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The Associations between Daylight Sufficiency in Hospital Wards and Patient Satisfaction with Mental Healthcare Services: An Egyptian Sample

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ABSTRACT

Introduction: Certain building design and environmental factors are important to characterize in critical building environments, such as psychiatric hospitals, because they influence occupant's comfort, health, indoor environmental quality, and duration of admission. Lighting has its critical importance in hospitals. A sufficient level of daylight is essential to carry out the necessarytasks. Carefully designed daylighting can transform the appearance of the ward and make it attractive, welcoming and even restful.

The Aim of Work: In this study is to find the associations between sufficiency in daylight inside psychiatric hospital wards and patient satisfaction with mental healthcare services.

Methods: Inpatient wards of psychiatric hospitals were screened for patient's satisfaction towards health care services. Measuring the daylight intensity was performed by using a building performance tool (BPS tool) called Autodesk Ecotect as well as by professional lux meter to ensure the accuracy of the measurements. Measuring the patient's satisfaction was done by using a questionnaire designed by the research team which included six subscales: personal information, care from the staff, overall rating of hospital experience, rating the exterior spaces, rating the interior spacing and patient's enjoyment of life over the last week.

Results: Daylight readings and patient's questionnaire were correlated together. In the form of tables, the 1st correlation between daylight intensity and patient's subjective opinion about daylight. The 2nd correlation was between daylight sufficiency and patient's enjoyment of life questionnaire. The 3rd correlation was between window-wall ratio in the ward and patient's visual and thermal comfort.

Conclusion: Many positive relationships like daylight intensity with patient's life enjoyment, and WWR with visual and thermal comfort were found.

INTRODUCTION

The characteristics of any built environment affects health and human productivity in spaces. Daylight, unpolluted air, and proper ventilation are essential to improve the Indoor Environmental Quality (IEQ) in healthcare buildings.[1]

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Ambient, well-designed environments will have transitions of lighting and color design to allow the eye to adapt to changes in lighting levels. Sometimes relatively small changesin the lighting of spaces can solve an on-going, apparently unconquerable problem (for example, more daylight on walls with an accent color to brighten up a dark area). Colour and lighting consultants can often spot the reason why a place does not "feel" right. For example, a change in the size of thewindow or adding a skylight can affect a whole area dramatically and may suggest appropriate solutions. For the healthcare industry, the issue of environmental impact is especially fundamental. The profession is committed to not doing any harm, yet many issues related to the design and operation of healthcare

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facilities contradict this principle tenet.[2] Compared to electrical light, daylight in mental hospitals is preferred by most occupants as it offers dynamic interiors and views. It has been used to maximize occupant comfort, besides providing more pleasant and attractive indoor environment with higher productivity and performance. Energy and its associated environmental emissions can be reduced with the help of daylight. This is also significant and useful regarding visual comfort and energy-efficient building design.[3]

Patients often face troubles trying to adapt to the clinical environment inside the hospital.This adaptation includes the structure of lighting.[4] Bright light that flashes into the eyes, frequent interruptions, and noise are frequent environmental difficulties that have been sufficiently investigated in earlier sttudies.[5] All of these factors have an impact on sleep wake cycle. On the other hand mood disorder shave been frequently encountered in hospitalized inpatients,[6] even though researchers involved stated thatpain and sleep disturbancesare prevelant worldwide during hospital admission.[7]

Regardless of the technological advancement in the interior designs of hospitals aiming to augment patient well-being; the techniques of indoor lighting has not reached its appropriate levels that could aid in patient improvement.[8] Worldwide. it was found that light levels in standard patient rooms are very low nearly (50–300 lux).[9] Nurses in most hospitals; turn off the lighting to minimal; thinking that darkness and quietness benefits patients and help them sleep restfully.[10] However, this attitude results in low light levels that are considered inadequate for maintaining the normal chronobiological rhythms inside the human body especially the sleep/wake cycle and the various circadian rhythms. Research evidence has provided data concluding the role of light–dark cycles, and its necessity in regulation of a patient's 24-hour sleep–wake cycle.[11] A circadian rhythm is any"physiological body process thatrecurs approximately every 24 hours". The suprachiasmatic nucleus is the master body clock that regulates body rhythms by internal messengers suchas hormones. The human circadian rhythm becomes entrained by Zeitgebers, mainly the natural night/day cycle.[3] Many negative psychological andphysical effects are consequences of disrupted sleep. For example depression,pain,tendency to smoke differ[12] according to the sleep timing and duration.

