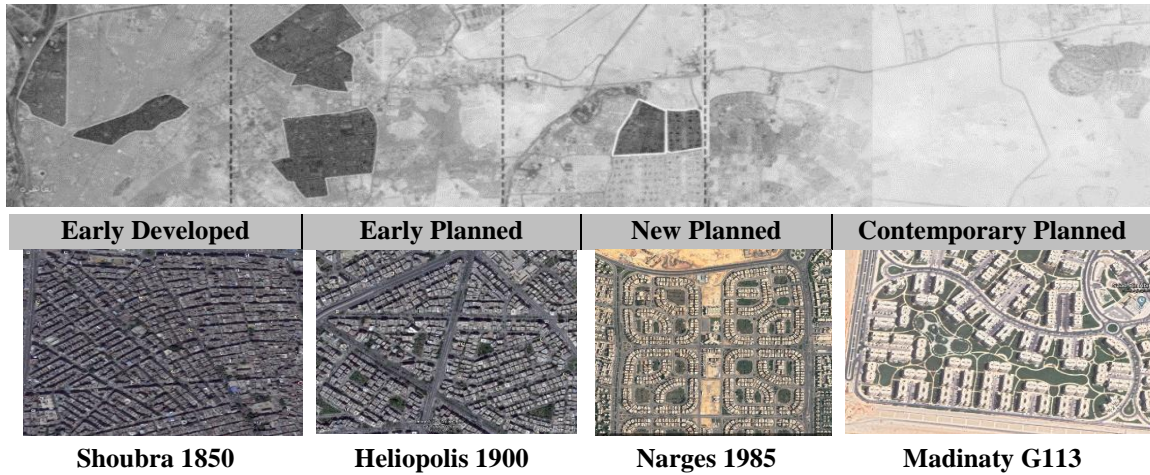

Early Developed	Early Planned	New Planned	Contemporary Planned
Shoubra 1850	Heliopolis 1900	Narges 1985	Madinaty G113

Figure (2): Selected case study area across different stages of GCR – Egypt.

4.2.   Data collection and classification:

Three forms of data were collected, the first aims to measure patterns of urban form based on spatial data, the second aims to measure social distance based on circle packing method and observation, and the third aims to measure coping behavior patterns based on questioner and observation, finally their correlation are deduced.

4.2.1. Measurements of urban patterns:

This part proposes to measure urban form patterns represented in street network pattern, housing income pattern, and land use pattern. Data were collected using surveying maps, observation, satellite maps, photographic images to document and explore neighborhoods urban configuration patterns as in table (3) as follow:

• Street-network pattern are classified under three headings: Street networks categorize grid, loop, and tree patterns. Linear feet of streets, No. of blocks, No. of intersections, No. of access point, No. of cul-de-sacs, and percentage of streets area. And Depth, cycle, permeability, and accessibility index.

• Land use pattern are classified under three headings: Land-use diversity: measure diversity between different land-use types, Land use variation: measure length of (dividing vs. connecting) line between different land-use types, it represents the degree of mix vs. separation. Land use density: measure the ratio of nonresidential to residential use, it represents density of land use.

• Housing patterns are classified under four headings: Housing variation, Housing mixt hat represents inclusion vs. segregation; Housing Density ranges between low density (60-120 Person/ Acre), soft density (300-500 Person/ Acre) and hard density (800-1000 Person/Acre).

4.2.2. Measuring occupation density (social distance – crowding):

Social distance and occupation data were collected through spatial analysis of photograph, and video camera records that are taken at different times of the day, and at different distribution of location of each type of neighborhoods. Spatial analysis is used based on Circles Packing Method to deduce and compare the achieved social distance across different neighborhood types, beside observation tools to double check the reported scores by spatial analysis. (WHO) recommends keeping social distance not less than 1m from others. Applying circles packing method will recommend a circle with radius 0.8 m surrounding each person in urban spaces including 0.3 for the person and 0.5m minimum distance. Based on such assumption occupation rates will be 2 m2/person. This could create occupation density by dividing urban space area by 4m2/person.

