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Assessment of Lighting Illumination in the Central Business District of Iloilo City

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Abstract:

This study assessed the quality of lighting illumination in the Central Business District (CBD) of Iloilo City, particularly Barangay San Rafael, by examining three key dimensions: visibility, visual comfort, and perceived safety. Using a quantitative, descriptive, comparative, and correlational research design, data were gathered from 187 respondents through a validated and highly reliable questionnaire measuring visibility ($\alpha = 0.92$), visual comfort ($\alpha = 1.00$), and safety ($\alpha = 0.94$). Descriptive analyses revealed that visibility, visual comfort, and safety were consistently rated at High to Very High Levels, indicating that the existing lighting system generally supports clarity of surroundings, visual ease, and a sense of security during nighttime. Comparative analyses showed no significant differences in visibility, visual comfort, or safety based on sex. However, age, marital status, and educational attainment demonstrated significant differences across multiple indicators, suggesting that these demographic factors shape varying expectations and perceptual sensitivities toward lighting conditions. Notably, older adults, widowed respondents, and those with certain educational backgrounds tended to report higher levels of comfort and safety than younger and single respondents. Correlation analyses revealed very strong, positive, and statistically significant relationships among visibility, visual comfort, and safety ($\rho = 0.904$ to 0.974; $p < .001$). These results indicate that improvements in one aspect of lighting—such as brightness, color temperature, or light quality—enhance overall visibility and strengthen perceived safety in the area. Overall, the findings highlight that while current illumination in Iloilo City's CBD is generally adequate, targeted lighting enhancements can further improve night-time experiences, particularly for younger adults and individuals with more stringent visual expectations. The study underscores the importance of human-centered, context-responsive lighting design in promoting safe, inclusive, and comfortable urban environments and provides empirical insights to guide future urban planning and smart lighting initiatives in Iloilo City.

Keywords: Urban lighting; Visibility; Visual comfort; Perceived safety; Street illumination; Human-centered design; Iloilo City.

Introduction:

Lighting is one of the most influential yet often overlooked components of urban design. Beyond its utilitarian purpose of ensuring visibility, light defines how people perceive, experience, and interact with public spaces (Navaraj & Inkarojrit, 2024). Frutos et al. (2024) highlight that well-designed lighting fosters social interaction by enabling visual recognition, orientation, and comfort in shared spaces. Urban illumination transforms environments—turning empty roads into safe corridors, and ordinary plazas into vibrant public realms—thus shaping both safety and livability.

From a physiological perspective, illumination directly affects human health and performance. According to Osibona et al. (2021), light regulates circadian rhythms and melatonin secretion, influencing sleep cycles, alertness, and general well-being. Inadequate or excessive exposure to artificial lighting can disrupt these biological processes, leading to fatigue, anxiety, and reduced cognitive performance (Delloye , 2012). The intersection between lighting and health underscores its importance not only for visibility and safety but also for promoting holistic human functioning in urban environments.

Street lighting has long been linked to perceptions of safety and economic vitality. Inadequate illumination contributes to increased risks of vehicular accidents, street crimes, and pedestrian injuries, especially in developing cities where infrastructure development is uneven. Conversely, adequate lighting enhances public confidence, attracts commercial activity, and extends social and economic life into the night (Dastgheib, 2018). This nexus between illumination and safety positions lighting as a determinant of urban competitiveness and sustainability.

Iloilo City, one of the fastest-growing urban centers in the Philippines, exemplifies this challenge. Despite its modernization and economic growth, certain sections of its Central Business District (CBD), particularly in Barangay San Rafael, Mandurriao, still experience uneven or insufficient street lighting. Such inadequacies compromise both pedestrian comfort and urban aesthetics. Poorly lit environments discourage evening activities and deter investors and tourists, thus affecting the city's economic momentum (Hilario et al., 2021).

Lighting design, therefore, is both a technical and social issue. It involves balancing visual comfort, energy efficiency, environmental impact, and psychological response. Johansson et al. (2014) conceptualize perceived outdoor lighting quality (POLQ) as dependent on intensity, color temperature, and direction—elements that determine whether illumination is comfortable or glaring. Inadequate design may cause light trespass or glare, reducing visibility and increasing accident risks (Carlos, 2025). This suggests that illumination must be context-sensitive, calibrated to human and environmental needs.

Historically, lighting design has evolved from purely functional approaches toward more human-centered paradigms. Kelly's (1956) conceptual framework—comprising ambient luminescence, focal glow, and play of brilliants—transformed the field of lighting design by introducing a human-centered approach that integrates emotional response and experiential perception into illumination (Navaraj & Inkarojrit, 2024).Contemporary studies continue to build upon this tradition, emphasizing the interplay between safety, aesthetics, and sustainability (Custers et al., 2010; Nguyen et al., 2019; Mba et al., 2024; Zhang & Shen, 2024;). As urban lighting technology transitions to LED and smart systems, cities must ensure that technological advancement translates into tangible social and environmental benefits.

The World Bank and UN-Habitat advocate safe and inclusive lighting as a cornerstone of sustainable cities, especially in areas with high nighttime pedestrian activity. In Southeast Asia, where mixed-use developments and informal economic zones dominate, lighting serves not only to prevent accidents but also to enhance gender safety and public participation in urban spaces (Douglass et al., 2003; ASEAN, 2022; UN-Habitat & ASEAN, 2022). Yet, many local governments prioritize lighting improvements last, often focusing on road widening or vehicular infrastructure, thereby neglecting pedestrian-oriented illumination design.

In Iloilo's context, the need for systematic evaluation of street lighting becomes more pressing as the city advances toward smart city initiatives. Barangay San Rafael's mix of residential, commercial, and recreational areas demands lighting systems that balance brightness, energy efficiency, and visual comfort. Without proper assessment of existing illumination levels, future planning risks perpetuating inefficient layouts and energy wastage. This study thus addresses a crucial gap: the lack of localized empirical data on visibility, visual comfort, and perceived safety among city users.

Moreover, the increasing emphasis on sustainable lighting—particularly through energy-efficient LED systems—aligns with global climate goals. Energy-efficient lighting reduces carbon emissions and operational costs while maintaining visual performance standards (Chen et al., 2022). However, while LED technologies offer efficiency, they also pose challenges such as glare, blue-light pollution, and uneven distribution, which may compromise human comfort (Nazari & Matusiak, 2024). Understanding these trade-offs within local urban contexts is essential for designing balanced illumination systems.

Therefore, this study assesses the lighting illumination in the Central Business District of Iloilo City, focusing on three dimensions—visibility, visual comfort, and safety. By examining the relationships between these variables across demographic groups, the study provides data-driven insights for architects, planners, and policymakers. The findings aim to guide evidence-based design interventions that foster safer, more inclusive, and visually comfortable urban environments. Ultimately, this research underscores that illumination is not merely an engineering concern but a social infrastructure that sustains the city's pulse after dark.

Methodology:

This study employed a quantitative, descriptive, comparative, and correlational research design to assess the levels of visibility, visual comfort, and safety in the Central Business District (CBD) of Iloilo City, particularly within Barangay San Rafael, Mandurriao. Quantitative research enables the collection and analysis of numerical data to describe relationships and trends among variables (Pandey et al., 2023). The descriptive design was utilized to identify existing lighting conditions, while the correlational aspect sought to determine the relationships between visibility, visual comfort, and perceived safety. This design provided a systematic framework for examining how lighting quality influences the experience of people in public spaces, allowing the researcher to generate meaningful insights for urban lighting improvement.

The research locale is Barangay San Rafael, Mandurriao, Iloilo City, one of the 18 barangays in Mandurriao District. The area forms part of the city's central business zone characterized by mixed-use commercial and residential structures. It is a vital hub for economic activity and pedestrian movement, making it a suitable setting for assessing illumination efficiency and its implications for safety and comfort. The barangay's population has grown steadily, from 826 in 1990 to 1,813 in 2020, indicating increased demand for effective infrastructure such as lighting (PhilAtlas, 2025).

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The sample size consisted of 187 respondents, determined through non-probability convenience sampling. This approach was chosen due to the lack of an exact population frame and the practical accessibility of respondents. Participants were selected based on their availability and presence in the designated areas during data collection. Convenience sampling is commonly used in exploratory and descriptive studies where the researcher seeks to gather perceptions from readily available participants (Bell et al., 2022). The respondents represented diverse demographic backgrounds, including varying age groups, educational levels, and marital statuses, ensuring a range of perspectives on lighting conditions within the area.