Many practical studies were done over the last decades to measure lighting in general and daylight in specific, and how it affects the inpatient's physical and psychological health.[13] Focusing on the last three years, it was found that there is a growing interest among researchers towards figuring the effect of daylight on mental health. Bemhofer and his group at the Western Reserve University tried to figure out the associations between exposure to daylight, sleep–wake cycle,and mood,[14] A wrist actigraphy with a light sensor was used to estimate levels of light exposure and track sleep/wake patterns. Mood was measured on daily basis using the" Profile Of Mood States(POMS)-BriefTM Form".[15] Medical records were used to extract levels of pain.It was found that exposure to"1500 lux of light" for at least 15 min/day was essential for the participants,while the circadianrhythms can be improvedif the patient gets exposed to" 4000 Lux of daylight "for 8 hours/day", which wasn't reached in any of the included hospitals.[16]

Cannelas and his team in Spain focused on daylight association with depressed patients in the psychiatric department of the Universities of Son Dureta hospital. They compared between the (old hospital building) and (hospital new developed building). As in the old building the psychiatric department was located on the basement floor, that made the daylight sufficiency poor for all depressive patients. On the other hand, the new building included the psychiatric departmenton the ground floor, which increased the overall daylight in the department around ~300% compared to the old building.[17] The study reached a conclusion that the increase in light sufficiency from 86 Lux in the old building to 258 Lux in the new building reduced the hospitalization duration around three days, which is similar to the range of reduction (about 3–4 days) recorded in previous similar studies were done in Canada and Italy.[13]

Meanwhile, scientific research in Egypt isn't yet directed towards figuring a sustainable architectural design for mental hospital wards that guarantee the best available psychological comfort for the patients. A group of researchers from the Arab Academy ofScience and Technology aimed to find daylight criteria for healthcare architecture through analyzing three different patient's room in Children Cancer Hospital 57357 (CCH). The room selection was based on creating variety in orientation, and the room window size, simulations were done in the three rooms to measure the daylight in ten points divided into four contours. The researchers then assumed certain criteria to measure the sufficiency of the daylight and connect it to the physical design and orientation of the room[18] with afocus on the rooms depth relationship with the window-wall ratio (WWR).The study used a Lux meter to measure the daylight at a particular time with no validation of the results with any other tool like computer-based simulation tools.[19]

To the best of our knowledge, there is a lack of research studies investigating the influence of design variables like indoor daylight quality and the mental hospital user's satisfaction towards architectural elements and hospitality service generally and in our geographical region specifically. This study is attempting to fill in these

gaps. Focusing on how natural daylight sufficiency affects hospital occupancy and whether or not the inpatient's opinion towards hospitality service and hospital buildings is related to the intensities of naturaldaylight.

The ultimate objective of this study is to set roles of the relation between two significant stages of the building cycle: the pre- and post- occupancy stages. That will set up a framework for hospital design that focuses on daylight factors to provide architects with information on the impact of hospital design and occupancy on the quality of daylight. It eventually leads to the design of healthy, comfortable, and energy-efficient hospital spaces.

MATERIAL AND METHOD

Figuring out the relationship between daylight and hospitality service satisfaction in this study will be based on comparison methodology, as comparing between patients who are satisfied with hospitality service and their daylight intensity, and patients with less hospitality service satisfaction and their daylight intensity.