Figure (3) represent ethnographic observation based on photography to record occupation density at different places of the community, different times of the day, and record occupation mode choices, duration, and times.
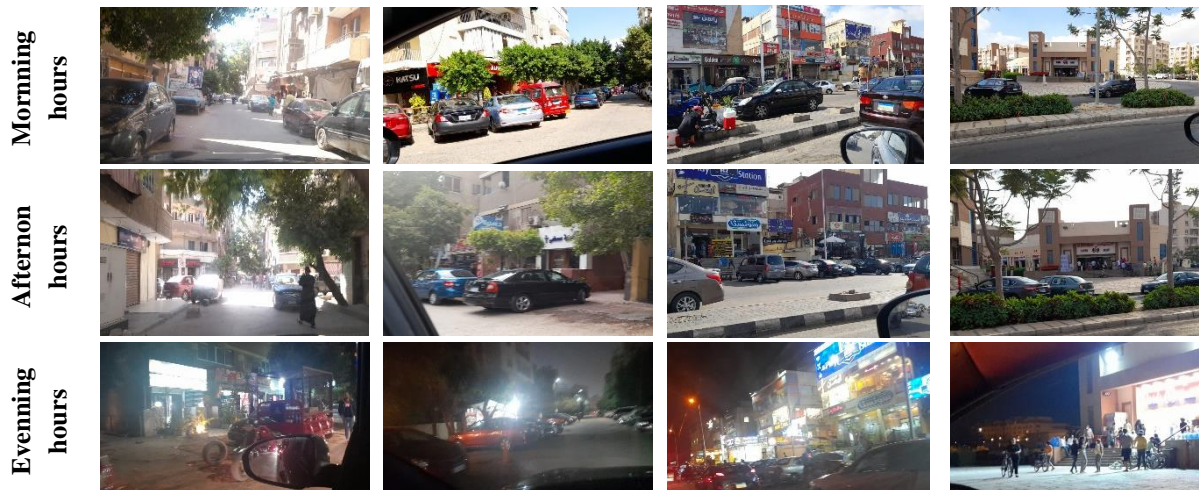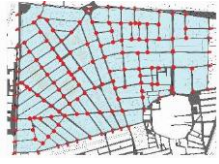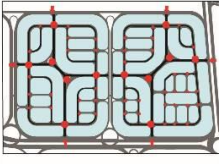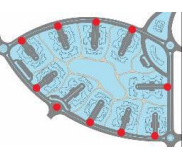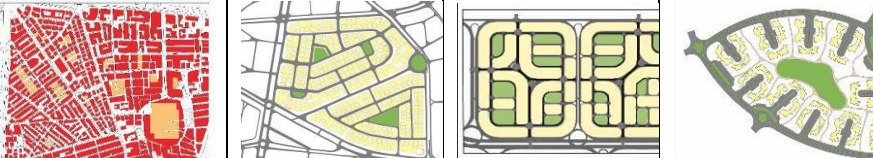

Figure (3): Observation of occupation density at different times of the day.

Table (3): Main Socio-Spatial Characteristics of Case Study Area

		Early Developed	Early Planned	New Planned	Contemporary Planned
		Khalafawy	Heliopolis	Jasmin (New Cairo)	Madinaty G113
Street Network Pattern	Access point	27	13	10	13
	Road Length	12344.9434	11467.1854	8070.7919	
	Type	Grid	Treed	Hierarchical (Loops)	Hierarchical (cul-de-sac)
	Orientation	outward oriented	inward oriented	inward oriented	inward oriented
	No. of intersections	107	55	16	0
		High	Mid	Low	Very low
	L. of grid	16166.5529	14736.7059	0	0
			Mid	High	Very low
	L. of loops	0	0	6958.8716	0
		Low	Mid	High	Very low
	L. of cul-de-sacs	0	0	0	
		Low	Mid	High	Very high
	No. of blocks	180	63	20	1
		High	Mid	Low	Very low
	Road percentage	40%	30%	20%	10%
		(A): Fine grained public Transit oriented Development with high no. Of intersections, egress points, and street length.	(B): Fine grained public urban form Transit oriented Development	(C): Super block public Treed inward oriented Super block with low intersection density, egress points, and street length.	(D): Super block public Treed inward oriented Super block with low intersection density, egress points, and street length.
Street Analysis	Density Index	107	52	14	5
	Cycle Network Index	53	12	1	1
	Relative Continuity index	72	17	4	1
	Relative Depth index	53	12	1	1
	Permeability Index	98%	48%	13%	3%
	Accessibility Index	98%	28%	5%	5%

Land use pattern	Landuse Type	Residential	80333	162375	200700	
		Commercial	216333	8500	0	0
		Educational	12850	0	0	0
		Religion	25500	3000	0	0
		recreational		18000	65000	
			Diverse - Residential, Commercial, and crafts	Mixed – Residential and Commercial	Single - Residential	Single - Residential
			Hard Land use Variation	Soft Land use Variation	Single Land use	Single Land use
	Landuse Density	(nonresidential/residential (m2)	68%	25%	0%	0%
			Hard density use	soft density use	Single use	Single use
	Landuse Mix	Connecting line	6543	3951	250	0
			Hard mixed	Soft Mixed	Single Use	Single Use
Housing pattern	Housing Variation		Low, Mid and High	Mid and High income	High Income	High Income
			Hard Variation	Soft Variation	No Variation	No Variation
	Housing Density	(person/fedan)	1100	400	80	60
			Hard high density	Soft high density	Soft Low Density	Hard Low Density
	Housing Mix	Connection between types	5850		0	0
			soft mixed income	Soft mixed income	Hard	No variation

The critical occupation density is defined as the highest recorded occupation values at critical location of the community, critical time of the day, and critical duration. It can be defined with high red values in the graphical representation. A graphical representation of occupation density based on recorded spatial occupation values in term of allowed occupation based on safe social distance, the actual number of observed persons at morning, afternoon, and evening times.

Crowdedness factor (safety risk factor) is calculated by dividing critical occupation density to allowed safe value, four types of occupation density are recorded:

- Low occupation density to 25% with green color.
- Medium occupation density starting from 25% up to 50% with yellow color.
- High occupation density starting from 50% up to 75% with orange color.
- The critical highest occupation density greater than 75%. with red color.

