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Assessing Traffic Noise and Its Impact on High-Rise Apartment Buildings Adjacent to an Urban Expressway: A Case Study in Chengdu, China

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Abstract: With rapid urbanization, traffic growth has accelerated in some cities in China. Due to strict urban construction land utilization policies, many high-rise apartment buildings have been constructed adjacent to expressways. To better understand the impact of urban traffic noise on the residents of high residential buildings adjacent to expressways and the differences in noise impacts on different floors, on-site noise monitoring and questionnaires for building residents have been conducted. The characteristics of traffic noise were analyzed based on the measured data, and factors, including time periods and building floors, were considered. According to the results of the questionnaire survey, 56.06% of the male respondents and 54.55% of the female respondents think that the impact of traffic noise on high-rise buildings is "high" or "very high"; 50.53% of the respondents who were in "good" or "very good" condition thought that the traffic noise has a "significant impact" or "very significant impact" on their sleep and daily life. In addition, 25% of respondents living on floors 4–10 and 62.5% of respondents living on floors 11–20 considered the traffic noise to have a "significant impact" or "very significant impact" on their sleep and daily life. The on-site noise monitoring results show that the noise levels (L_{Aeq}) outside the windows of the studied buildings remain significantly elevated, with daytime noise on working days ranging from 56 to 70 dB(A), and on weekends ranging from 50 to 65 dB(A). During the four time periods on weekdays from 7 a.m. to 9 a.m., 11 a.m. to 1 p.m., 5 p.m. to 7 p.m., and 10 p.m. to 12 a.m., the average L_{Aeq} levels on floors 11–20 are higher than those on floors 4–10 by 4.04 dB(A), 4.92 dB(A), 4.06 dB(A), and 2.67 dB(A), respectively. Similarly, during these time periods on weekends, the levels on floors 11–20 are higher than those on floors 4–10 by 4.96 dB(A), 6.32 dB(A), 5.28 dB(A), and 5.24 dB(A), respectively. This indicates that floors 4–10 of the building experience relatively lower noise levels, while floors 11–20 are subjected to comparatively higher levels of noise disturbance.

Keywords: traffic noise; high-rise apartment buildings; noise monitoring; expressway

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1. Introduction

1.1. Background

In today's rapidly expanding cities, urbanization and transportation development have become intertwined [1]. As a response to the growing volume of vehicles, urban expressways have been constructed, efficiently connecting different parts of the city [2–4]. While these developments improve transportation, they have also resulted in the construction of residential buildings and communities close to these expressways. This situation has raised concerns about the potential impact of traffic noise on residents' well-being and health [5,6]. In Chengdu, China, the Tianfu New Area has witnessed the development of a network of urban expressways, including the busy Jian-Nan Avenue, connecting the area to the downtown region (Figure 1). Under China's strict policies aimed at protecting arable land, which are designed to preserve agricultural resources and limit urban sprawl, some residential structures and communities have been built close to these expressways. Consequently, there is an urgent need to address the potential consequences of traffic noise on the residents living adjacent to these expressways.

Figure 1. Location of Jian-Nan Avenue in Chengdu, China (Original image source: Bing Maps).

Figure 2 depicts the numerous high-rise residential buildings close to Jian-Nan Avenue. Since its construction, Jian-Nan Avenue has significantly eased the daily commute for people traveling between their homes and workplaces. However, the heavy traffic flow also generates excessive noise, potentially impacting the comfort and well-being of residents in the adjacent high-rise buildings. The avenue spans approximately 41 km, with over 50,000 inhabitants residing in the tall structures lining its path. During peak hours, certain sections of Jian-Nan Avenue experience hourly traffic volumes exceeding 6000 vehicles, predominantly commuters traveling to and from work, including cars, motorcycles, and electric bicycles. The maximum speed limit on Jian-Nan Avenue is 80 km/h, but due to heavy traffic, vehicles typically travel at speeds ranging from 50 to 60 km/h. As a result, the primary sources of traffic noise on Jian-Nan Avenue are aerodynamic noise and tire–asphalt friction. Consequently, addressing the potential effects of traffic noise on urban expressway residents in Chengdu, China, has become a major concern. Ongoing research and the development of effective noise mitigation strategies are crucial to safeguarding the well-being and quality of life of individuals living in these areas.

The noise produced by passing vehicles poses a significant source of disturbance and annoyance for residents, leading to potential negative impacts on their quality of life and health. Several research reports have linked long-term exposure to traffic noise with various health issues, including hearing loss [7,8], cardiovascular disease [9,10], sleep disturbances [11–13], and impaired cognitive function [14]. Moreover, traffic noise can result in annoyance [15], stress [16], and tinnitus [17]. Overall, it is clear that traffic noise can significantly reduce the overall quality of life for residents.