Psychiatric hospitals in Egypt are divided into four national councils; each council represents a geographic zone in Egypt.[20] This study will focus on Cairo & Deltazones, in order to represent the biggest available samples from hospitals and patients. The study was approved by the Ethical Committee of The Faculty of Medicine Mansoura University and IRB of The Faculty of Engineering.We obtained the approval ofthe Egyptian General Secretary Of Mental Health to facilitate entry into the target hospitals, the approval covered governmental hospitals only,this limited the access to private hospitals which are usually better designed and follow aesthetic guidelines for buildings more than the governmental hospitals. Cairo region was represented by two mental hospitals (Al-A'bbasia' psychiatric hospital and Helwan psychiatric hospital)while the Delta Council was represented by the Department of Psychiatry at Mansoura University Hospitals.

Ward orientation was one ofthe basic selection criteria while examining the architecture of the included hospitals inorder toensure variability in the daylight quantity among the selected locations. Each ward 's capacity was around 2:8 patient which gave us variety in responses to daylight satisfaction for each patient because some patients were near the windows with high daylight intensity while other patients wereaway from the window with lower daylight intensity.

Participation in the study was completely voluntary. Each patient was introduced to the research aims, and oral consent was obtained before applying the study questionnaires, Privacy and confidentiality of each participant were maintained. Patients were informed that on publication their personal data and responses will remain anonymous. Each patient's bed was located, and geometrical data about the patient's room like orientation, room dimensions, distance between the patient's bed and windowfinishing materials and colors were collected.

Daylight intensity and patient satisfaction towards hospitality servicewere assessed.

Measuring Daylight

The daylight can be measured in many ways, Building Performance Simulation (BPS) tool was used to measure daylight in the selected wards. A computer program developed by Autodesk called "Ecotect" was used. It has a built-in daylightmeasurement function in a user-friendly interface.[21] Readings obtained from the software program were validated by usage of theLux meter (check Figure 1), which was used to double check readings from each room. This method increased theaccuracy of light measurement. Means and standard deviations of light measurements obtained from the two devices are presented in theAppendix.[1] Rooms were divided into two groups depending upon the amount of light entering each room into (good lighting rooms with readings above 500 Lux, and inadequate lighting rooms with readings below 500 Lux).[16]

Assessing Patient's Satisfaction

We screened for patient's satisfaction towards hospitality service and the surrounding environment using a questionnaire designed by the research team (check Appendix 2).The items were extracted from twoquestionnairesthatwere previously published validated and used for similar purposes.[22,23]

1st part of the designed screening tool consisted of six mainsubscales: 1.Personal information, 2.rating of hospital

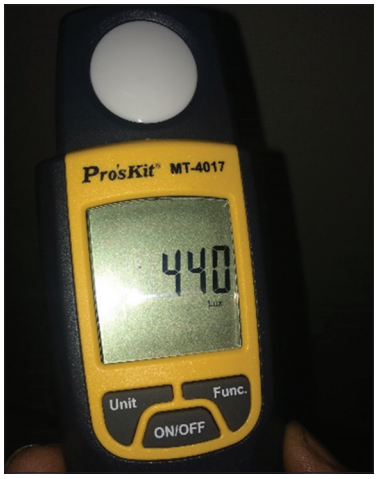


Figure 1: The used Lux meter

staff, 3. overall rating of hospital experience, 4. rating of external spaces, 5. rating of internal spaces, 6. rating of the patient's mood over the last week. The questions were read out to the patient by the research team, and answers were noted accordingly. Items were defined as sentences that express environmental evaluations (e.g. 'in this in-patient/waiting area the quality of furnishings is good''), and responses were made on 5-point Likert-type scales (from 0''totally disagree''to 4''totally agree''). Each scale contains both positive (i.e. indicating the presence of quality) and negative (i.e. showing the absence of quality) items. Furthermore, some items were taken from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAPS) Including communication with nurses, communication with doctors, the responsiveness of hospital staff, pain management, communication about medicines, and discharge information, cleanliness of hospital environment and quietness of hospital environment) together with anoverall rating of the hospital and willingness to recommend this hospital).