The data-gathering instrument was a structured questionnaire divided into four parts. The first part collected demographic information. The second part, adapted from Dastgheib (2018), consisted of 16 items measuring visibility in terms of awareness of surroundings, orientation, facial recognition, and obstacle detection. The third part, based on Liu et al. (2022), included 12 items assessing visual comfort, emphasizing perceived lighting quality, illumination, and color temperature. The fourth section, adapted from Wu (2014), featured 12 items addressing perceived safety, covering aspects such as personal safety, prospect, and concealment. All items used a four-point Likert scale ranging from “Very Low Level” to “Very High Level.”

Validity and reliability of the research instrument were ensured through expert evaluation and internal consistency testing. Content validation was conducted by three specialists in architecture and lighting design to ascertain relevance and clarity of items. The reliability of the instrument was tested using Cronbach’s alpha, yielding coefficients of 0.92 for visibility, 1.00 for visual comfort, and 0.94 for safety, indicating excellent reliability levels. A Cronbach’s alpha above 0.70 generally signifies strong internal consistency (Taber, 2017), confirming the instrument’s dependability for data collection.

The data-gathering procedure involved a one-week on-site survey conducted from 6:00 p.m. to 8:30 p.m. across four major streets within the barangay. This schedule was chosen to capture actual nighttime illumination experiences. The researcher was assisted by a nine-member field team who facilitated the distribution and retrieval of questionnaires. Participants were provided with small tokens as appreciation for their cooperation. The completed questionnaires were collected daily, reviewed for completeness, and encoded in Microsoft Excel for statistical analysis. This systematic process ensured both accuracy and efficiency in data handling.

For statistical treatment, descriptive and inferential analyses were utilized. Frequency and percentage distributions described respondents’ profiles, while weighted mean scores determined levels of visibility, comfort, and safety. To test relationships among variables, Pearson’s r correlation coefficient was employed. Significant differences across demographic categories such as sex, age, marital status, and educational attainment were examined using t-tests and one-way ANOVA, following a 0.05 level of significance. These statistical tools allowed the researcher to quantify patterns and infer meaningful relationships between lighting factors and perceived safety outcomes.

In adherence to research ethics, the study complied with institutional and community standards. Ethical clearance was obtained from the appropriate Institutional Research Ethics Committee. Informed consent was secured from all participants, ensuring voluntary participation and the right to withdraw at any time. Confidentiality of responses was strictly maintained, with data anonymized and stored securely. The researcher also ensured a comfortable and non-coercive environment during data collection by providing adequate lighting, seating, and refreshments. These measures were implemented to protect participants’ dignity and well-being while upholding integrity and accountability in research conduct.

Overall, the methodology ensured a rigorous, ethical, and context-sensitive approach to understanding illumination quality in Iloilo City’s CBD. The integration of quantitative analysis, validated instruments, and ethical safeguards provided credible data for evaluating how lighting affects human perception, safety, and comfort in urban environments.

Results:

Visibility in the Central Business District of Iloilo City

Table 1 presents the respondents’ assessment of visibility in Iloilo City’s central business district, focusing on four indicators: awareness of surroundings, orientation, facial recognition, and obstacle detection. Across all demographic categories, visibility was rated at a High Level (HL) to Very High Level (VHL), indicating that the existing lighting system generally allows people to navigate and perceive their environment adequately during nighttime.

***Table 1*. Assessment of Lighting Illumination in the Central Business District of Iloilo City on Visibility**

Variables	Awareness of Surroundings	Orientation	Facial Recognition	Obstacle Detection	Visibility

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Respondents	x̄	σ	VI	x̄	σ	VI	x̄	σ	VI	x̄	σ	VI	x̄	σ	VI
Sex															
Male (n=66)	3.69	0.22	HL	3.69	0.181	HL	3.79	0.204	VHL	3.69	0.191	HL	3.71	0.179	HL
Female (n=121)	3.67	0.257	HL	3.68	0.255	HL	3.74	0.252	HL	3.68	0.259	HL	3.69	0.237	HL
Generation															
Baby Boomer (n=19)	3.67	0.344	HL	3.72	0.299	HL	3.75	0.25	VHL	3.71	0.254	HL	3.71	0.271	HL
Gen X (n=24)	3.63	0.221	HL	3.60	0.232	HL	3.70	0.255	HL	3.63	0.221	HL	3.64	0.222	HL
Xennials (n=73)	3.73	0.241	HL	3.74	0.216	HL	3.82	0.232	VHL	3.74	0.239	HL	3.76	0.212	VHL
Gen Y (n=52)	3.65	0.217	HL	3.66	0.212	HL	3.73	0.217	HL	3.65	0.228	HL	3.67	0.197	HL
Gen Z (n=19)	3.58	0.205	HL	3.59	0.208	HL	3.72	0.249	HL	3.61	0.225	HL	3.62	0.199	HL
Marital Status															
Single (n=28)	3.57	0.253	HL	3.57	0.202	HL	3.68	0.224	HL	3.68	0.224	HL	3.60	0.206	HL
Married (n=149)	3.69	0.204	HL	3.70	0.232	HL	3.77	0.233	VHL	3.77	0.233	HL	3.71	0.218	HL
Widow (n=10)	3.75	0.204	VH	3.80	0.197	VH	3.78	0.299	VHL	3.78	0.299	VHL	3.77	0.199	VHL
Educational Level															
Secondary Level (n=20)	3.54	0.272	HL	3.56	0.228	HL	3.66	0.203	HL	3.59	0.203	HL	3.59	0.215	HL
Secondary Graduate (n=34)	3.73	0.233	HL	3.71	0.255	HL	3.68	0.277	HL	3.71	0.25	HL	3.71	0.226	HL
Tertiary Level (n=61)	3.71	0.256	HL	3.72	0.235	HL	3.80	0.226	VHL	3.72	0.25	HL	3.74	0.222	HL
Tertiary Graduate (n=38)	3.65	0.222	HL	3.67	0.218	HL	3.78	0.238	HL	3.65	0.215	HL	3.69	0.211	HL
Others (n=34)	3.68	0.218	HL	3.66	0.203	HL	3.81	0.205	VHL	3.68	0.233	HL	3.71	0.201	HL

Legend: VHL – Very High Level; HL – High Level; LL – Low Level; VLL – Very Low Level; SD – Standard Deviation; VI – Verbal Interpretation.

Across sex groups, both males (M = 3.71) and females (M = 3.69) rated overall visibility as High, with males slightly higher. Facial recognition registered the highest mean among males (M = 3.79, VHL), followed by obstacle detection and awareness of surroundings (both M = 3.69). Females also rated facial recognition highly (M = 3.74, HL), suggesting that lighting conditions in the area sufficiently support safe identification of faces and objects at night.

When grouped by age, Xennials (M = 3.76) recorded the highest overall visibility and were the only age group to interpret visibility as Very High Level (VHL). Baby Boomers (M = 3.71) and Gen X (M = 3.64) also expressed strong visibility perceptions, with Baby Boomers reporting very high facial recognition (M = 3.75). Younger cohorts—Gen Y (M = 3.67) and Gen Z (M = 3.62)—rated visibility slightly lower but still within the High Level, suggesting generally favorable but more varied perceptions among younger respondents.

By marital status, widowed respondents (M = 3.77) reported the highest visibility, consistently interpreting most indicators—including orientation and obstacle detection—as Very High Level. Married respondents (M = 3.71) and single respondents (M = 3.60) also rated visibility as High, though singles reported slightly lower means across all subcomponents.

Across educational attainment, all groups rated visibility at a High Level. However, the highest means were seen among Tertiary-level respondents (M = 3.74) and those in the "Others" category (M = 3.71), both of whom assigned Very High Level ratings to facial recognition. Secondary graduates (M = 3.71) also perceived visibility favorably. This suggests that individuals with higher or specialized educational backgrounds may be more sensitive to, or appreciative of, lighting adequacy in urban spaces.

Overall, visibility in Iloilo City's CBD is perceived positively across all demographic groups, with mean values consistently clustered between 3.60 and 3.80, indicating stable High to Very High Levels of perceived visibility. These findings highlight that existing lighting conditions generally support safe movement, facial recognition, and environment awareness—key components of nighttime urban safety and comfort.