TABLE (4) Measured Scores for social distance and crowdedness factor

Social distance		Early developed	Early planned	New Planned	Private community
		NH1	NH2	NH3	NH4
Allowed ocupation with keeping social distance	Area	200 m2	300 m2	400 m2	500 m2
	Rate	2 m2	2 m2	2 m2	2 m2
	Density	100	150	200	250
Actual no. of observed person	Morning	100	80	20	30
	Afternon	115	70	110	120
	Evenning	110	65	210	240
	Total	325	215	340	390
Critical ocupation density		120	80	210	240
Crowdedness factor (safety factor)		115%	50%	105%	95%

Figure (4) graphically represent the distribution of occupation density at different locations of the community at different times of the day. Safety risk factor is presented in a graphical chart to spatially represent crowded ness distribution at different locations and different times of the community.
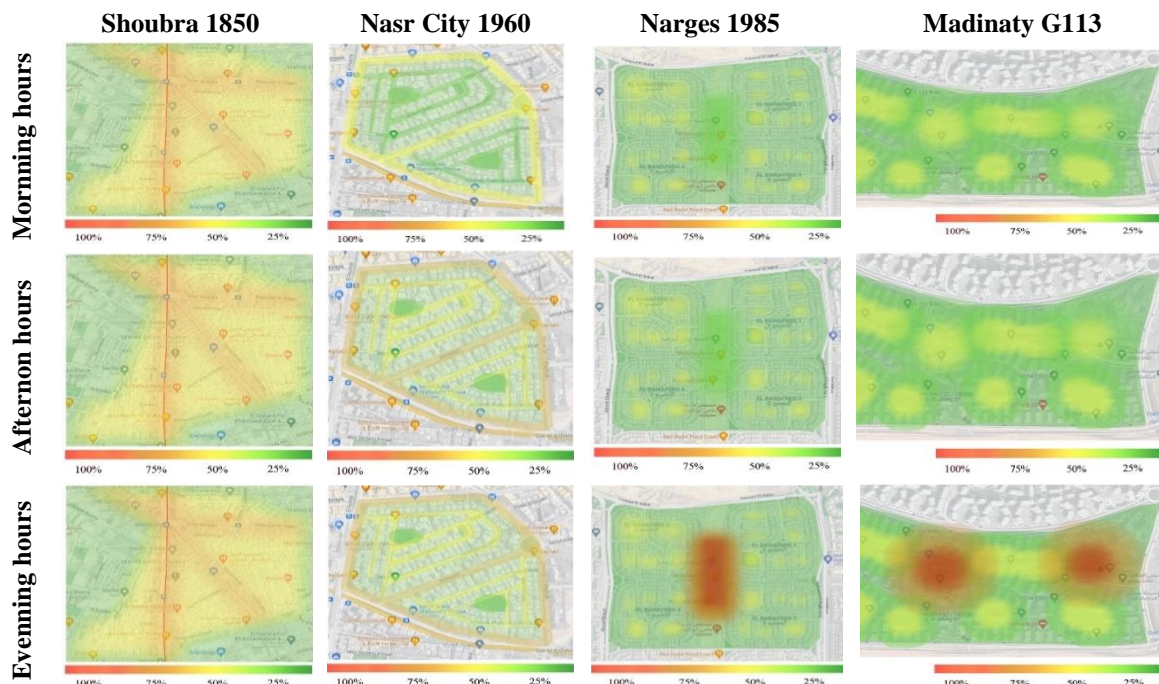

FIGURE (4): GRAPHICAL REPRESENTATION OF OCCUPATION DENSITY IN EACH NEIGHBORHOOD.

4.2.3. Measuring coping urban behavior and occupation strategies :

Measuring urban behavior concerns the change in repeated way of behaving with urban spaces and with each other, it concerns what residents more likely to act. It requires different investigation tools, to give clear conclusion. Coping urban behavior data were collected through observation and an online questionnaire survey. A questionnaire administered to district residents: Sample selection of average 40 residents are randomly selected in each case study to represent different gender, age, education, and income. It concerns coping urban behavior attitudes to keep social distance including questions on activities mode choice, frequency, duration, place, and time of doing activities. It depends on closed ended questions using 5 Likert scale. The questionnaire list major expectation of coping behavior in different neighborhood types. Table (5) represent recorded coping indicators.

TABLE (5): Recorded Scores for Coping Behavior of Urban Activities

	Urban activities coping behavior		Early Development	Early planned	New Planned	Private Community
Mode Choice of Physical occupation	Necessary activities (times/day/ type)	Work from home	2.3	3.3	4.1	5.2
		Educate from home	2.2	3.5	4.3	5.3
		Shop from home	2.4	3.1	4.2	5.2
	Keeping inculsion of necessary activities to urban space.		70%	60%	30%	40%
	Optional activities (times/day/ type)	Encourage kids playing	3.5	3.2	2.1	4.2
		Entertainment and Recreation	3.2	3.3	2.2	4.4
		Walking, Dogging and Cycling	3.1	3.4	2.3	4.3
	Keeping inclusion of optional activities to urban space.					
	Social activities (times/day/ type)	Encourage Social occasions	3.2	4.2	2.3	4.3
		Encourage Religion occasions	3.3	4.1	2.1	4.2
		Encourage meeting neighbors and friends	3.1	4.1	2.1	4.3
	Keeping inclusion of social activities to urban spaces.					
Frequency of Physical activities		High frequency activities	4	3	20	30
		Medium frequency activities	4	3	160	170
		Low frequency activities	4	3	190	200