As urbanization and the construction of new expressways continue to grow, cities are confronting an increasing problem of traffic noise pollution, particularly in buildings or residential areas situated near urban expressways. Understanding the impact of traffic noise on high-rise apartment buildings has become more critical than ever before.

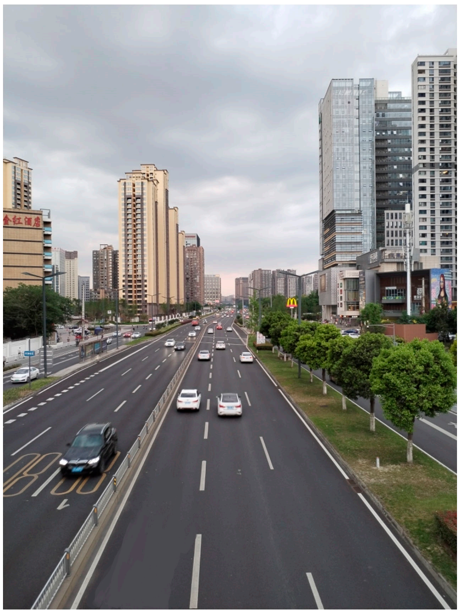

Figure 2. High-rise buildings are built close to Jian-Nan Avenue in Chengdu, China (Image source: photo taken by authors).

1.2. Related Works

As previously discussed, recent research has shown that traffic noise has a significant impact on daily life comfort and can affect both the mental and physical health of individuals. Consequently, a considerable amount of research has been conducted to assess noise levels, inhabitants' perception, and measures for soundproofing and noise reduction in various settings, such as wind farms [18,19], schools [20], hypermarket [21], university community [22], metro trains and stations [23–25], airports [26,27], office buildings [28], and gyms [29]. Regarding the impact of traffic noise, recent studies have shed light on the various negative effects it has on residents' health and well-being, especially in the context of urban expressways. Sleep quality, in particular, is significantly affected. For instance, research conducted by Vallet, M. et al. in homes adjacent to main roads revealed that young people exhibit deficits in stage 3 and 4 sleep, while older individuals experience REM sleep deficits under the influence of traffic noise [30]. Similarly, a questionnaire survey by Jorunn Evandt et al. indicated that individuals living in areas highly exposed to nighttime traffic noise may experience compromised sleep quantity [31]. Furthermore, traffic noise has been associated with mental health issues. A study by Karin Sygna et al. found that individuals with poor sleep quality appear more vulnerable to the effects of road traffic noise on mental health compared to those with better sleep quality [32]. Other researchers have also suggested that traffic noise can have a complex relationship with mental health, potentially leading to annoyance, nervousness, anxiety, tension, or depression in cases of overexposure [33,34].

As for the impact of traffic noise on adjacent buildings next to highways or roads, researchers have conducted several studies that indicated various adverse effects. These include structural vibrations [35,36] and compromised indoor acoustic environments [37,38]. Prolonged exposure to high noise levels can compromise occupants' comfort and well-being, impacting their quality of life [39,40]. Buildings located near expressways are particularly susceptible to the detrimental effects of traffic noise. Regarding on-site noise measurement, Huang et al. (2017) conducted a noise survey on different floors of high-rise buildings located along a free-flow expressway and established an acoustic amenity and noise analysis model [41]. Wu et al. (2019) evaluated the impact of traffic noise on individuals by measuring noise levels in three buildings with 12 or 18 stories, along with conducting a questionnaire survey among residents [42]. R. Benocci et al. (2020) undertook noise measurements at three sites with varying elevations and developed a three-dimensional acoustic simulation of building structures in Milan to estimate levels of traffic-generated noise. Their analysis of buildings exceeding 50 m in height across Milan provided insights into variations in noise exposure levels, contributing to the planning and design of new high-rise constructions aimed at mitigating noise exposure for residents [43]. Additionally, in 2024, Qin et al. investigated the characteristics of noise distribution among diverse building layouts along an ultra-wide cross-section highway, considering the influence of high-rise building arrangements and urban planning strategies on noise mitigation [44].