The Quality of Life Enjoyment and Satisfaction Questionnaire – Short Form (Q-LES-Q-SF)[24]: Was used to asses happiness and satisfaction. The questionnaire is composed of 16 item asking about topics that are related to enjoyment of life. The scoring of the Q-LES-Q-SF involves adding up the scores of first 14 questions to produce a raw total score. The last two questions were not included in the scoring process. The raw total score ranges from (14 -70). The raw total score aretransformed into a maximum percentage of enjoyment by the formula (raw score −14)/56. The final percentage obtained represents the level of life enjoyment. The questionnaire items are presented in Appendix (3). The percentage of life enjoyment were correlated with items of satisfaction with the health services and the opinion about hospital architectural design. Since the scores of the patients included in the study ranged between 30 and 50 for statistical issues we decided to classify the obtained percentage of life enjoyment into three groups (mild enjoyment from 30-40), (moderate enjoyment from 40-50) and maximum enjoyment above 50.

Statistical Analysis

All patients' data was enteredinto an Excel sheet which was copied into the SPSS program version 20.[25] The data were properly coded, and variables were grouped accordingly. Means and standard deviations of numerical data were presented and then Cross tabulation between objective light measurements and the survey questions related to room lighting, satisfaction with the hospital and mood levels.

RESULTS

Recruitment of subjects was adopted in a way that ensures representation of all the inpatient rooms inside each hospital by occupants of that room. Inclusion of all the available rooms in a way that equaly distributes inhabitants of each room inside the studied hospitals was stressed upon by the study team. The researchers thought that including all the available spaces in the study would be more beneficial thanrecruiting a large number of patients from each room or each hospital alone. A hundred patients whom occupied the studied hospitals at the time of the study were asked to join, 53 patients accepted while 30 patients were excluded due to uncontrollable mental status preventing them from proper communication with the research team, and 17 patient refused participation. The sample was obtained from the three included hospitals, there were 6 patients in A'bbasia mental hospital (11.3%), 23 patient in Helwan psychiatric hospital (43.4%) and 24 patient in Mansoura University Hospital (45.3%). Demographics of the recruited sample are shown in Table 1.

The relationship between the actual daylight exposure and the subjective opinion about the daylight satisfaction, distribution, type and what he thinks about the windows in the ward are shown in (Table 2). From the calculated P value it is noticed that the subjective survey questions did actually represent the objective lighting measured by

Table 1: Sample demographic data

Patient	N	Education				Work				
		Can read and write	Secondary education	High education	MSc & PHD degree holders	Employee	Businessmen	Manual jobs	Works at home	Not working
Male	31	7	10	8	5	9	3	12	0	6
Female	22	5	9	3	6	8	2	0	9	4
Total	53	12	19	11	11	17	5	12	9	10
Percent	100	22.6	35.8	20.8	20.8	32	9.4	22.6	17	19
		Age						Marital status		
		<20	20:30	30:40	40:50	50:60	>60	Single	Married	Divorced
Male		2	9	8	8	1	0	13	12	4
Female		2	4	9	7	2	1	6	11	7
Total		4	13	17	15	3	1	19	23	11
Percent		7.5	24.5	32	28.4	5.7	1.9	35.8	43.4	20.8

the Luxmeter evident by absence of statistical significance. P values in the (Table 2) range from (0.2: 1)

Figuring out the relation between patient's enjoyment of life, daylight intensity, daylight related architectural elements. Daylight sufficiency was found to affect the patient's quality of life enjoyment by raising it from mildenjoyment to optimum enjoyment. Raw total scores and weighed percentage of life enjoyment questionnaire are represented in Table 3. The higher the satisfaction of the patient with the amount of lighting the better mood status he had. Furthermore ability to see green areas from the window, and equal distribution of sunlight on every bed in the room affected the life enjoyment status (p=0.015, 0.04, 0.06.0.049 respectively) (Table 4).

The relation between patient's opinion about daylighting intensity and Window-Wall Ratio (WWR) in patient's ward (Table 5). It should be noted that the study was done in three hospitals in four different wards in each hospital, which means there are 12 different ward. The window-to-wall was calculated by the following equation $(\text{WWR}=\frac{\text{total windows area}}{\text{total envelop area}})$. Results are presented in Table 5 and that the higher the ratio the better architectural design. Helwan hospital got the best WWR (25-28.5) among the studied hospitals followed by Mansoura university hospitals (15-26.6) and A'bbasia hospital came last to the three surveyed hospitals (8.3-15).