	Coping with low frequency occupation		**95%**	**90%**	**85%**	**25%**
Duration of Physical activities		Short-stay occupation	120	80	20	30
		Medium-stay occupation	125	70	160	170
		Long-stay occupation	120	65	190	200
	Coping with minimum long stay occupation		**95%**	**90%**	**85%**	**25%**
Time of Physical activities		Morning times	100	80	20	30
		Afternoon times	115	70	110	120
		Night times	110	65	210	240
	Coping by distribution at different times of the day		**70%**	**85%**	**15%**	**20%**
Place of Physical activities		Indoor	40	50	80	20
		Outdoor	60	50	20	80
	Coping by displacement of activities to out-door		**70%**	**85%**	**60%**	**50%**
		Central location	10	30	90	70
		Distributed locations	90	70	10	30
	Coping by displacement of activities to different places.		**90%**	**80%**	**10%**	**30%**

5.   RESULTS AND DISCUSSION

Based on the collected data, this part traces any significant difference of coping behavioral change in urban activities across different types of neighborhoods, in terms of displacement of activities to virtual, reducing unnecessary activities, distribute of activities to different places of the community, displace activities to different times of the day, displace activities from indoor to outdoor, and convertibility and versality.

5.1.   Coping by displacement of physical to virtual activities

Figure (5) reveals that covid 19 is associated with great turn from physical to virtual modes of doing necessary activities in all types of neighborhoods. Covid-19 caused a dramatic reduction in people inclusion to urban spaces, where most personal activities that are not safe, people can do virtually through online are no longer requiring people physical present, virtual rooming can be enough without need to get out home.
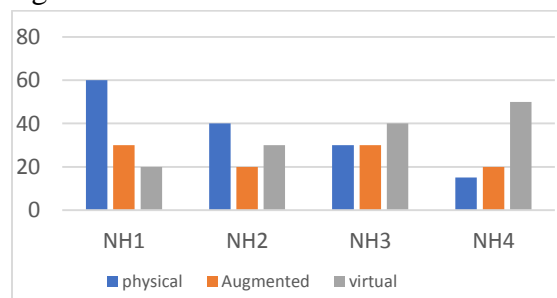

Fig. 5. Graphical representation of patterns of activities.

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المؤتمـــــر الدولي "رؤي لمدن المستقبل – التطبيقات والتقنيات المبتكرة"

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Figure (6) reveals that Covid-19 moved necessary activities from second place to first place (home); where people work, shop, educate, and bank from home based on ICT. Moving from traditional to modern NHs displace necessary activities to home, people feel safer to stay home to do most of their necessary activities, they depend on virtual rooming in work, education, shopping and other.
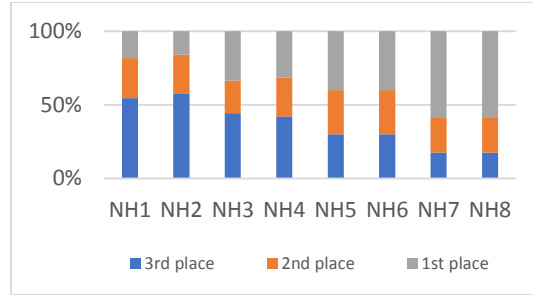
Fig. 6. Graphical representation of patterns of activities.

It seems that moving from traditional to modern neighborhoods limit the role of urban spaces. It seems that traditional neighborhood did not forbid people inclusion to urban spaces and did not limit the role of urban spaces. Traditional neighborhoods encouraged coping behavior and make their residents continue practice their activities in safe way than in modern neighborhoods.

5.2. Coping by reducing unnecessary activities

Figure (7) reveals that Covid-19 reduces total physical activities in urban spaces in all types of neighborhoods. It showed significant physical participation types across different type of neighborhoods.

• Traditional neighborhoods record high level of necessary, social, and optional activities 48%, 30%, 20%. It seems that the main activities are necessary activities with limited concern to optional and social activities. It allowed relative high personal doing physical activities compared to other neighborhoods.

• Early planned neighborhoods revealed high interest for necessary, optional and social activities 30%, 25%, and 25%. It reveals equal concern for all types of activities. People are free to do all types of activities than other neighborhoods.

• Modern neighborhoods revealed total reduced interest for necessary, optional and social activities 5%, 5%, and 5%. It seems that Limited concern for necessary activities are associated with limited interest to participate in optional and social activities. Revels a significant reduction in retail and entertainment, supermarket and pharmacy, park visits.