As for noise evaluation and prediction, researchers have conducted several studies scrutinizing different methods' precision in predicting traffic noise levels within high-rise buildings. Mak, C. et al. (2010) assessed the CRTN method's precision in predicting the vertical distribution of traffic noise levels (LA10) at various floor levels within a 20-story residential building in Hong Kong [45]. Similarly, Cai et al. (2019) utilized the Calculation of Road Traffic Noise (CRTN) method, specifically employing the LA10 descriptor, to assess the accuracy and suitability of predicting road traffic noise in Hong Kong [46]. To contribute to noise protection design in future high-rise structures, Sotiropoulou, A. et al. (2020) conducted traffic noise measurements and predictions using the CRTN model along the facade of a high-rise building in central Athens [47]. Additionally, Gao et al. (2021) monitored the environmental effects of traffic noise in a high-rise residential area and utilized SoundPLAN software to establish a model simulating the vertical distribution of traffic noise in the sound field of high-rise buildings [48]. In addition to traditional methods, new technologies have been adopted in research to evaluate the impact of traffic noise on high-rise buildings. Jeon et al. (2019) proposed a noise evaluation method utilizing virtual reality (VR) technology, specifically employing a head-related transfer function (HRTF) and a head-mounted display (HMD) to assess the noise experienced inside residential buildings [49].

While numerous studies have examined the effects of traffic noise on nearby buildings and residents, there remains a gap in research that combines field noise testing with questionnaire surveys to assess residents' awareness of noise. This article aims to address this gap by analyzing the impact of traffic noise on residents and the characteristics of different floors affected by noise through a combined approach of questionnaire surveys and on-site noise monitoring. This study focuses on a high-rise residential building adjacent to Jian-Nan Avenue, providing insights into traffic noise control for similar urban expressways and offering localized insights for urban planning and policy-making.

2. Methods

2.1. Questionnaire Survey

Questionnaire surveys are widely used methods for exploring the impact of daily life on individuals. To gain deeper insights into the residential experience of those living in buildings near Jian-Nan Avenue, a questionnaire consisting of 6 questions was created and distributed to households in the selected buildings. The questionnaire includes questions about the respondent's age, gender, health condition, residential floor, evaluations of traffic noise impact, and perceptions of its effects on sleep quality and daily activities. The main objective of this survey is to understand residents' awareness of traffic noise and the extent to which it significantly affects their sleep quality and daily lives. The specific questions of the questionnaire are listed in the Appendix A.

2.2. On-Site Noise Monitoring

2.2.1. Building to Be Studied

The high-rise residential building studied is a 32-story apartment complex located in Chengdu, China. As shown in Figure 3, the building is situated adjacent to Jian-Nan Avenue, with a distance of approximately 60 m between the building and the edge of the avenue.

Figure 3. The location of the studied building Original image source: Google Earth).

2.2.2. Measuring Instrument

The Class-2 sound level meter (model DT-8852), shown in Figure 4, is a versatile device designed for measuring sound levels across various applications, including industrial, environmental, and occupational noise monitoring. Equipped with a large LCD, it provides precise and easily legible readings of sound levels in decibels (dB(A)). With a measurement range spanning from 30 to 130 dB(A), it is capable of recording both A and C-weighted sound levels. The DT-8852 sound level meter was chosen for the on-site noise test due to its reliability, accuracy, and suitability for the task at hand. The sound level meter was calibrated before and after each test to ensure accurate measurements, meeting the requirements of the International Electrotechnical Commission [50].

Figure 4. DT-8852 sound level meter used for the noise test (Image source: photo taken by authors).

2.2.3. Measuring Points

When studying a residential building, it is essential to consider location accessibility when determining noise measuring points. These points should be strategically placed at representative locations to accurately assess noise levels and exposure. As the structures of the first to third floors are different from those of the upper floors, the noise measuring points are set outside the aisles from the 4th to the 32nd floor, as indicated in Figures 5 and 6. The codes for these points are V04, V05, V06, and so on, up to V32. The noise measurements were performed outside the window rather than inside.

Figure 5. The location of noise measuring points of the building to be studied (Image source: photo taken by authors).

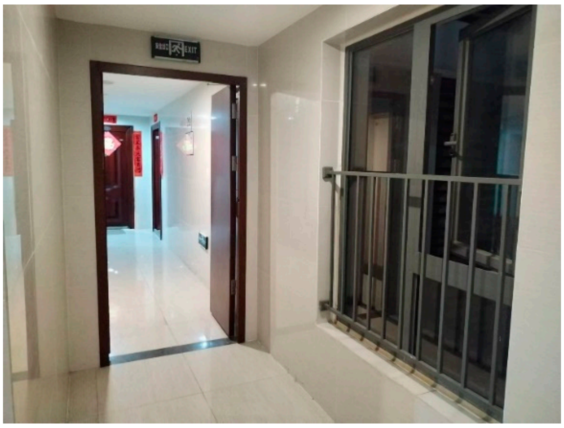

Figure 6. Noise measuring points outside the windows of the aisles from floor 4 to floor 32. (Image source: photo taken by authors).