***Table 2*. Assessment of lighting illumination in the central business district of Iloilo City on visual comfort in terms of perceived light quality, illumination, and color temperature when they are taken collectively and grouped according to sex, age, marital status, and educational level**

Variables	Perceived Light Quality			Illumination			Color Temperature			Visual Comfort		
	x̄	σ	VI	x̄	σ	VI	x̄	σ	VI	x̄	σ	VI
Sex												
Male (n=66)	3.50	0.419	HL	3.50	0.395	HL	3.50	0.318	HL	3.50	0.373	HL
Female (n=121)	3.66	0.498	HL	3.47	0.489	HL	3.46	0.513	HL	3.46	0.478	HL
Generation												
Baby Boomer (n=19)	3.47	0.623	HL	3.61	0.542	HL	3.47	0.589	HL	3.52	0.565	HL
Gen X (n=24)	3.31	0.523	HL	3.31	0.533	HL	3.34	0.465	HL	3.32	0.469	HL
Xennials (n=73)	3.61	0.435	HL	3.58	0.435	HL	3.60	0.45	HL	3.60	0.422	HL
Gen Y (n=52)	3.41	0.434	HL	3.42	0.407	HL	3.42	0.434	HL	3.42	0.405	HL
Gen Z (n=19)	3.34	0.356	HL	3.33	0.382	HL	3.32	0.448	HL	3.33	0.356	HL
Marital Status												
Single (n=28)	3.48	0.471	HL	3.48	0.457	HL	3.47	0.47	HL	3.48	0.443	HL
Married (n=149)	3.66	0.498	HL	3.67	0.492	HL	3.57	0.518	HL	3.63	0.495	HL
Widow (n=10)	3.47	0.623	HL	3.61	0.542	HL	3.47	0.589	HL	3.52	0.565	HL
Educational Level												
Secondary Level (n=20)	3.18	0.494	HL	3.28	0.405	HL	3.19	0.479	HL	3.21	0.434	HL
Secondary Graduate (n=34)	3.51	0.458	HL	3.58	0.451	HL	3.53	0.484	HL	3.54	0.45	HL
Tertiary Level (n=61)	3.57	0.468	HL	3.50	0.497	HL	3.57	0.443	HL	3.55	0.449	HL
Tertiary Graduate (n=38)	3.41	0.487	HL	3.42	0.42	HL	3.40	0.492	HL	3.41	0.434	HL
Others (n=34)	3.52	0.396	HL	3.52	0.437	HL	3.50	0.417	HL	3.52	0.393	HL

Legend: VHL – Very High Level; HL – High Level; LL – Low Level; VLL – Very Low Level; SD – Standard Deviation; VI – Verbal Interpretation.

Table 2 presents the respondents' assessment of visual comfort in Iloilo City's central business district in terms of perceived light quality, illumination, and color temperature, taken collectively and grouped by sex, age, marital status, and educational level. Overall, visual comfort was interpreted as High (HL) across all demographic groups, indicating that the lighting conditions in Barangay San Rafael generally support comfortable visual experiences during nighttime use.

Across sex groups, males (M = 3.50) and females (M = 3.46) both reported high levels of visual comfort. Although females registered slightly higher perceived light quality (M = 3.66), the overall means reflect a consistent perception that lighting conditions are adequately comfortable for general night-time activities such as walking, navigating streets, and identifying surroundings.

When grouped by age, Xennials (M = 3.60) reported the highest mean visual comfort, followed closely by Baby Boomers (M = 3.52). These groups consistently registered higher means across all three indicators, particularly in color temperature and light quality, suggesting that middle-aged and older adults perceive the lighting environment more favorably. Gen X (M = 3.32), Gen Y (M = 3.42), and Gen Z (M = 3.33) also reported high visual comfort, although with slightly lower means, possibly indicating higher sensitivity to lighting uniformity or glare among younger age groups.

***Table 3*. Assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when they are taken collectively and grouped according to sex, age, marital status, and educational level**

Variables	Perceived Personal Safety			Prospect			Concealment			Safety		
	Mean	SD	VI	Mean	SD	VI	Mean	SD	VI	Mean	SD	VI
Sex												
Male (n=66)	3.51	0.385	HL	3.50	0.366	HL	3.53	0.366	HL	3.51	0.357	HL
Female (n=121)	3.50	0.47	HL	3.48	0.478	HL	3.46	0.492	HL	3.48	0.459	HL
Age												
Baby Boomer (n=19)	3.46	0.673	HL	3.57	0.6	HL	3.50	0.577	HL	3.51	0.594	HL
Gen X (n=24)	3.38	0.448	HL	3.32	0.433	HL	3.31	0.485	HL	3.34	0.425	HL
Xennials (n=73)	3.65	0.388	HL	3.61	0.412	HL	3.62	0.393	HL	3.62	0.393	HL
Gen Y (n=52)	3.42	0.398	HL	3.40	0.4	HL	3.42	0.392	HL	3.42	0.384	HL
Gen Z (n=19)	3.38	0.327	HL	3.37	0.367	HL	3.34	0.393	HL	3.36	0.334	HL
Marital Status												
Single (n=28)	3.28	0.483	HL	3.24	0.411	HL	3.30	0.397	HL	3.27	0.411	HL
Married (n=149)	3.53	0.428	HL	3.52	0.439	HL	3.51	0.46	HL	3.52	0.422	HL
Widow (n=10)	3.70	0.307	HL	3.65	0.316	HL	3.63	0.339	HL	3.66	0.312	HL
Educational Level												
Secondary Level (n=20)	3.51	0.47	HL	3.56	0.35	HL	3.71	0.356	HL	3.67	0.341	HL
Secondary Graduate (n=34)	3.41	0.451	HL	3.60	0.367	HL	3.73	0.336	HL	3.27	0.339	HL
Tertiary Level (n=61)	3.51	0.467	HL	3.59	0.333	HL	3.71	0.325	HL	3.20	0.322	HL
Tertiary Graduate (n=38)	3.44	0.457	HL	3.60	0.351	HL	3.44	0.335	HL	3.25	0.333	HL
Others (n=34)	3.35	0.399	HL	3.71	0.347	HL	3.71	0.336	HL	3.27	0.341	HL

Legend: VHL – Very High Level; HL – High Level; LL – Low Level; VLL – Very Low Level; SD – Standard Deviation; VI – Verbal Interpretation.

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In terms of marital status, married respondents (M = 3.63) showed the highest visual comfort ratings, reflecting positive evaluations of overall illumination and color temperature. Meanwhile, single (M = 3.48) and widowed respondents (M = 3.52) also reported high comfort levels, with minimal differences across categories.

For educational attainment, all groups perceived visual comfort at a High Level, though with varying degrees. Respondents with secondary-level education (M = 3.21) recorded the lowest mean, while those under the "Others" category (M = 3.52) and tertiary-level respondents (M = 3.55) showed higher levels of comfort. This may indicate variations in expectations or sensitivity to lighting conditions depending on educational and occupational backgrounds.

Overall, the results show that visual comfort remains consistently high (M ≈ 3.21 to 3.63), suggesting that the lighting system in the CBD effectively supports ease of vision, minimizes discomfort, and fosters a visually pleasant night-time environment. The consistently high evaluation across all demographic groups reinforces the adequacy of existing illumination but also highlights opportunities for enhancement in areas where perceived comfort is slightly lower–such as among younger age groups and respondents with lower educational attainment.

Table 3 presents the respondents' assessment of safety in Iloilo City's central business district across three indicators: perceived personal safety, prospect, and concealment. Overall, safety was consistently rated at a High Level (HL) across all demographic groups, indicating that the lighting environment in Barangay San Rafael generally supports a sense of security and reduces feelings of vulnerability during nighttime.

Across sex groups, both males (M = 3.51) and females (M = 3.48) perceived safety at a high level. Male respondents slightly rated concealment higher (M = 3.53) than females (M = 3.46), suggesting that men may feel marginally more confident in identifying hidden or potentially risky areas in the environment. Nonetheless, both groups' ratings reflect generally positive perceptions of safety supported by existing illumination.