The relationship between WWR and patient's opinions about daylight elements shows that the increase in WWR was in proportion to patient's feeling towards daylight sufficiency, distribution over ward's area and sunlight sufficiency. On the other hand, patient's thermal comfort was related to the increase in WWR as with higher WWR, patients though that air humidity and air breath ability got better, but with low WWR patients usually felt bad towards humidity and though that air is unbreathable. Some other elements like the relationship of air exchange rate with WWR weren't significant like other elements (Table 6).

Table 2: Associations between patient's subjective daylight experience and daylight intensity by Lux meter

Selected questionnaire items	Lighting level above 500 Lux	Lighting level below 500 Lux	P value
Intensity of lighting is satisfactory?			0.2
• Disagree	3	16	
• Agree	12	21	
The daylight is poorly distributedon ward beds?			0.2
• Disagree	12	22	
• Agree	3	15	
The intensity of artificial lighting is satisfactory at daytime?			0.7
• Disagree	7	15	
• Agree	8	22	
The intensity of artificial lighting is satisfactory at nighttime?			1
• Disagree	6	15	
• Agree	9	22	
The artificial light color and rendering is noisy to the eyes at night?			0.7
	12	13	
• Disagree	3	6	
• Agree			
The ward has large windows?			0.5
• Disagree	6	14	
• Agree	9	23	

Table 3: Summary of scores obtained on the quality of life enjoyment questionnaire

	Quality of life enjoyment	
	Raw score	Total score
Min	35	34
Max	59	55.75
Mean	48.8	48.5
±SD	6.2	10.6

DISCUSSION

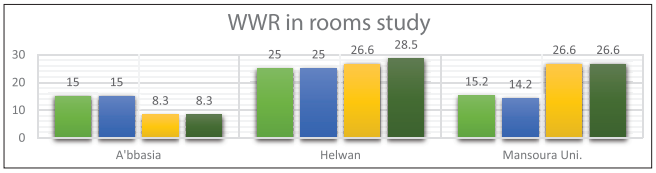
The healing environment is a term indicating the importance of architectural designs in augmenting the effect of medical care and even improving the results of drug administration.[26] Light sufficiency in hospitals is expected to have its positive impact on the healing environment and satisfaction with the hospital and its services. The admission process in the hospital itself is a stressful situation; not to mention also the uncomfortable environment resulting from three possible reasons (psychological perception,feel of pain from medical procedures, and the environment itself including the noise,thelight, the wall colors etc).[27] Studies investigating the role of light sufficiency in mental health hospitals and patient satisfaction are quite scanty, and this necessitates more research in this field. This study tried to illuminate the relationship between daylight levels in mental hospitals and patients satisfaction with the hospital and its services together with quality of life enjoyment from the satisfying (or not satisfying) hospital environment.Satisfaction was defined as the subjective perception of care or the similarity between what patient expects, and what he actually gets from the health service. This study proved a good relationship between the objective levels of light measurements and the subjective questions answered by the patients regarding the lighting levels,also higher light intensities are associated with better life enjoyment.Similarly in a study conducted by Marum RJ in 2008.[28] Rooms with adequate daylight helped in improving cognitive functions in dementia patients. Furthermore,we reported that the bigger the WWR, the more positive the patient responded to questions about

Table 4: Associations between patient's opinions about daylight satisfaction and their mood status