2.2.4. Noise Indicator

When investigating the traffic noise exposure of high-rise apartment buildings neighboring Jian-Nan Avenue, the A-weighted sound pressure level was employed as the primary characterization of noise. The main indicator used in the study is L_{Aeq}, A-weighted equivalent sound pressure level during the measuring period (dB(A)), which was chosen for its effectiveness in assessing traffic noise exposure and its alignment with similar noise monitoring tests [51,52], as well as Section B.3.1.1 of the Environmental Quality Standard for Noise of China [53].

2.2.5. Measuring Methods

Noise measuring points were assessed separately at specific time intervals on both weekdays and weekends. The time slots for measurement were as follows: morning (7 a.m. to 9 a.m.), noon (11 a.m. to 1 p.m.), afternoon (5 p.m. to 7 p.m.), night (10 p.m. to 12 a.m.), and early morning (3 a.m to 4 a.m.). As for the measuring methods, all the noise monitoring times were 10 min, according to the Environmental Quality Standard for Noise of China [53]. Since traffic noise is variable and fluctuating, that is, unsteady, the following methods were used for testing. When carrying out on-site testing, the sound level meter was held with a clamping tool 20 cm outside of the window, and then the noise level was recorded for 10 min, with an interval of 6 s. Then, 100 pieces of instantaneous noise data were obtained at each measuring point. The 100 measured data were arranged from the largest to the smallest, and the 10th piece of data was recorded as L_{10}, the 50th piece of data was recorded as L_{50}, the 90th piece of data was recorded as L_{90}, and L_{Aeq} was then calculated using Equation (1).

$$L_{Aeq} = L_{50} + \frac{d^2}{60} \quad (1)$$

In which, $L_{10} - L_{90}$.

3. Discussions

3.1. Results of the Questionnaire Survey

The survey was conducted between 26 March and 28 March 2024, and a total of 121 valid responses were collected. Of the respondents, there were 66 males and 55 females. Among them, there were 12 males and 9 females under the age of 20, 20 males and 18 females aged 21–35, 22 males and 12 females aged 36–50, 4 males and 6 females aged 51–65, and 8 males and 10 females aged 60 and above. The distribution of respondents according to residential floor levels is as follows: 42 on floors 4–10, 38 on floors 11–20, 35 on floors 21–30, and 6 on floors 31–32. In terms of self-reported health status, 26 respondents rated their health as "very good", 69 as "good", 16 as "fair", 6 as "poor", and 4 as "very poor" among all respondents.

The evaluation of the impact level of Jian-Nan Avenue traffic noise on residential buildings by males and females in different age groups is depicted in Figures 7 and 8. From both figures, it can be observed that out of 66 males, 37 perceived the impact of traffic noise on their residential buildings as "high" or "very high", accounting for 56.06%. Similarly, out of 55 females, 30 perceived the impact of traffic noise on their residential buildings as "high" or "very high", accounting for 54.55%. Additionally, Figures 7 and 8 also indicate that for both males and females across different age groups, the perception of the impact of traffic noise on their residential buildings as "high" or "very high" exceeds 50% of the total number of respondents in each age group. Overall, the impact of Jiannan Avenue traffic noise on the residents of the studied high-rise residential buildings is significant.

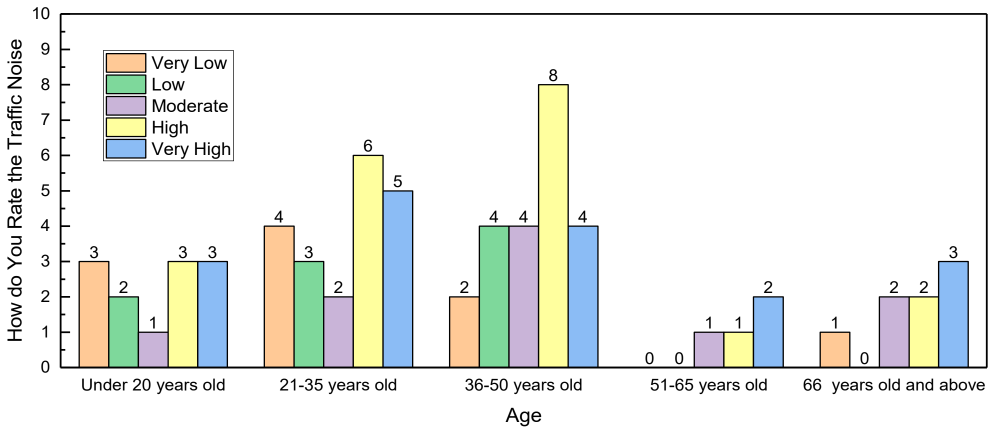

Figure 7. Evaluation of traffic noise level of Jian-Nan Avenue by male respondents of different ages.