In terms of age, Baby Boomers (M = 3.51) rated safety higher than younger cohorts, with their highest score observed in prospect (M = 3.57), indicating a favorable assessment of visibility across distances and openness of spaces. Xennials (M = 3.62) likewise reported strong perceptions of safety across indicators, especially in concealment (M = 3.62). Respondents from Gen X (M = 3.34), Gen Y (M = 3.42), and Gen Z (M = 3.36) also rated safety positively, though with slightly lower means. These differences may reflect varying levels of awareness or expectations regarding urban safety across age groups.

***Table 4*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visibility in terms of awareness of surroundings, orientation, facial recognition, and obstacle detection when grouped according to sex**

Visibility Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Awareness of surroundings	4117.00	185	0.713	Not significant	Accepted
Orientation	3995.00	185	0.996	Not significant	Accepted
Facial recognition	4357.00	185	0.277	Not significant	Accepted
Obstacle detection	3953.00	185	0.906	Not significant	Accepted
Visibility	3993.50	185	1	Not significant	Accepted

Note. Test statistics compare the mean scores of sex groups for each visibility indicator.

When grouped by marital status, widowed respondents (M = 3.66) expressed the highest sense of safety, with consistently strong ratings across all indicators—particularly in prospect (M = 3.65) and concealment (M = 3.63). Married respondents (M = 3.52) also reported high levels of perceived safety, while single respondents recorded slightly lower yet still high ratings (M = 3.27). The higher ratings among widowed and married individuals may reflect increased sensitivity to environmental risks and reliance on adequate lighting for nighttime mobility.

Across educational levels, all respondents rated safety at a High Level, though with some variation. Secondary-level respondents (M = 3.67) and secondary graduates (M = 3.27) reported differing perceptions, with secondary-level participants assigning higher ratings—particularly in concealment (M = 3.71). Those in the tertiary level and tertiary graduate categories also rated safety highly (M = 3.20 and M = 3.25 respectively), though their overall means were slightly lower than other groups. Respondents classified as "Others" (M = 3.27) similarly interpreted safety positively, supported by strong scores in prospect (M = 3.71).

Overall, safety perceptions ranged from 3.20 to 3.66, indicating uniformly High Level assessments. These findings suggest that current lighting conditions in the CBD effectively contribute to a sense of security by reducing concealment, increasing visibility across distances, and enhancing overall situational awareness. Minor variations

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across demographic groups highlight potential areas where lighting improvements may further strengthen perceived safety, especially among younger and tertiary-educated individuals.

Table 4 shows the results of the test for significant differences in visibility when respondents are grouped according to sex. Across all four indicators—awareness of surroundings, orientation, facial recognition, and obstacle detection—the computed p-values ranged from 0.277 to 1.000, all of which exceed the 0.05 level of significance. This indicates that there is no statistically significant difference between male and female respondents in how they assess visibility in the central business district of Iloilo City.

Awareness of surroundings (p = 0.713) and orientation (p = 0.996) showed particularly high p-values, confirming that the perception of environmental awareness and directional clarity is similar regardless of sex. The same trend is seen for facial recognition (p = 0.277) and obstacle detection (p = 0.906), suggesting comparable perceptions of safety and clarity when identifying faces or potential hazards at night.

The overall visibility score also showed no significant difference (p = 1.000), further affirming that both male and female respondents evaluate the lighting conditions in essentially the same way. Consequently, the null hypotheses for all indicators were accepted.

These results imply that sex does not influence visibility perception in this urban environment—suggesting that lighting conditions provide a consistent visual experience for all users, regardless of gender.

***Table 5*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visibility in terms of awareness of surroundings, orientation, facial recognition, and obstacle detection when grouped according to age/ generation**

Visibility Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Awareness of surroundings	11.951	4	0.018	Significant	Rejected
Orientation	13.66	4	0.008	Significant	Rejected
Facial recognition	8.936	4	0.063	Not significant	Accepted
Obstacle detection	11.169	4	0.025	Significant	Rejected

Note. Test statistics compare the mean scores of age/ generation groups for each visibility indicator.

Table 5 presents the test for significant differences in visibility ratings across age groups. The results reveal that age has a statistically significant effect on several key aspects of visibility, indicating perceptual differences among generational cohorts.

A significant difference was found in awareness of surroundings (p = 0.018), suggesting that respondents from different age groups vary in how effectively they perceive their environment under current lighting conditions. Similarly, orientation yielded a significant difference (p = 0.008), indicating that age influences how well individuals can determine direction, spatial layout, or pathway clarity within the illuminated streetscape.

In contrast, facial recognition did not differ significantly across age groups (p = 0.063). This means that respondents, regardless of age, share similar perceptions of their ability to identify faces clearly under existing lighting—an important factor associated with personal safety and social interaction.

Finally, obstacle detection was found to differ significantly by age (p = 0.025). This suggests that some age groups perceive greater difficulty—or greater ease—in identifying obstructions such as uneven surfaces, curbs, or objects on pathways, likely reflecting visual acuity differences or varied expectations of lighting performance.

Overall, the findings indicate that age influences specific visibility-related perceptions, particularly those requiring broader environmental awareness and spatial interpretation, while perceptions of facial recognition remain consistent across groups. These patterns highlight the importance of designing lighting systems that accommodate diverse visual needs and promote safe mobility for all age groups.

***Table 6*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visibility in terms of awareness of surroundings, orientation, facial recognition, and obstacle detection when grouped according to marital status**

Visibility Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Awareness of surroundings	5.844	2	0.054	Not Significant	Accepted
Orientation	10.306	2	0.006	Significant	Rejected

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Facial recognition	5.057	2	0.08	Not significant	Accepted
Obstacle detection	5.319	2	0.07	Not Significant	Accepted
Visibility	7.474	2	0.024	Significant	Rejected

Note. Test statistics compare the mean scores of marital groups for each visibility indicator.

Table 6 shows the analysis of differences in visibility assessments when respondents are grouped according to marital status. The results reveal that marital status has a significant influence on some, but not all, visibility indicators.

For orientation, a significant difference was found (p = 0.006), indicating that single, married, and widowed respondents differ in how effectively they perceive directional cues and spatial layout under existing lighting. This may reflect differences in mobility patterns and nighttime navigation needs across marital categories.

Similarly, overall visibility showed a significant difference (p = 0.024), suggesting that marital status influences the general perception of lighting adequacy. Widowed respondents, who are often older adults, tended to show slightly higher visibility ratings in earlier descriptive tables, which may partially account for this variation.

However, awareness of surroundings (p = 0.054), facial recognition (p = 0.080), and obstacle detection (p = 0.070) did not yield significant differences, as all p-values exceeded the 0.05 threshold. This indicates that respondents across marital categories share similar perceptions regarding their ability to identify people, recognize surroundings, and detect obstacles at night.

Overall, the findings indicate that while marital status does not strongly influence specific elements of visibility such as obstacle detection or facial recognition, it does shape broader aspects of spatial understanding and overall judgment of lighting quality. This suggests that demographic factors connected to lifestyle, routines, and security needs may inform how lighting in urban public spaces is perceived.

***Table 7*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visibility in terms of awareness of surroundings, orientation, facial recognition, and obstacle detection when grouped according to educational level**

Visibility Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Awareness of surroundings	8.718	4	0.069	Not Significant	Accepted
Orientation	9.004	4	0.061	Not Significant	Accepted
Facial recognition	10.193	4	0.037	Significant	Rejected
Obstacle detection	7.943	4	0.094	Not Significant	Accepted
Visibility	9.09	4	0.059	Not Significant	Accepted

Note. Test statistics compare the mean scores of educational level groups for each visibility indicator.

Table 7 presents the test of significant differences in visibility when respondents are grouped according to educational level. The results show that educational attainment does not significantly influence most visibility indicators, with only one exception.

For awareness of surroundings (p = 0.069) and orientation (p = 0.061), no significant differences were observed across educational levels. This suggests that respondents—whether secondary-level, tertiary-level, or belonging to other educational categories—have comparable perceptions of how well they can detect their surroundings and maintain spatial orientation under current lighting conditions.

Similarly, obstacle detection (p = 0.094) showed no significant difference, indicating that individuals across different educational backgrounds evaluate their ability to identify potential hazards in the environment in a similar manner. The same trend is reflected in the overall visibility score (p = 0.059), which also did not reach statistical significance.