• Contemporary neighborhood revealed reduced interest to necessary activities, compared to high interest in optional and social activities than before pandemic 20%, 30%, and 30%. People in high density community take a behavior of social distance with serious. They limit their movement. People in low density community become more socially connected, they are more willing to include to urban spaces than before the pandemic. They showed low precautions regarding social distance.
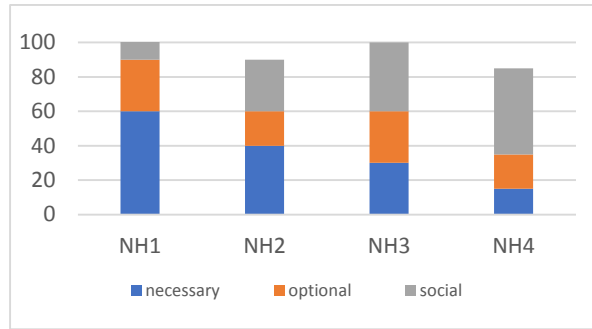
Fig. 7. Graphical representation of patterns of activities in term of necessity

It seems that the main activities are optional and social activities, with limited concern to necessary activities. It seems that contemporary neighborhoods reveal increased interest for optional and social activities than before the pandemic, this may because residents found social distance encouraging them to feel free to participate in urban spaces.

5.3. Coping by distribution of activities to different times of the day

Figure (8) compares coping by distribution of activities to different times of the day, it reveals a significant difference across different types of neighborhoods (70, 90, 120, 200) respectively, it is explained as follow:

• Total number of recorded increased occupation with moving from traditional to modern neighborhoods. This can be explained due to the concentration of occupants to central services area, compared to linear distribution of services in traditional neighborhoods.

• Traditional neighborhoods recorded high occupation density beyond allowed save density. Although it allows great distribution of occupation at different times of the day, and at different places rather the high density with limited urban spaces makes it still pass over the maximum allowed save density. It succeeded to cop by distribution of participation at different times of the day and different places of the community, rather still more urban spaces are needed to keep save density.

• Early planed neighborhoods recorded save occupation density at all day times. This can be explained as it enables regular distribution of people at morning, afternoon, and evening times, and keep distribution of activities at different places of the community keeping the maximum observed people beyond maximum allowed.

• Modern and contemporary neighborhoods record high concentration of occupation density at evening times, exceeding the save allowed occupancy rate. It failed to cope by distribution of participation in activities at different times of the day.
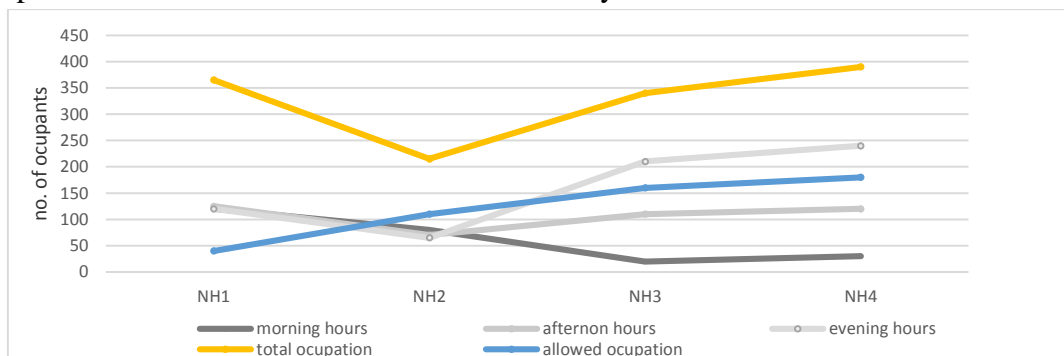

Fig. 8. Graphical representation of distribution of physical activities at day times.

It seems that traditional and early planned neighborhoods facilitate coping by redistribution of activities to different times during less busy times of the day than modern and contemporary neighborhoods that limit activities to evening times.

5.4. Coping by distribution of activities to different places of the community

Figure (9) reveals that total the critical occupation density record higher value in traditional neighborhood then increased with moving from early planned to modern neighborhoods (365, 215, 270, 390) respectively, this can be explained as follow:

• Modern neighborhood records critical occupation at night times in services area with value 365, it can be explained that it depends on central services area that concentrate services of large area of the community to central location. All these people have to go to central location to get services.

• Early planned neighborhoods provide rough mixed use that distribute services gradually to all community to meet the requirements of necessary activities, with keeping green area in central locations to give required spaces for optional and social activities.

• Traditional neighbourhood facilitate distribute of activities and services to different places of the community and accordingly distribute occupation for necessary activities.

Figure (9): Observation of occupation density at different places in critical occupation time.

a) Early developed   b) Early planned   c) New planned   c) Contemporary planned

Figure (10): graphical representation of occupation distribution in different places of the community.

It seems that traditional and early planned neighborhoods facilitate coping by redistribution of activities to different places of the community at linear mixed-use spine than modern neighborhood that failed to cope with distribution of occupation and limit occupation to central location. Observation of crowdedness in services revealed, reduced crowdedness in services of traditional compared to modern where concentration of services in central area to serve all community members than the distribution to linear areas.

5.5. Coping by displacement of indoor activities to outdoor

Figure (11) reveals displacement of activities from indoor to the outdoor, revealed a significant difference across different types of neighborhoods:

• Modern neighborhoods provide enough spaces to keep social distance, rather it is not always suitable for use in term of shading area, people tend to gather near the buildings to be save from sunshine causing less social distance.

• Traditional neighborhoods provide limited urban spaces that are not fit for safe allocation of activities with keeping social distance, with providing required shading area for encourage participation.

• Early planned neighborhoods provide urban spaces with limited participation.

| Sidewalk do not meet displacement of activities to the outdoor. | Sidewalk is wide enough to provide shaded sitting area. | Sidewalk is wide, but people could not sit in sunny area. | Sidewalk is very wide, but people could not sit in sunny area. |

Fig. 11. Observed behavior by displacement of activities from the indoor to outdoor.