Further statistical analysis was conducted on the responses regarding the impact of traffic noise on sleep and daily life among individuals residing on different floors and reporting their physical condition as "good" or "very good". Figure 9 illustrates the distribution of responses among these individuals. Out of the 95 respondents reporting their physical condition as "good" or "very good", 48 perceived their sleep and daily life to be "seriously affected" or "very seriously affected", accounting for 50.53%. In terms of residential floor distribution, the analysis revealed varying proportions of respondents believing that their sleep and daily life were "seriously affected" or "very seriously affected". Among respondents living on floors 4–10, 11–20, 21–30, and 31–32, the proportions were

25%, 62.5%, 61.29%, and 50%, respectively, with the highest proportion observed among those residing on floors 11–20. These findings highlight the significant impact of traffic noise on the sleep and daily life of residents, particularly those living on intermediate floors of the high-rise residential building.

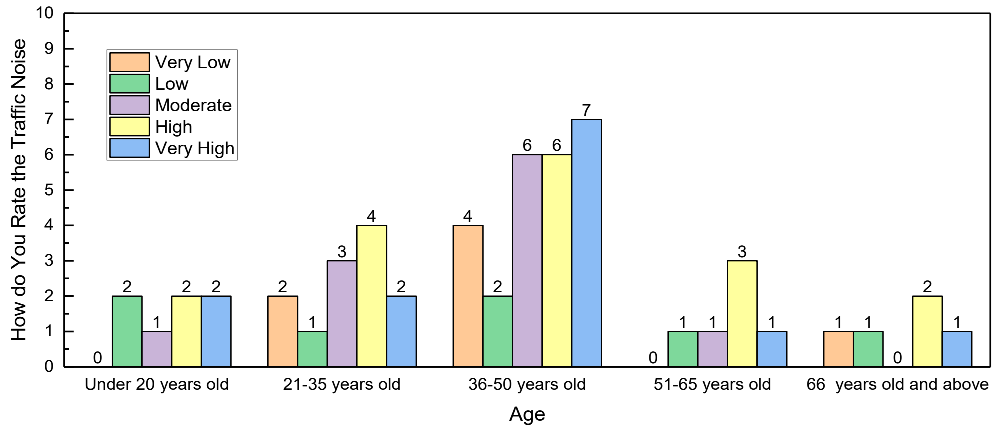

Figure 8. Evaluation of traffic noise level of Jian-Nan Avenue by female respondents of different ages.

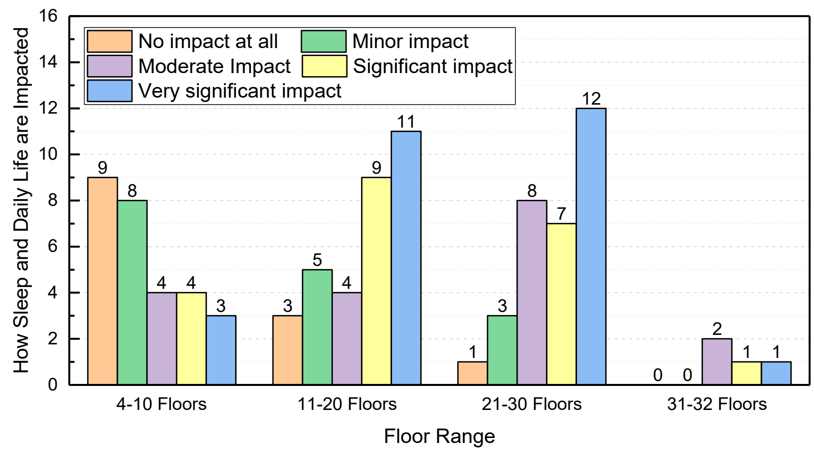

Figure 9. Comments on how noise affects sleep and daily life by residents on different floors who are in "good" or "very good" physical condition.

3.2. Noise of Different Layers

The noise (L_{Aeq}) test records for the measuring points on weekdays (28 June 2023) and weekends (1 July 2023) are illustrated in Figure 10. As shown in Figure 10, whether during the morning (7 a.m. to 9 a.m.), midday (11 a.m. to 1 p.m.), or evening (5 p.m. to 7 p.m.) on both workdays and weekends, the noise levels (L_{Aeq}) outside the windows of the studied buildings remain significantly elevated, with daytime noise on working days ranging from 56 to 70 dB(A), and on weekends ranging from 50 to 65 dB(A). During nighttime (10 p.m. to 12 a.m.), the noise L_{Aeq} measurements on both weekdays and weekends show a notable reduction due to decreased traffic flow, with levels ranging between 56–62 dB(A) and 50–63 dB(A), respectively. The monitoring results show that Jian-Nan Avenue serves as a primary road connecting the central urban area to the newly developed urban region. The high traffic volumes throughout the day lead to consistently high noise impacts on the high-rise building studied. The results of this noise monitoring are consistent with the findings of the questionnaire survey, in which 56.06% of male respondents and 54.55% of female respondents considered the traffic noise level to be "high" or "very high".