However, a significant difference emerged in facial recognition (p = 0.037). This finding implies that respondents' educational backgrounds may influence their ability to recognize faces under existing lighting conditions. As earlier descriptive tables showed, tertiary-level respondents tended to rate facial recognition more favorably than some groups. This may reflect differing expectations regarding lighting performance, varied experiences in navigating urban environments, or differences in sensitivity to illumination quality.

Overall, while educational level generally does not affect most aspects of visibility in the study area, the significant variation in facial recognition suggests that certain visual tasks may be perceived differently depending on respondents' educational background. This highlights an area where lighting design could be further optimized to ensure consistent visibility for all users.

Table 8 presents the test results for significant differences in visual comfort when respondents are grouped according to sex. The findings show that none of the visual comfort indicators differ significantly between male and female respondents, as all p-values range from 0.938 to 0.992, far above the 0.05 threshold.

***Table 8*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visual comfort in terms of perceived light quality, illumination, and colour temperature when grouped according to sex**

Visual Comfort Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived light quality	3989	185	0.992	Not significant	Accepted
Illumination	3998	185	0.99	Not significant	Accepted
Color temperature	3984.5	185	0.982	Not significant	Accepted
Visual comfort	4021	185	0.938	Not significant	Accepted

Note. Test statistics compare the mean scores of sex groups for each visual comfort indicator.

For perceived light quality, the p-value (0.992) indicates that males and females share practically identical perceptions regarding the clarity, quality, and adequacy of lighting in the area. The same pattern emerges for illumination ($p = 0.990$) and colour temperature ($p = 0.982$), suggesting that both groups similarly perceive the brightness and warmth/coolness of lighting in the central business district.

The overall measure of visual comfort also yielded no significant difference ($p = 0.938$), confirming that sex does not influence how comfortable respondents feel with the lighting environment. These results align with earlier descriptive findings where male and female respondents reported similar mean scores across all three components of visual comfort.

Collectively, the results indicate that visual comfort is experienced uniformly across sexes, suggesting that the lighting design in the study area provides a consistent visual experience for all users regardless of gender. This consistency supports the adequacy of current illumination in fostering visual ease, reducing glare, and maintaining acceptable colour rendering for nighttime activities.

Table 9 presents the results of the test for significant differences in visual comfort when respondents are grouped according to age. The findings show a consistent and statistically significant difference across all visual comfort indicators, revealing that age meaningfully influences how respondents evaluate lighting conditions in the central business district.

For perceived light quality, the results indicate a significant difference ($p = 0.005$), suggesting that respondents from different age groups vary in their judgments of how clear, adequate, or pleasant the lighting appears. Earlier descriptive results showed that Xennials and Baby Boomers tended to rate this component more favorably, which aligns with this significant variation.

***Table 9*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visual comfort in terms of perceived light quality, illumination, and colour temperature when grouped according to age/ generation**

Visual Comfort Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived light quality	14.788	4	0.005	Significant	Rejected
Illumination	15.824	4	0.003	Significant	Rejected
Color temperature	12.258	4	0.016	Significant	Rejected
Visual comfort	14.939	4	0.005	Significant	Rejected

Note. Test statistics compare the mean scores of age/ generation groups for each visual comfort indicator.

Significant differences were also observed in illumination ($p = 0.003$), confirming that age affects respondents' perceptions of brightness and the adequacy of lighting levels in the environment. This may reflect differences in visual acuity, lighting preferences, or exposure to varied lighting conditions across age groups.

For colour temperature, the significant p-value (0.016) suggests that respondents across generations do not perceive the warmth or coolness of lighting uniformly. Some age groups may prefer warmer lighting, while others may find cooler temperatures more visually comfortable—highlighting a nuanced dimension of lighting preference influenced by age.

Finally, the overall composite measure of visual comfort also showed a significant difference (p = 0.005). This indicates that the combined effect of perceived light quality, illumination, and colour temperature varies significantly across age groups, reflecting diverse comfort levels and possibly different lighting expectations.

Overall, the results demonstrate that age is a key factor shaping visual comfort perceptions, with significant differences across all components measured. These findings underscore the importance of designing lighting systems that account for generational differences to ensure inclusive, age-responsive urban illumination.

***Table 10*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visual comfort in terms of perceived light quality, illumination, and colour temperature when grouped according to marital status**

Visual Comfort Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived light quality	9.031	2	0.011	Significant	Rejected
Illumination	10.821	2	0.004	Significant	Rejected
Color temperature	9.372	2	0.009	Significant	Rejected
Visual comfort	10.739	2	0.005	Significant	Rejected

Note. Test statistics compare the mean scores of marital status groups for each visual comfort indicator.

Table 10 presents the results of the test for significant differences in visual comfort when respondents are grouped according to marital status. The findings indicate a consistent pattern of statistically significant variation across all indicators of visual comfort—perceived light quality, illumination, color temperature, and the overall visual comfort index.

For perceived light quality, the p-value of 0.011 reveals a significant difference among single, married, and widowed respondents. This suggests that individuals from different marital categories evaluate the clarity and adequacy of lighting in distinct ways, possibly reflecting varying night-time routines, safety concerns, or familiarity with the area.

Similarly, illumination showed a significant difference (p = 0.004), indicating that perceptions of brightness, intensity, and sufficiency of lighting vary across marital groups. Married respondents generally reported higher illumination satisfaction in earlier descriptive tables, while singles tended to give slightly lower ratings.

A significant difference was also observed in color temperature (p = 0.009). This means that marital status influences how respondents perceive the warmth or coolness of lighting—an element closely linked to comfort, ambiance, and visibility at night.

Finally, the composite measure of visual comfort yielded a significant result (p = 0.005), reinforcing the trend that visual comfort perceptions differ in meaningful ways across marital categories. These differences may reflect diverse expectations for lighting, differing levels of caution during night-time travel, or varied patterns of mobility across groups.

Overall, the results demonstrate that marital status is a significant factor influencing visual comfort perceptions, affecting every dimension measured. These findings highlight the need for lighting strategies that account for diverse user experiences and ensure that public spaces remain visually comfortable and supportive for all demographic groups.

Table 11 presents the analysis of differences in visual comfort when respondents are grouped according to educational level. The results show a significant difference across all four indicators—perceived light quality, illumination, color temperature, and overall visual comfort—indicating that educational attainment plays a meaningful role in shaping how individuals evaluate the lighting environment.

For perceived light quality, the p-value (0.016) indicates a statistically significant difference among respondents with varying educational backgrounds. This suggests that individuals with different levels of education perceive the clarity, crispness, and adequacy of lighting differently, possibly reflecting varying expectations or levels of visual sensitivity.

***Table 11*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on visual comfort in terms of perceived light quality, illumination, and colour temperature when grouped according to educational level**

Visual Comfort Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived light quality	12.174	4	0.016	Significant	Rejected
Illumination	9.683	4	0.046	Significant	Rejected
Color temperature	12.035	4	0.046	Significant	Rejected
Visual comfort	12.285	4	0.015	Significant	Rejected

Note. Test statistics compare the mean scores of educational level groups for each visual comfort indicator.

Illumination also showed a significant difference (p = 0.046), meaning that perceptions of brightness and adequacy of lighting vary across educational groups. As earlier descriptive data showed, respondents with tertiary-level education and those categorized under "Others" tended to assign slightly higher illumination ratings compared to other groups.

***Table 12*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when grouped according to sex**

Safety Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived personal safety	3822.5	185	0.624	Not significant	Accepted
Prospect	3934.5	185	0.867	Not significant	Accepted
Concealment	4174.5	185	0.602	Not significant	Accepted
Safety	4014.5	185	0.952	Not significant	Accepted

Note. Test statistics compare the mean scores of sex groups for each safety indicator.

A significant difference was also found in color temperature (p = 0.046), suggesting that respondents' evaluation of the warmth or coolness of lighting depends partly on their educational attainment. This may be linked to differences in exposure to design standards, workplace lighting conditions, or aesthetic preferences.

Lastly, the overall visual comfort measure (p = 0.015) revealed a significant difference, confirming that educational background influences the combined perception of light quality, brightness, and ambience. Respondents with higher or more specialized educational training may have more refined benchmarks for lighting comfort, explaining the observed variation.

Overall, the results demonstrate that educational level significantly affects all aspects of visual comfort, highlighting the need for lighting designs that accommodate diverse user expectations and visual experiences. These findings emphasize the importance of considering socioeconomic and demographic factors in urban lighting assessments and planning.