It seems that moving from traditional to modern NHs reveals a total increase in occupation rates. It reveals a reduced coping behaviour in term of, lack of distribution of activities to different times of the day, lack of distribution of activities at different places of the community. It reflects an increased rates of crowdedness at services area. It reveals a significant adaptation to new utilization of the same urban spaces without change in dimensions to include other activities. Reduced rely on public transportation and concern to convert street function into safe walkways with enough width for keeping social distance.

• Traditional neighbourhoods showed limited area to facilitate convertibility of urban spaces to meet displacement and multifunctionality of other necessary activities.

• Early planned neighbourhoods achieve gradual distribution of activities to different places of the community, with keeping garden area for optional and social activities.

• Modern neighbourhoods rely on single use that limit convertibility and versality of urban spaces to less occupied location. Accordingly, it failed to achieve equal distribution of activities and occupation to different places, observation reveals empty spaces in residential areas, and high crowded spaces in services area.

It seems that modern neighbourhoods failed to cope by change between different types of activities. Modern neighbourhoods provide large urban spaces but failed to provide flexibility.

6. RECOMMENDATIONS AND DESIGN GUIDELINES

This part intends to deduce two interlocking hypotheses. The first regarding the corelation exist between social distance and coping urban behaviour with moving from traditional to modern neighbourhoods. The second regarding the impacts of neighbourhood's urban configuration on facilitating coping urban behaviour to achieve social distance and reduce crowdedness rates.

6.1. The correlation between social distance and coping urban behavior:

Figure (13) reveals a correlation between coping urban behavior and social distance in early planned, modern, and contemporary neighborhoods. This indicates that moving from traditional to modern neighborhoods can increase coping behavior, to an extent that reduce social distance. On the other side a deviation of correlation values in traditional neighborhoods where hard density, hard mixed use, and hard grid pattern can minimize the allowed space for achieving social distance.
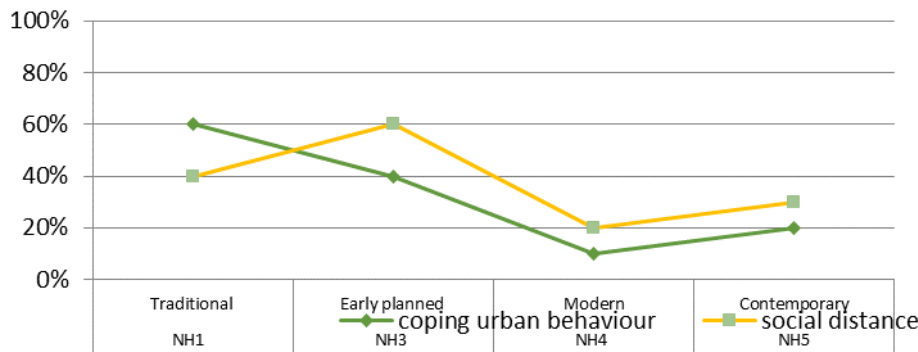

Fig. (13). Relation between density and social distance.

6.2. The correlation between neighborhood urban form and coping behavior and social distance:

This part intends to deduce the correlation exist between neighbourhood patterns and its impacts on both facilitating coping urban behaviour and recorded social distance.

6.2.1. The impacts of density on the spread of covid infection:

Figure (13) reveals that increasing density is not corresponding to less social distance, rather it revealed that early planned neighbourhoods can keep save social distance and save occupation rates than traditional and modern neighbourhoods by encouraging distribution of occupation at different times of the day, different places of the community, and by relying on equitable private modes of walkability. It seems that high density community increase services feasibility and facilitate walkability and cycling as equitable safe travel mode for short, medium, and long-distance trips than public transportation. On the contrary, low density would increase demand for mobility, private mobility would be safe for high income who can afford their cost, rather it is inequitable for low-income people who are forced to use public transportation. Empirical data revealed that dense areas put policies on their resident's urban behaviour that foster social distance. On the contrary, sprawled neighbourhoods' free resident's urban behaviour and increase their exposure to urban spaces and increase their contact.
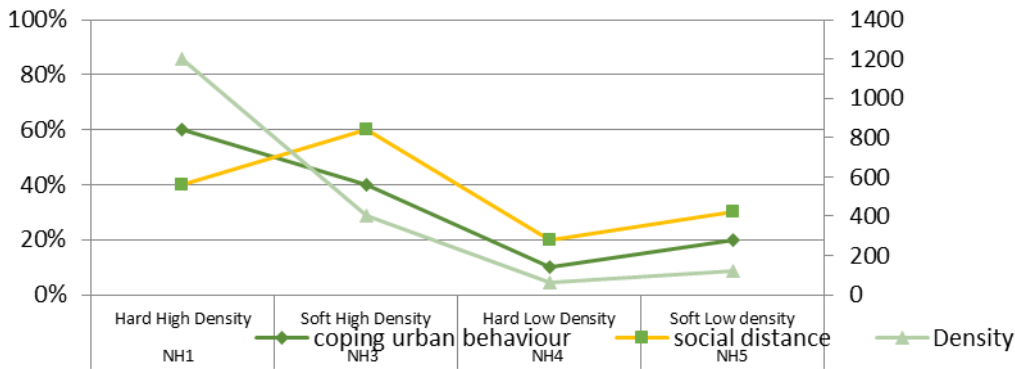
Fig. (13). Relation between density and social distance.