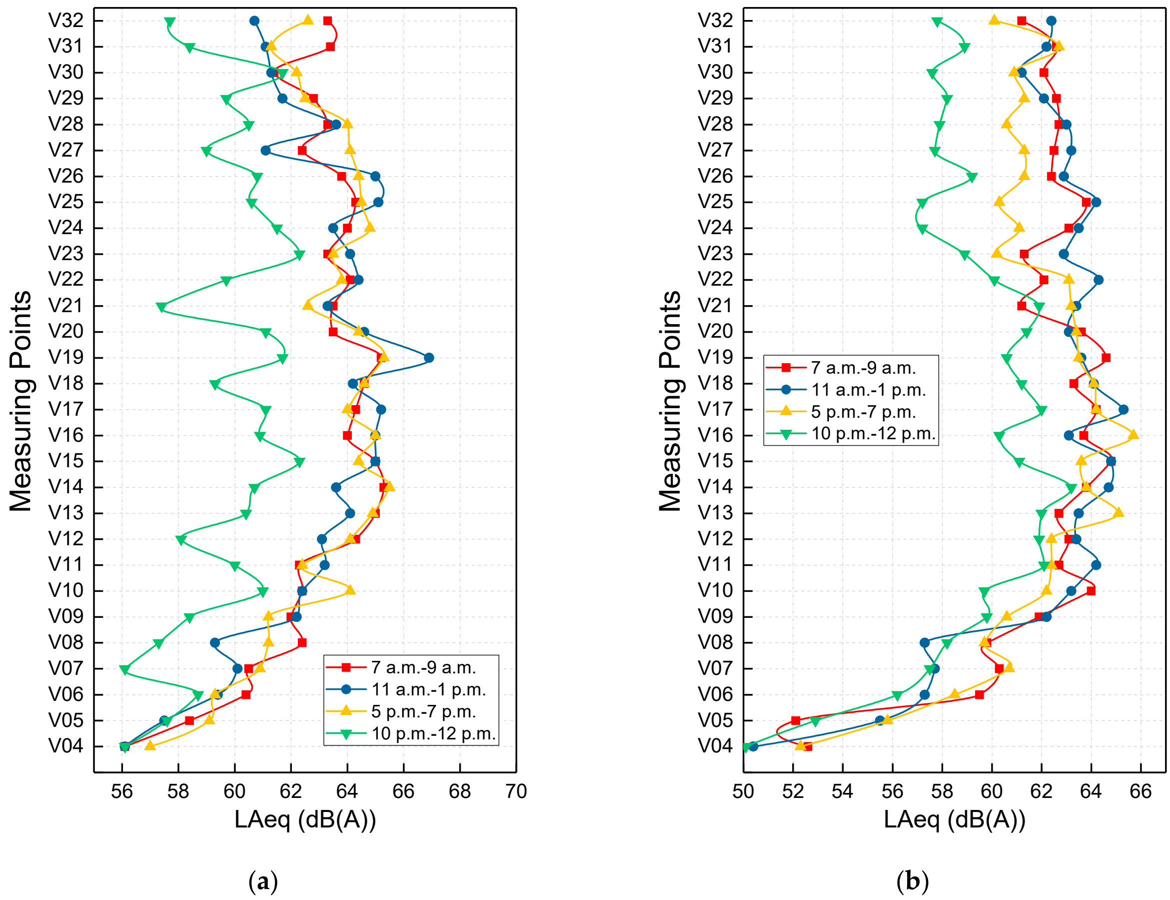

Figure 10. L_{Aeq} test record of measuring points during 4 different periods. (**a**) on workday; (**b**) on weekends.

The graph lines in Figure 10 demonstrate a trend where noise impact is relatively lower for floors below the 10th floor (i.e., floors 4–10). The daytime noise L_{Aeq} measured on both weekdays and weekends ranges from 55 to 63 dB(A) and 52 to 63 dB(A), respectively, and the nighttime noise data range between 56 to 58 dB(A) and 50 to 59 dB(A), respectively, all of which seem lower than the measurements recorded for other floors.

To validate the above speculation, the average L_{Aeq} levels were calculated separately for different floor ranges during different time slots on weekdays and weekends. The results are summarized in Tables 1 and 2. Overall, the noise levels measured on floors 4–10 are the lowest among all floor ranges, while the levels measured on floors 11–20 are the highest. During the four time periods on weekdays and weekends, the average L_{Aeq} levels on floors 11–20 are consistently higher than those on floors 4–10 by a range of 2.67 to 6.32 dB(A), indicating comparatively higher levels of noise disturbance on higher floors. This statistical result is consistent with the survey findings, where 25% of the respondents residing on floors 4–10 reported a “significant impact” or “very significant impact” of traffic noise on their sleep and daily life, whereas 62.5% of the residents on floors 11–20 reported the same.