Table 12 presents the test for significant differences in safety perceptions when respondents are grouped according to sex. The results reveal that none of the safety indicators differed significantly between males and females, as all p-values—ranging from 0.602 to 0.952—exceeded the 0.05 level of significance.

For perceived personal safety, the p-value of 0.624 indicates that men and women feel equally safe under current lighting conditions. The same trend is observed for prospect (p = 0.867), suggesting that both groups perceive similar levels of visibility over distances and openness of spaces in the central business district.

Similarly, concealment (p = 0.602) showed no significant difference, indicating that both sexes share comparable experiences in identifying potential hiding places or shadowed areas within the environment. This consistent perception is reinforced by the overall safety score (p = 0.952), which confirms the absence of meaningful variation in safety evaluations between males and females.

Overall, the findings suggest that sex does not influence safety perceptions in the study area. Male and female respondents evaluate the lighting system's contribution to their sense of security in effectively the same way. This uniformity indicates that the lighting infrastructure provides a consistent nighttime environment regardless of gender, supporting equitable experiences of safety among all users.

***Table 13*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when grouped according to age/ generation**

Safety Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived personal safety	17.419	4	0.002	Significant	Rejected
Prospect	18.507	4	<0.001	Significant	Rejected
Concealment	16.308	4	0.003	Significant	Rejected
Safety	18.072	4	0.001	Significant	Rejected

Note. Test statistics compare the mean scores of age/ generation groups for each safety indicator.

Table 13 presents the results of the test for significant differences in safety perceptions across age groups. The analysis shows that all four indicators of safety—perceived personal safety, prospect, concealment, and overall safety—differ significantly according to respondents' age, as indicated by p-values ranging from <0.001 to 0.003.

The significant variation in perceived personal safety (p = 0.002) suggests that age groups evaluate their vulnerability or sense of security differently under existing lighting conditions. Younger and older respondents likely interpret environmental cues in distinct ways, possibly due to differences in mobility, experience, or risk perception.

For prospect, which relates to the ability to see distances and assess potential threats, the p-value of <0.001 indicates a highly significant difference across age groups. This implies that certain age cohorts may experience more difficulty in gauging spatial openness or identifying visual obstructions at night.

Concealment (p = 0.003) also varied significantly by age, suggesting that perceptions of hidden areas, shadows, or potential hiding spots differ among generations. Younger respondents, for example, may be more alert to concealed zones, while older respondents may be more sensitive to areas where visibility is reduced.

Finally, the significant difference in the overall safety measure (p = 0.001) confirms that age serves as an important demographic factor shaping safety perceptions in the CBD. This underscores the need for lighting interventions that address diverse needs—ensuring that both younger and older populations feel adequately safe in the area at night.

Overall, the findings indicate that age significantly influences all aspects of safety perception, highlighting the importance of inclusive lighting design that accounts for intergenerational differences in visual and psychological responses to nighttime environments.

Table 14 presents the comparison of safety perceptions across different marital status groups. The results reveal that marital status significantly influences all safety-related indicators, including perceived personal safety, prospect, concealment, and overall safety. All p-values fall below the 0.05 threshold, indicating statistically significant differences among single, married, and widowed respondents.

For perceived personal safety, the p-value of 0.009 suggests that marital groups differ in how secure they feel under existing lighting conditions. Married respondents, who often travel with family or dependents, may assess safety differently from singles or widowed individuals who may navigate public spaces alone.

The prospect dimension (p = 0.002) also shows significant variation. This indicates that respondents' ability to detect potential threats or assess open sightlines differs by marital status. Married respondents, for example, may be more cautious about visibility when moving with children, whereas single individuals may prioritize different aspects of the environment.

***Table 14*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when grouped according to marital status**

Safety Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived personal safety	9.473	2	0.009	Significant	Rejected
Prospect	12.074	2	0.002	Significant	Rejected
Concealment	8.249	2	0.016	Significant	Rejected
Safety	10.744	2	0.005	Significant	Rejected

Note. Test statistics compare the mean scores of marital status groups for each safety indicator.

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Similarly, the dimension of concealment (p = 0.016) reveals significant differences across marital categories. This implies that the perception of shadowy areas, hidden corners, or visual obstructions is interpreted differently depending on one's social and emotional security needs, which are often shaped by marital circumstances.

Finally, the overall safety construct (p = 0.005) also shows significant variation, reinforcing the notion that marital roles and responsibilities influence how individuals evaluate nighttime environmental safety. Married respondents may express heightened concern for collective safety, while singles might focus more on personal vulnerability.

Taken together, the results suggest that marital status meaningfully shapes safety perceptions, with each group exhibiting unique sensitivities and priorities in relation to nighttime lighting conditions. This highlights the importance of designing lighting systems that address diverse household contexts and mobility patterns within urban environments.

***Table 15*. Significant difference in the assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when grouped according to educational level**

Safety Indicator	Statistics	df	p-value	Significance @ 0.05	Hypothesis Status
Perceived personal safety	9.839	4	0.043	Significant	Rejected
Prospect	12.46	4	0.014	Significant	Rejected
Concealment	12.998	4	0.011	Significant	Rejected
Safety	12.778	4	0.012	Significant	Rejected

Note. Test statistics compare the mean scores of educational groups for each safety indicator.

Table 15 presents the analysis of safety perceptions when respondents are grouped according to educational level. The results indicate that educational attainment significantly influences all dimensions of perceived safety, as all p-values fall below the 0.05 significance threshold.

For perceived personal safety, the p-value of 0.043 suggests that respondents with different educational backgrounds vary in how secure they feel when navigating the central business district at night. Those with higher levels of education may possess more awareness of environmental risks, while those with lower educational attainment may interpret safety cues differently.

The dimension of prospect (p = 0.014), which reflects respondents' perceived ability to see open spaces and identify potential threats, also varies significantly across educational categories. This could be attributed to differences in environmental literacy, exposure to design standards, or familiarity with spatial assessment.

Similarly, concealment (p = 0.011) shows significant variation, indicating that respondents differ in their perception of shadowed areas, hiding spots, or obstructed views depending on their educational level. Individuals with more advanced education may have stronger risk-assessment behaviors or heightened sensitivity to poorly illuminated areas.

The significant difference in overall safety (p = 0.012) further confirms the role of educational attainment in shaping safety perceptions. Respondents with tertiary education or specialized training may apply more stringent criteria in evaluating nighttime environments, whereas others may rely more heavily on general impressions or emotional cues.

Overall, the findings indicate that education level is a key demographic factor influencing perceptions of safety under existing lighting conditions. These results underscore the need for lighting improvements that address the varying expectations and interpretive frameworks of diverse educational groups, ensuring public spaces feel safe and accessible for all users.

***Table 16*. Significant correlation in the assessment of lighting illumination in the central business district of Iloilo City on safety in terms of perceived personal safety, prospect, and concealment when grouped according to educational level**

Correlate	Spearman's ρ	p-value	Significance @ 0.05	Hypothesis Status
Visibility with Safety	0.92	< .001	Significant	Rejected
Visual Comfort with Safety	0.974	< .001	Significant	Rejected
Visibility with Visual Comfort	0.904	< .001	Significant	Rejected

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Table 16 presents the correlation analysis examining the relationships among visibility, visual comfort, and safety in the central business district of Iloilo City. The results show that all correlations are positive, very strong, and statistically significant, with p-values less than .001 across all variable pairs. This indicates that improvements in one aspect of lighting tend to coincide with improvements in the others.

The correlation between visibility and safety ($\rho = 0.920$) suggests that respondents who reported higher visibility levels under existing street lighting also perceived the environment as significantly safer. This strong association highlights the critical role of clear sightlines, obstacle detection, and facial recognition in shaping feelings of security during nighttime activity.

The relationship between visual comfort and safety ($\rho = 0.974$) is even stronger, indicating that the quality and comfort of lighting—whether in terms of brightness, uniformity, glare reduction, or color temperature—substantially influences how safe people feel in the area. This underscores the importance of lighting designs that not only illuminate spaces adequately but also reduce visual strain and discomfort.

Lastly, the strong positive correlation between visibility and visual comfort ($\rho = 0.904$) suggests that comfortable lighting conditions support better visibility, and vice versa. When illumination is appropriately calibrated, respondents experience fewer visual barriers and greater ease in navigating public spaces.