Quality of life enjoyment	Mild satisfaction	Moderate satisfaction	Optimum satisfaction	P value
Light sufficiency (≥500 Lux)?				
Good	2	11	3	0.015
Bad	18	19	0	
View from the window has little interest?				
Disagree	13	23	3	0.3
Agree	7	6	0	
Can see green areas from the window?				
Disagree	14	20	0	0.04
Agree	6	9	3	
The Ward has large windows?				
Disagree	9	10	1	0.7
Agree	11	19	2	
Everybed gets enough sunlight?				
Disagree	14	27	3	0.06
Agree	6	2	0	
Artificial light color and rendering noisy to eyes at night?				
Disagree	16	25	2	0.64
Agree	4	4	1	
The intensity of artificial lighting is satisfactory at night?				
Disagree	7	14	0	0.22
Agree	13	15	3	
The intensity of artificial lighting is satisfactory at daytime?				
Disagree	10	1	22	0.67
Agree	10	2	30	
Daylight is poorly distributedon the ward?				
Disagree	11	20	3	0.26
Agree	9	9	0	
The intensity of day lighting is satisfactory?				
Disagree	11	8	0	0.049
Agree	9	21	3	

Table 5: WWR analysis over study wards

Hospital name	A'bbasia mental hospital				Helwan mental hospital				Mansoura university			
Room number	1	2	3	4	1	2	3	4	1	2	3	4
Patients gender Women/Men	W	W	M	M	M	M	W	W	M	M	W	W
WWR (%)	15	15	8.3	8.3	25	25	26.6	28.5	15.2	14.2	26.6	26.6



hospital environment and satisfaction with the hospitals. Additionally, WWR seems to affect the thermal comfort of patients, as with the increase of WWR most of the patients demonstrated they feel better towards air humidity and breathability in their rooms. Previous studies proved the importance of providing efficient daylighting in decreasing admission periods in certain psychiatric patients,[29] and someother studies proved that daylighting is not the actual sufficiency as much as it is the subjective sense of feeling that there is enough light.[17] On the other hand, Wunshand and his team in 2011 found that presence of a window in the ICU room didn't improve health outcomes of patients with subarachnoid heamorrhage which is a quite controversial finding regarding the literature.[30] This study has some strengths differentiating it from previous studies that measured light sufficiency; we validated the light measures by two methods including (professional Lux meter andacomputer-based simulation tool (Autodesk Ecotect) this stepensured theaccuracyof readings. On the other hand, measuring the patient's satisfaction was done by re-designing a questionnaire, which was based on two previously validated questionnairesby Andrade and his team,[22] and by Giordano and his research team.[23] We also assessed life enjoyment levels using The Quality of Life Enjoyment and Satisfaction Questionnaire Short Form (Q-LES-Q-SF) 24 to asses level of enjoyment during hospital stay and this was not assessed in similar previous studies.

Furthermore, in this study we included the usage of a computer-based simulation which could help in proper

Table 6: Associations between patient's opinions about visual and thermal comfort and WWR in their wards

Daylight questions	WWR							
	8.3	14.2	15	15.2	25	26.6	28.5	r value
Light sufficiency								
• Good lighting	0	0	2	3	4	4	2	0.04
• Bad lighting	4	7	0	2	6	15	3	
Daylight is poorly distributed on the ward beds								
• Disagree	0	5	1	2	8	13	5	0.04
• Agree	4	2	1	3	2	6	0	
Artificial lighting is satisfactory at daytime								
• Disagree	0	4	2	3	3	10	0	0.06
• Agree	4	3	0	2	7	9	5	
Artificial lighting is satisfactory at night time								
• Disagree	0	4	0	4	2	11	0	0.16
• Agree	4	3	2	1	8	8	5	
Every bed gets enough sunlight								
• Disagree	4	3	1	5	9	17	5	0.026
• Agree	0	4	1	0	1	2	0	
Ward has large window								
• Disagree	3	2	1	0	7	5	2	0.08
• Agree	1	5	1	5	3	14	3	
Air exchange from outside is adequate								
• Disagree	2	1	1	4	7	8	3	0.26
• Agree	2	6	1	1	3	11	2	
Air humidity is adequate								
• Disagree	3	7	0	3	4	4	3	0.019
• Agree	1	0	2	2	6	15	2	
Air in unbreathable								
• Disagree	0	7	0	5	8	18	5	0.0000
• Agree	4	0	2	0	2	1	0	

designing of hospitals and is recommended to predict daylight intensity to make sure each patient gets enough daylight sufficiency especially in the predesign phases. We calculated theWWR,which is considered an important index to the proper design of hospital rooms to ensure patient comfortability, and we reported its effect on patient's mood and opinions towards hospitality period in general. Results of this study and similar ones are important to patients, nurses, hospital staff, hospital managers, and policy makers it provides feedback information to improve defects and negative points in future hospital designs and take into consideration the steps toward optimum service through fulfilling patient's needs and requests by enhancing the environment toward a more appealing one thus ensuring rapid recovery and better mood status.