Furthermore, as depicted in Figure 5, green belts (including trees and bushes) are present between the tested high-rise building and Jian-Nan Avenue. These green belts may block and reflect traffic noise to some extent during the process of noise propagation, resulting in reduced noise impact on the lower floors of the building. This observation suggests that the presence of green belts plays a role in mitigating traffic noise and improving the living environment for residents.

Table 1. Average L_{Aeq} of different floor ranges (workday).

Time Periods	Floor Range			
	4–10 Floors	11–20 Floors	21–30 Floors	30–32 Floors
7 a.m. to 9 a.m.	60.31	64.35	63.29	63.35
11 a.m. to 1 p.m.	59.57	64.49	63.31	60.90
5 p.m. to 7 p.m.	60.40	64.46	63.64	61.95
10 p.m. to 12 a.m.	57.89	60.56	60.32	58.05

Table 2. Average L_{Aeq} of different floor ranges (weekend).

Time Periods	Floor Range			
	4–10 Floors	11–20 Floors	21–30 Floors	30–32 Floors
7 a.m. to 9 a.m.	58.60	63.65	62.38	61.90
11 a.m. to 1 p.m.	57.66	63.98	63.07	62.30
5 p.m. to 7 p.m.	58.54	63.82	61.33	61.40
10 p.m. to 12 a.m.	56.34	61.58	58.59	58.35

To assess the impact of traffic noise from Jian-Nan Avenue on the studied high-rise residential buildings, the author conducted noise monitoring again from 3:00 a.m. to 4:00 a.m. on 22 March 2024. The test results are shown in Figure 11.

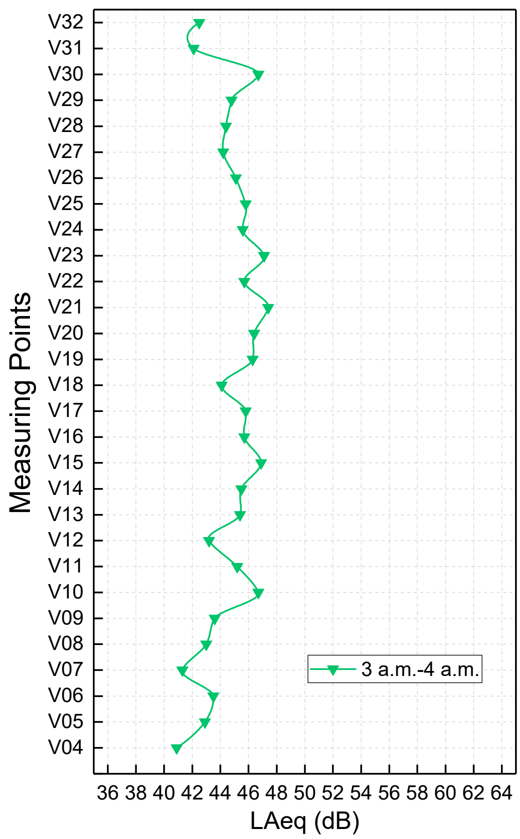

Figure 11. L_{Aeq} test record of measuring points from 3:00 a.m. to 4:00 a.m. on 22 March 2024.

It can be observed from Figure 11 that during the time period of 3:00 a.m. to 4:00 a.m., there is a significant reduction in noise levels across all floors due to a decrease in traffic volume compared to other time periods (7:00 a.m. to 9:00 a.m., 11:00 a.m. to 1:00 p.m., 5:00 p.m. to 7:00 p.m., and 10:00 p.m. to 12:00 a.m.). The reduction relative to other time periods ranges from 9 to 21 dB(A) at different measurement points. However, even during the early morning when traffic volume is lower, the noise levels recorded on each floor are still relatively high, ranging between 41 and 45 dB(A). In such a relatively noisy environment, residents' sleep quality is more likely to be affected.

According to the questionnaire survey results, among the 95 respondents who reported their physical condition as "good" or "very good", 48 of them perceived that their sleep and daily life were "seriously affected" or "very seriously affected", accounting for 50.53% of the total. This consistency between the noise monitoring data and the questionnaire survey results highlights the significant impact of traffic noise on residents' sleep and daily life, underscoring the importance of implementing effective noise mitigation measures to improve living conditions in urban environments".