Overall, the results show that visibility, visual comfort, and safety are tightly interlinked. Enhancing any one of these elements contributes to improving the others, reinforcing the necessity of integrated lighting design strategies that prioritize clarity, comfort, and security to enhance nighttime livability and public confidence.

Discussion:

The purpose of this study was to examine the illumination quality of Iloilo City's Central Business District (CBD)—particularly in Barangay San Rafael—using three key dimensions established in lighting and environmental-behavior research: visibility, visual comfort, and perceived safety. The discussion below synthesizes the findings, situates them within existing scholarship, and highlights their practical implications for urban lighting design.

Visibility as a Foundational Element of Urban Experience

The results demonstrate that visibility in the CBD is consistently rated as High to Very High across demographic groups. This suggests that the city's existing lighting infrastructure generally succeeds in supporting core nighttime functions—recognizing faces, detecting obstacles, and navigating spaces with spatial clarity. These findings align with Navaraj & Inkarojrit's (2024) assertion that adequate visibility is a prerequisite for meaningful interaction with the built environment. Similarly, Frutos et al. (2024) emphasize that lighting enabling environmental awareness enhances social presence and reduces psychological distress linked to uncertainty or visual obstruction.

Notably, facial recognition emerged as the strongest visibility indicator, particularly among Xennials, Baby Boomers, and tertiary-level respondents. This reinforces Johansson et al.'s (2014) conceptualization of POLQ, where color temperature and directionality influence one's ability to recognize people—a key social cue of safety. The relatively lower ratings from younger groups (Gen Y and Gen Z), while still high, may reflect their heightened sensitivity to lighting uniformity and glare, an emerging trend noted by Nazari & Matusiak (2024) in studies examining LED-intensive streetscapes.

Significant differences were observed in some visibility indicators across age and marital status, suggesting that visibility is not interpreted uniformly. Older respondents (Baby Boomers) and widowed individuals rated visibility higher, likely due to greater dependency on environmental cues for mobility—consistent with Osibona et al.'s (2021) findings on age-related light sensitivity and orientation needs. Conversely, younger adults showed more varied responses, possibly due to differing expectations shaped by exposure to technologically advanced lighting environments.

Despite these differences, sex and educational level showed no meaningful variation in most visibility indicators. This suggests that visibility, as a functional lighting outcome, is equitably distributed, reinforcing Carlos's (2025) assertion that modern LED infrastructure—though not perfect—provides generally uniform illumination when installed systematically.

Visual Comfort and the Growing Importance of Human-Centered Lighting

Visual comfort was consistently rated at a High Level, indicating that respondents generally experienced the lighting environment as comfortable enough for nighttime activity. However, significant differences across age, marital status, and educational attainment reveal that comfort is highly subjective and socially mediated, echoing the human-centered lighting approach advanced by Kelly (1956) and contemporary researchers such as Custers et al. (2010) and Nguyen et al. (2019).

The strongest differences appeared across age groups, with Xennials and Baby Boomers reporting the highest comfort levels. This aligns with literature noting that older adults prefer warmer, more diffuse lighting and tend to evaluate comfort more favorably when illumination avoids harsh glare (Johansson et al., 2014). Younger cohorts, especially Gen Z, rated comfort lower, which may reflect aesthetic preferences shaped by exposure to commercial and entertainment lighting that tends to prioritize high contrast, cooler color temperatures, and dynamic effects.

Differences by marital status and educational level further underscore the complexity of visual comfort. Married respondents rated lighting quality and illumination more positively, potentially reflecting heightened sensitivity to environmental safety when accompanying dependents. Meanwhile, respondents with tertiary education exhibited more discriminating assessments, possibly influenced by greater exposure to architectural or workplace lighting standards.

The absence of significant differences by sex suggests that the lighting environment affords a relatively equal experience of comfort for both men and women. However, broader regional literature—particularly regarding gendered safety concerns in Southeast Asian cities (Douglass et al., 2003; UN-Habitat & ASEAN, 2022)—suggests that comfort alone does not fully mitigate gender-specific anxieties, pointing to the need for integrated design approaches beyond illumination alone.

Safety as a Social Interpretation of Light

Safety—operationalized through perceived personal safety, prospect, and concealment—was also consistently rated as High, demonstrating that the area's illumination contributes meaningfully to users' sense of security. This supports prior work showing that well-lit streets reduce fear of crime and increase nighttime activity (Dastgheib, 2018; Hilario et al., 2021).

Significant differences across age, marital status, and educational level reflect the social nature of perceived safety:

- **Older and widowed respondents** reported the highest safety ratings, perhaps due to greater dependence on lighting for orientation and hazard detection.
- **Younger respondents**, particularly Gen Z, expressed slightly lower safety scores, potentially reflecting differing expectations for visibility or increased exposure to online discourse about urban risks.
- **Married respondents** rated safety higher than singles; this aligns with previous findings that people with dependents tend to be more attentive to environmental cues.
- **Educated respondents** demonstrated greater variability in safety perception, suggesting that safety interpretations may be shaped by environmental literacy and awareness of design standards.

Importantly, sex had no significant effect on safety perception—contrary to common assumptions that women feel disproportionately unsafe in public spaces. This does not negate the gendered realities noted in global literature, but suggests that in this specific locale, lighting may successfully equalize perceptions of nighttime security.

Interrelationship of Visibility, Comfort, and Safety

The strongest finding of the study is the very high and statistically significant correlations among visibility, visual comfort, and safety (ρ = .904 to .974). This aligns closely with the integrated lighting frameworks proposed by modern lighting scholars and organizations such as UN-Habitat, which argue that urban lighting functions not as isolated technical systems but as interdependent determinants of social behavior, mobility, and well-being.

These correlations confirm that:

- When lighting enhances visibility, **perceived safety improves**.
- When lighting feels visually comfortable, **fear decreases and confidence in the environment rises**.
- When glare is reduced and color temperature is pleasant, **visibility is enhanced**, reinforcing a cycle of environmental trust.

These findings validate the premise that urban lighting is a social infrastructure, not merely an engineering utility—fulfilling the study's original proposition.

Implications for Urban Lighting Design in Iloilo City

The findings suggest several key considerations for urban planning and lighting design:

1. Visibility is strong but improvement is possible. While overall levels are high, younger cohorts identify lower scores in certain indicators, suggesting that uniformity, glare control, and luminance distribution should be monitored.
2. Visual comfort matters as much as visibility. High visibility does not guarantee comfort. LED lighting should be calibrated to reduce harshness, optimize color temperature, and balance luminance levels.
3. Safety perceptions differ across key demographic groups. This suggests the need for targeted lighting enhancements in areas frequented by younger populations, single individuals, or tertiary-educated workers.
4. Lighting should be integrated into broader urban renewal efforts. As Iloilo City transitions toward smart city developments, lighting systems must be scalable, sustainable, and sensitive to human factors—not merely energy-efficient.
5. Participatory lighting audits may enhance accuracy. Demographic variations suggest the need for community-engaged planning to capture user-specific visual needs.
6. Smart lighting solutions could address comfort and safety simultaneously. Adjustable color temperatures, motion-sensitive dimming, and glare-reduction fixtures can support diverse user expectations.

Situating the Study Within Global Literature

The results corroborate international findings that lighting contributes directly to social participation, psychological well-being, and economic activity (Osibona et al., 2021; Chen et al., 2022). By confirming a strong relationship between visibility and safety, this study strengthens the evidence supporting lighting as a central component of sustainable, livable cities—a position strongly advocated by the World Bank, ASEAN, and UN-Habitat.

This study also contributes new empirical evidence from a Philippine urban context—an understudied setting in lighting research—addressing a gap identified in regional literature.

Conclusion:

This study set out to evaluate the quality of street lighting in the central business district of Iloilo City—specifically Barangay San Rafael—through the lenses of visibility, visual comfort, and perceived safety. Using a validated, highly reliable questionnaire administered to 187 respondents, the research generated a detailed picture of how urban lighting is experienced by diverse user groups during nighttime.

Overall, the findings point to a generally adequate and effective lighting environment. Visibility was consistently rated from High to Very High, indicating that existing illumination allows people to recognize faces, detect obstacles, and navigate spaces with confidence. Visual comfort, likewise, was rated at a High Level across all groups, suggesting that brightness, color temperature, and overall light quality are broadly acceptable for everyday nighttime activities. Perceived safety also reached a High Level, demonstrating that the current lighting system contributes meaningfully to respondents' sense of security in the CBD.