Meanwhile, there is some weakness including the small sample size, the missing data regarding the original psychiatric diagnosis of the recruited patients to rule out communication disorders and excessive subjectivity. Actigraphs with light sensors would have been a good option for further assesement of lighting provided that the patient is given instructions not to cover up the device to ensure highest level of accuracy in light readngs. The Satisfaction of the staff members working inside the hospitals was not assessed and would have been better to compare their opinions to those of the admitted patients. We were not able to prove the relationship between WWR and air exchange rate due to thenon-optimum orientation of wards windows and the lack of artificial ventilation devices.

CONCLUSION

Future research in the areas of Visual and thermal comfort is the main keys toimproving the healing environment in psychiatric hospitals, as patients who have a better visual and thermal characteristics in their rooms, usually get recovered faster. The orientation of the wards windows during the design of the buildings is essential for securing natural ventilation. Mixing a suitable WWR with the optimum orientation helps to reach the visual and thermal comfort needed for achieving optimum hospitality experience. Policy Makers and healthcare providers should benefit from the results of this study and similar ones.

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APPENDICES

1.1. Appendix 1: Daylight measures by Lux meter and Autodesk Ecotect

Hospital	A'bbasia						Helwan					Helwan	
	R1	R2	R3	R3	R4	R4	Men room 1					Men room 2	
Daylight by Ecotect (Lux)	555	550	257	245	160	186	752	173	227	254	876	423	486
Daylight by Lux meter (Lux)	543	552	265	253	158	182	776	177	213	266	872	417	488
Mean daylight (Lux)	549	551	261	249	159	184	764	175	220	260	874	420	487
Standard deviation	6	−1	−4	−4	1	2	−12	−2	7	−6	2	3	−1
Hospital	**Helwan**				**Helwan**							**Helwan**	
	Men room 2				**Women room 1**							**Women room 2**	
Daylight by Ecotect (Lux)	319	600	628	400	603	454	420	264	506	585	632	320	388
Daylight by Lux meter (Lux)	319	610	632	404	603	450	420	266	492	575	620	328	384
Mean daylight (Lux)	319	605	630	402	603	452	420	265	499	580	626	324	386
Standard deviation	0	−5	−2	−2	0	2	0	−1	7	5	6	−4	2
Hospital	**Helwan**			**Mansoura UNI**							**Mansoura UNI**		
	Women room 2			**Room 1 men**							**Room 2 men**		
Daylight by Ecotect (Lux)	482	591	540	896	605	594	418	219	420	190	48	95	196
Daylight by Lux meter (Lux)	478	587	542	896	595	592	428	207	422	206	36	97	200
Mean daylight (Lux)	480	589	541	896	600	593	423	213	421	198	42	96	198
Standard deviation	2	2	−1	0	5	1	−5	6	−1	−8	6	−1	−2
Hospital	**Mansoura UNI**				**Mansoura UNI**							**Mansoura UNI**	
	Room 2 men				**Room 3 women**							**Room 4 women**	
Daylight by Ecotect (Lux)	135	214	230	40	630	544	81	485	462	144	361	108	78
Daylight by Lux meter (Lux)	133	210	230	54	630	540	89	489	462	142	367	104	78
Mean daylight (Lux)	134	212	230	47	630	542	85	487	462	143	364	106	78
Standard deviation	1	2	0	−7	0	2	−4	−2	0	1	−3	2	0

1.2. Appendix 2: The redesigned questionnaire used to measure hospitality satisfaction

A. Personal information:-

Name question - Age question - Gender question - Religion question - Education question - Job question - Place of birth question - Mutual status question

B. Care from staff

1) During your hospital stay, how often did doctors and nurses treat you with courtesy and respect?
2) During your hospital stay, how often the hospital staff listens to you carefully?
3) During your hospital stay, how often the hospital staff explained things in a way you can understand?
4) During your hospital stay, how often were your room and bathroom kept clean?