Reducing density make walkability are not practical and unsafe and makes private car inequitable mobility for low income, single car family, elders, and adults. Otherwise, all residents need to have private car to travel safely, which is more expensive for who can afford private car and can pay its running cost and reduce sustainability of contemporary city due to increase fuel consumption and air prolusion, and exclusive for low income who cannot afford private car or cannot afford its cost. On the other side, dense short-distance communities make walkability favoured and safe mobility.

It seems that higher density is not necessarily indicate crowded, crowded means that people personally gather within smaller spaces. People urban behaviour of doing activities and inclusion to urban spaces are key factors for having crowdedness and losing social distance. Complete local communities at local level enhances walkability and cyclability as main mobility mode for work, education, shopping, and any other aspect of life. It can help to enhance sustainability, at the same time achieve safety against viral infection. It is concluded that substitution of low density with soft density as in early planned neighbourhoods can create complete 15 min travel community that facilitate coping by distribution of activities to different times of the day and facilitate depending on walkability as single mobility mode and could mitigate viral infection.

6.2.2. The impacts of mixed use on the spread of covid infection:

Figure (14) revealed that mixed is not necessarily corresponding to less social distance, rather distributed services to linear multicentre can enhance social distance in different ways: first it reduces travel distance and make walkability feasible and safe. Second, it makes facilitate distribution of people than concentration to central service area. Third, it makes taking social distance precautions more easy, controlled, and safe than centralized solution that makes taking social distance hard to control.

It seems that mixed use community facilitate distribution of activities and crowdedness at different times of the day, and different places of the community. Separate use cause centralization of services to certain location where all community people are forced to include to get their services. This will reduce people opportunities for coping behaviour, cause more crowdedness and reduce social distance. It is concluded that substitution of neighbourhood service centre with soft mixed use as in early planned neighbourhoods can facilitate coping by

distribution of activities to different places of the community and facilitate walkability as single mobility to mitigate viral infection.
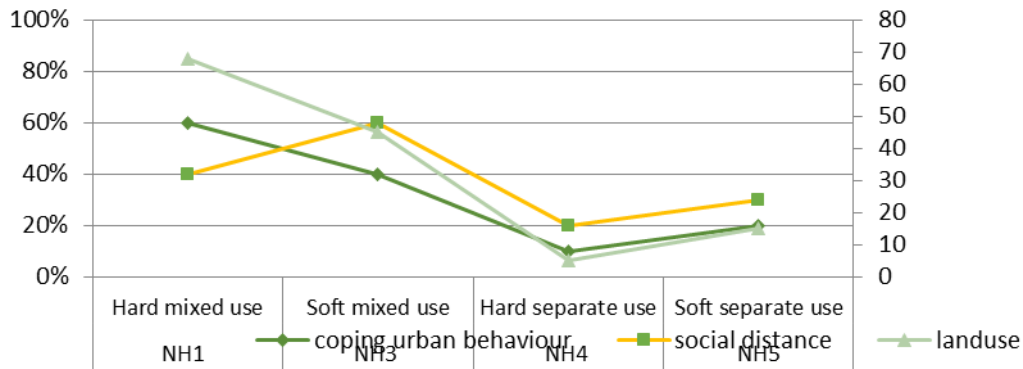

Fig. (14). Relation between land-use patterns and social distance.

It seems that separate use cause centralization of services to certain location where all community people are forced to include to get their services. This will reduce people opportunities for coping behaviours, cause more crowdedness and reduce social distance.

6.2.3. The impacts of street patterns on covid infection:

Figure (15) revealed that moving to grid patterns limit occupation density and increase social distance. This can be explained as it seems that grid patterns provide alternative short distance paths, that encourage walkability as equitable single-occupancy ride over public transportation. It encourages short and medium-distance trips. Walkable streets are more encouraging social distance than unwalkable streets, the first increase safe urban mobility, the second limit mobility to private mobility for long and short distance trips which could be unequitable for low-income people, and unsustainable.
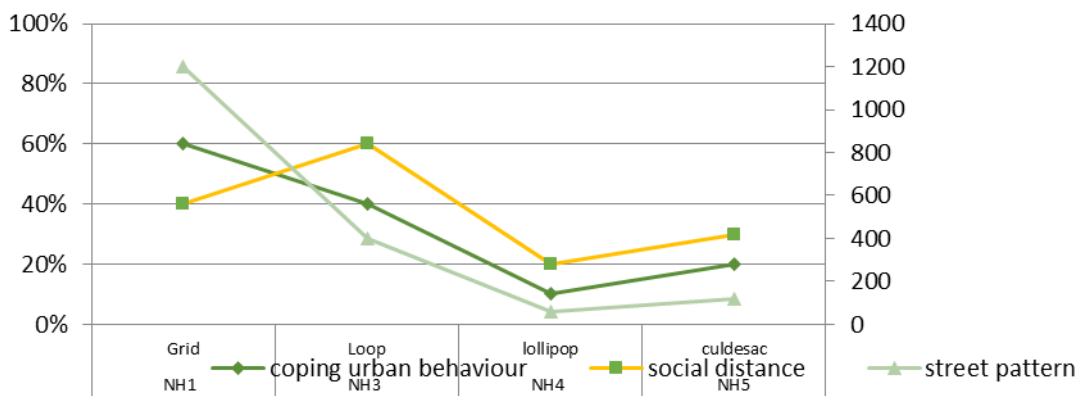

Fig. (15). Relation between street network patterns and social distance.