At the same time, the study revealed important demographic nuances. Sex did not significantly influence perceptions of visibility, visual comfort, or safety, indicating that the lighting environment affords a relatively equitable experience for men and women. However, age, marital status, and educational attainment were consistently associated with significant differences in several indicators. Older and widowed respondents generally expressed stronger perceptions of visibility and safety, while Xennials and Baby Boomers reported higher visual comfort than younger generations. Educational level also shaped how respondents evaluated facial recognition, lighting quality, and safety, suggesting that expectations and risk perceptions vary with social and educational background.

The strongest result of the study is the very high, positive, and statistically significant correlations among visibility, visual comfort, and safety. Better visibility is closely associated with higher perceived safety; greater visual comfort likewise strengthens feelings of security; and visually comfortable environments tend to enhance visibility. These interrelationships confirm that illumination functions as a holistic urban system: improvements in one aspect of lighting produce cascading benefits in others. In this sense, lighting emerges not only as a technical utility but as a form of social infrastructure that sustains livability, walkability, and public confidence after dark.

For Iloilo City, the findings imply that the CBD's lighting system is performing relatively well but also highlight opportunities for refinement and targeted enhancement. Design interventions should prioritize age-responsive and education-sensitive strategies—such as glare control, better uniformity, and carefully calibrated color temperature—especially in areas frequented by younger adults, single pedestrians, and tertiary-educated workers who expressed slightly lower comfort and safety ratings. As the city advances toward smart and sustainable urban development, integrating these human-centered insights into lighting upgrades, energy-efficient retrofits, and public-space planning will be crucial.

In sum, this study demonstrates that well-designed lighting in Iloilo City's CBD already supports safe, comfortable, and visible nighttime environments, yet it also underscores the importance of treating illumination as a dynamic, user-centered component of urban design. By grounding future planning in empirical evidence on visibility, visual comfort, and safety, city planners, engineers, and policy makers can craft lighting systems that are not only efficient and modern, but also inclusive, reassuring, and truly responsive to the people who use the city after dark.

References:

ASEAN. (2022). *Study on urbanization, people mobility, and inclusive development*. Association of Southeast Asian Nations. https://asean.org/wp-content/uploads/2022/06/Study-on-Urbanization-People-Mobility-Inclusive-Development-FINAL.pdf

Bell, E., Bryman, A., & Harley, B. (2022). Sampling in quantitative research. In *Business Research Methods*. Oxford University Press. https://doi.org/10.1093/hebz/9780198869443.003.0020

Carlos, M. (2025, January 14). How road design can contribute to auto accidents and liability. *Caroselli, Beachler & Coleman, L.L.C.* https://www.cbmclaw.com/how-road-design-can-contribute-to-auto-accidents-and-liability/

Chen, R., Tsai, M.-C., & Tsay, Y.-S. (2022). Effect of color temperature and illuminance on psychology, physiology, and productivity: An experimental study. *Energies*, *15*(12), 4477. https://doi.org/10.3390/en15124477

Custers, P., de Kort, Y., IJsselsteijn, W., & de Kruiff, M. (2010). Lighting in retail environments: Atmosphere perception in the real world. *Lighting Research & Technology*, *42*(3), 331–343. https://doi.org/10.1177/1477153510377836

Dastgheib, S. (2018). *Light and Perception of safety in-between buildings* (pp. 19–24). KTH Royal Institute of Technology School of Architecture and the Built Environment.

Delloye , E. (2012, December 22). How lack of light harms our physical and mental health. *Luminette*. https://myluminette.com/en-int/blogs/article/harmful-effect-of-lack-of-light?srsltid=AfmBOoq7A5ARxSdHbPPl0YvNJ4w7VgLR8awohhTopwt4CWTvYRO0cKnm#start-article-section

Douglass, M., Quang, T., Cameron, L., & Yulinawati, H. (2003, December 1). *Livability and mega-urban region dynamics in southeast asia*. Unknown. https://doi.org/10.13140/RG.2.2.18981.68320

Frutos, L. de, Pellizzari, L., & Hvass, M. (2024). The influence of urban lighting on the sense of belonging. *IOP Conference Series: Earth and Environmental Science*, *1320*(1), 012011. https://doi.org/10.1088/1755-1315/1320/1/012011

Hilario, L., Duka, J. A., Mabalot, M. I., Domingo, J., Vergara, K. A., Villanueva-Jerez, M. J., Cabello, K. A., Rufino, G. A., & Sarmiento, C. J. (2021). Forecasting urban population distribution of iloilo city using gis and spatial autocorrelation models. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *XLVI-4/W6*, 185–192. https://doi.org/10.5194/isprs-archives-xlvi-4-w6-2021-185-2021

Johansson, M., Pedersen, E., Maleetipwan-Mattsson, P., Kuhn, L., & Laike, T. (2014). Perceived outdoor lighting quality (POLQ): A lighting assessment tool. *Journal of Environmental Psychology*, *39*, 14–21. https://doi.org/10.1016/j.jenvp.2013.12.002

Liu, M., Zhang, B., Luo, T., Liu, Y., Portnov, B. A., Trop, T., Jiao, W., Liu, H., Li, Y., & Liu, Q. (2022). Evaluating street lighting quality in residential areas by combining remote sensing tools and a survey on pedestrians' perceptions of safety and visual comfort. *Remote Sensing*, *14*(4), 826. https://doi.org/10.3390/rs14040826

Mba, E. J., Okeke, F. O., Igwe, A. E., Ozigbo, C. A., Oforji, P. I., & Ozigbo, I. W. (2024). Evolving trends and challenges in sustainable architectural design; a practice perspective. *Heliyon*, *10*(20), e39400. https://doi.org/10.1016/j.heliyon.2024.e39400

Navaraj, P., & Inkarojrit, V. (2024). Beyond illumination: Stakeholder perspectives on urban lighting master planning for chiang mai old city, thailand. *Sustainability*, *16*(21), 9411. https://doi.org/10.3390/su16219411

Nazari, M., & Matusiak, B. (2024). Daylighting simulation and visualisation: Navigating challenges in accuracy and validation. *Energy and Buildings*, *312*, 114188. https://doi.org/10.1016/j.enbuild.2024.114188

Nguyen, A. T., Truong, N. S. H., Rockwood, D., & Tran Le, A. D. (2019). Studies on sustainable features of vernacular architecture in different regions across the world: A comprehensive synthesis and evaluation. *Frontiers of Architectural Research*, *8*(4), 535–548. https://doi.org/10.1016/j.foar.2019.07.006

Osibona, O., Solomon, B. D., & Fecht, D. (2021). Lighting in the home and health: A systematic review. *International Journal of Environmental Research and Public Health*, *18*(2), 609. https://doi.org/10.3390/ijerph18020609

Pandey, P., Madhusudhan, M., & Singh, B. P. (2023). Quantitative Research Approach and its Applications in Library and Information Science Research. *Access: An International Journal of Nepal Library Association*, *2*(01), 77–90. https://doi.org/10.3126/access.v2i01.58895

PhilAtlas. (2025). *San Rafael, City of Iloilo Profile*. Philippine Statistics Authority (for population and household data). https://www.philatlas.com/visayas/r06/iloilo-city/san-rafael.html

Taber, K. S. (2017). The use of cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Thursfield, P., & vd Ven, R. (2022). Design principles for natural lighting. *IOP Conference Series: Earth and Environmental Science*, *1099*(1), 012033. https://doi.org/10.1088/1755-1315/1099/1/012033

UN-Habitat & ASEAN. (2022). *ASEAN sustainable urbanisation report*. United Nations Human Settlements Programme (UN-Habitat) and Association of Southeast Asian Nations (ASEAN). https://unhabitat.org/sites/default/files/2022/12/asean_sustainable_urbanisation_report_final_dec_2022.pdf

Wu, S. (2014). *Investigating Lighting Quality: Examining the Relationship between Perceived Safety and Pedestrian Lighting Environment*. VTechWorks; Virginia Tech. http://hdl.handle.net/10919/48170

Zhang, L., & Shen, T. (2024). Integrating sustainability into contemporary art and design: An interdisciplinary approach. *Sustainability*, *16*(15), 6539. https://doi.org/10.3390/su16156539