3.3. Possible Noise Mitigation Measures

Based on the analysis above, both the questionnaire survey and on-site measurements indicate that traffic noise from Jian-Nan Avenue has had a significant impact on the lives and sleep of residents in the tested high-rise residential building. To improve the quality of life for residents, it is imperative to implement noise control measures. Previous research has suggested several potential solutions, including the incorporation of sound-absorbing materials such as adjustable parallel Helmholtz acoustic metamaterial [54,55], double-glazed windows [56], acoustic panels [57], and reflectors [58] into building facades, as well as converting existing roads into underground tunnels or depressed roads to improve the nearby acoustic environment [59]. While these measures hold promise for mitigating traffic noise, their effectiveness still requires further testing and validation. Future research could focus on evaluating the practicality, cost-effectiveness, and long-term sustainability of these measures.

4. Conclusions

In this study, a comprehensive investigation to examine the impact of heavy traffic noise from the nearby Jian-Nan Avenue on the living environment of a high-rise apartment building in Chengdu, China, was conducted. Through a combination of questionnaire surveys and on-site noise monitoring, valuable insights into the impacts of traffic noise on the residents were gained.

(1) Among the 121 respondents, more than 50% of respondents in each age group perceived the impact of traffic noise on their residential buildings as "high" or "very high". Out of the 66 male respondents, 37 perceived the impact of traffic noise on their residential buildings as "high" or "very high", accounting for 56.06%. Similarly, out of the 55 female respondents, 30 perceived the impact of traffic noise on their residential buildings as "high" or "very high", accounting for 54.55%. These findings highlight the significant influence of traffic noise on the residential experience of the studied buildings.

(2) According to the questionnaire survey results, 25% of the respondents residing on floors 4–10 reported that the traffic noise has a "significant impact" or "very significant impact" on their sleep and daily life, whereas 62.5% of the residents on floors 11–20 reported that the traffic noise has a "significant impact" or "very significant impact" on their sleep and daily life.

(3) The on-site noise monitoring results show that whether during the morning (7 a.m. to 9 a.m.), midday (11 a.m. to 1 p.m.), or evening (5 p.m. to 7 p.m.) on both workdays and weekends, the noise levels (L_{Aeq}) outside the windows of the studied buildings remain significantly elevated, with daytime noise on working days ranging from 56 to 70 dB(A), and on weekends ranging from 50 to 65 dB(A).

(4) According to the on-site noise monitoring, during the four time periods on weekdays from 7 a.m. to 9 a.m., 11 a.m. to 1 p.m., 5 p.m. to 7 p.m., and 10 p.m. to 12 a.m., the average L_{Aeq} levels on floors 11–20 are higher than those on floors 4–10 by 4.04 dB(A), 4.92 dB(A), 4.06 dB(A), and 2.67 dB(A), respectively. Similarly, during these time periods

on weekends, the levels on floors 11–20 are higher than those on floors 4–10 by 5.05 dB(A), 6.32 dB(A), 5.28 dB(A), and 5.24 dB(A), respectively. The monitoring results, as well as the questionnaire survey results, indicate that floors 4–10 of the building experience relatively lower noise levels, while floors 11–20 are subjected to comparatively higher levels of noise impact. The reason for the relatively low noise on these floors may be that traffic noise is absorbed and reflected by the green belt between the building and the avenue.

Overall, our research highlights the significance of understanding the impact of traffic noise on high-rise apartment buildings situated near busy expressways, and conclusions can be drawn. However, there are still some limitations. First, the study only focused on a specific high-rise apartment building adjacent to one particular urban expressway in Chengdu. This could limit the generalizability of the findings to other urban settings or different types of high-rise buildings. Second, possible noise control measures were not validated. Future research will address these limitations to provide a more robust understanding of the complex relationship between traffic noise and urban living environments, as well as possible noise control measures.

Author Contributions: H.Y. was mainly responsible for summarizing the research status, designing the survey questionnaire, processing noise measurement data, creating graphs and conducting analysis, and polishing the language of the paper, on the other hand; A.L. was primarily responsible for the design and implementation of the noise field measurement plan, as well as formatting the outline of papers. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Relevant data can be obtained for reasonable reasons by contacting the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Questionnaire Survey

1. What is your age?
   A. Under 20 years old   B. 21–35 years old   C. 36–50 years old
   D. 51–65 years old   E. 66 years old and above

2. What is your gender?
   A. Male   B. Female
   C. Other

3. How would you rate your overall health condition?
   A. Very good   B. Good   C. Fair
   D. Poor   E. Very poor

4. What floor do you live on in the building? (Floors 4–32)
   A. 4–10 floors   B. 11–20 floors   C. 21–30 floors
   D. 31–32 floors

5. How do you rate the level of traffic noise around you?
   A. Very low   B. Low   C. Moderate
   D. High   E. Very high

6. To what extent does traffic noise affect your sleep and daily life?
   A. No impact at all   B. Minor impact   C. Moderate impact
   D. Significant impact   E. Very significant impact

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