C. Overall rating of the hospital experience

1) During your hospital stay, how often was the area around you kept quiet at night?
2) Using any number from 0 to 10 where 0 is the worst hospital possible and 10 is the best hospital possible, what number would you rate this hospital during your stay?
3) Would you recommend this hospital toafriend of the family?

D. External spaces

1) During your hospital stay, how can you rate the hospital external spaces care & clean?
2) During your stay, how do you rate the green areas in this hospital?
3) From the external spaces, how can you judge the building aesthetics?

E. Indoor spaces and wards

1) During your hospital stay, please check on the circle beside the sentence to approve your opinion about wards inner spaces

1. furnishings are in poor condition
2. furnishings are in good condition

3. the quality of furnishings is good
4. furnishings are unpleasant
5. walls, doors, and ceilings are in poor condition
6. walls, doors, and ceilings have nice colors
7. walls, doors, and ceilings are well-kept
8. walls, doors, and ceilings are unpleasant
9. This ward entrance is welcoming
10. This ward entranceis cleaned
11. windows are dirty
12. seats are uncomfortable
13. the number of beds is appropriate
14. the number of places to sit (chairs/sofas) is appropriate
15. temperature is inadequate (too hot or too cold)
16. the air exchange from outside is adequate
17. air humidity is adequate (neither too wet nor too dry)
18. the air is unbreathable
19. In this ward, there is a lack of well-equipped waiting or lounge
20. Wards are well-equipped (chairs, tables, TV, newspapers, magazines, etc.)

2) During your hospital stay, please check on the circle beside the sentence to approve your opinion about the orientation of wards.

1. It is easy to recognize the entrance of this care unit
2. there are few signposts to help find your way around
3. it is difficult to find your way around
4. you can easily find information points
5. Area space is clearly defined

3) During your hospital stay, please check on the circle beside the sentence to approve your opinion about wards quietness.

1. There is enough quietness
2. you can hear dins and screams
3. there are not many noises

4) During your hospital stay, please check on the circle beside the sentence to approve your opinion about wards view and lighting

1. The intensity of daylighting is satisfactory.
2. Thedaylightis poorly distributed on the ward beds
3. The intensity of artificial is satisfactory at day time.
4. The intensity of artificial is satisfactory at night time
5. the artificial light color and rendering noisy to your eyes at night
6. every bed gets enough sunlight each day
7. the ward has large windows
8. you can see green areas from the window
9. theview from the window has little interest.

F. Quality of life satisfaction questionnaire

1) Taking everything into consideration, during the past week how satisfied have you been with your …

Taking everything into consideration, during the past week how satisfied have you been with your.....

	Very Poor	Poor	Fair	Good	Very Good
.....physical health?	1	2	3	4	5
.....mood?	1	2	3	4	5
.....work?	1	2	3	4	5
.....household activities?	1	2	3	4	5
.....social relationships?	1	2	3	4	5
.....family relationships?	1	2	3	4	5
.....leisure time activities?	1	2	3	4	5
.....ability to function in daily life?	1	2	3	4	5
.....sexual drive, interest and/or performance?*	1	2	3	4	5
.....economic status?	1	2	3	4	5
.....living/housing situation?*	1	2	3	4	5
.....ability to get around physically without feeling dizzy or unsteady or falling?*	1	2	3	4	5
.....your vision in terms of ability to do work or hobbies?*	1	2	3	4	5
.....overall sense of well being?	1	2	3	4	5
.....medication? (If not taking any, check here _____ and leave item blank.)	1	2	3	4	5
.....How would you rate your overall life satisfaction and contentment during the past week?	1	2	3	4	5

*If satisfaction is very poor, poor or fair on these items, please UNDERLINE the factor(s) associated with a lack of satisfaction.