Public transportation become unsafe, so walkability and cyclability become the best option for short-distance trips. High walkable communities are less infection rates with covid 19. Different types of street network could encourage walkability as safe mobility options.

7. CONCLUSION

Covid 19 is one of the recent emerged respiratory viruses' diseases that cause a dramatic impact on contemporary and future city. Covid is proved to have great impacts on people urban behavior. People adopt different coping strategies to put social distance as key factor in their style of life. And caused behavioral changes as follow:

1) (Virtual – physical): Modal shift of activities from personal to virtual and online activities in necessary, optional, and social. Very limited interest for personal physical activities.

2) (Indoor to outdoor): Modal shift of most of services activities moved from indoor to outdoor activities. People moved interest from indoor to outdoor to feel safe. Urban spaces are not enough in traditional neighbourhood for achieving this goal.

3) Activities removed: Most activates that require face to face contact are removed and replaced with virtual one.

4) Activities reduced: Most social activities are minimized only necessary activities are allowed with taking precautions. People limit to attend events and gathering in indoor activities e.g. restaurants.

5) Activities changed: Most physical activities changed to virtual one. Many schools depend on virtual and augmented learning. Shopping activities are limited and depend on virtual shopping.

6) New activities: Most activities are done at home. Limited inclusion to urban spaces are noticed.

Empirical evidence records significant coping difference across different types of neighborhoods.

1) Traditional neighborhoods with high density, grid street patterns and mixed land use within walking distance are not necessarily corresponding to high crowdedness and less social distance. Rather a great role of urban form in shaping people coping behavior that can encourage redistribution of occupation to different times of the day, different places of the community, and concern to equitable single drive mobility.

2) Early planned neighborhoods revealed relative reduced residential density, loop street patterns and mixed land use within walking distance, it revealed lowest occupation density, and lowest crowdedness. It revealed high people coping behavior that can encourage redistribution of occupation to different times of the day, different places of the community, and concern to equitable single drive mobility.

3) Modern neighborhoods revealed low residential density, loop street patterns and separate land use, it revealed heights occupation density, and crowdedness. It discourages redistribution of occupation to different times of the day, different places of the community, and concern to inequitable single drive mobility.

To face covid infection and enhance sustainability the following recommendations and strategies are deduced to maintain safe social distance distribute of occupation, and reduce crowdedness:

1) Encourage well-distributed decentralized services instead of concentrating them to centralized places, to facilitate safely and sustainable doing of necessary activities.

2)   Encourage well-distributed decentralized public open space; to facilitate safely and sustainable doing of optional and social activities.

3)   Encourage traditional and mixed use to facilitates accessibility of services for long duration of the day to distribute occupation density and reduce crowdedness.

4)   Support extendable urban spaces by increasing outdoor urban spaces, widen sidewalk, to enable displacement of activities to outdoor with considering the required shading area.

5)   Flexibility of reuse in of urban spaces.

6)   Encourage convertibility of function by encouraging street market, outdoor food area, outdoor sport area, which can easily achieve good ventilation and social distance in the out public plaza.

7)   Design 15min small self-contained walking community that can depends on short-distance trips to facilitate single occupancy rides.

8)   Design mixed use community that enables the change between different types of activities than single concern to single activity.

9)   Encouraging small complete communities at local level to enhance walkability and cyclablity as main mobility mode for work, education, shop, and any other aspect of life.

10)   Support 15 minutes short distance trips imposing all types of services within walking distance to make walkability and cycling favored as single-occupancy ride over public transportation, to provide safe mobility that can limit contact and achieve social distance for short, medium, and long-distance mobility and can achieve both safety and sustainability.

A new standards and requirements for urban spaces are required with significant flexibility for multifunctional activities. An emergent need for outdoor area is increased with wider sidewalks to provide safe walkway, safe flexible place for displacement of activities from the indoor to the outdoor, imposing flexible urban spaces to fit different activities, especially the one that used to do indoor before covid.

1)   Remap location and size of doing activities to guide people how to do activities with keeping social distance.

2)   Decentralization of markets, and creation of a shopping environment free of hazards.

3)   Deconstructing big markets by distributing the same around the city and opening for longer durations to avoid crowdedness.

4)   Displace shopping to the outdoor and allowing limit number to inter to the indoor.

5)   Displace Food area in cafeteria and restaurants to the outside

6)   Encourage street market outside shopping to occur in parking areas in the outdoor.

7)   Which can easily achieve social distance in the out public plaza and street markets.

8)   Arrange with local authorities to use part of the streets and Increase pavement widths and using the same for various purposes.

9)   Distribute of occupation to different times of the day and different places of the community.

10)   Providing an outdoor area for transferring indoor activities to the outdoor.

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