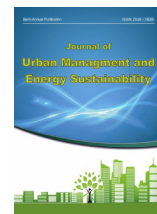


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Investigating the Effect of the Architectural Components of Metropolitan Soundscape on the Mental Well-being of Citizens

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ABSTRACT

As one of the dimensions of environmental perception, the soundscape of metropolises plays an important role in shaping the mental well-being of citizens. Accordingly, the present research was conducted with the aim of synthesizing and integrating the existing body of knowledge on the relationship between the architectural components of soundscape and citizens' mental well-being in the areas adjacent to the take-off and landing runways of Mehrabad Airport in the metropolis of Tehran city. The research was carried out with a qualitative approach, using the meta-synthesis method based on the seven-step model of Sandelowski and Barroso; reputable domestic and international sources were searched systematically, the quality of the studies was appraised with the CASP checklist and the reporting followed the ENTREQ principles, and after systematic screening forty selected studies were analyzed through open, axial and selective coding and organized into conceptual categories. The findings showed that the architectural components of soundscape can be classified into four main groups and sixteen indicators, which affect the various dimensions of mental well-being among these, while architectural design strategies and soundscape management play a key role in improving the quality of sound perception and the psychological and functional outcomes. Finally, a multilayered conceptual model was presented that explains the interaction between the architectural components, the quality of sound perception and the dimensions of mental well-being and the results of this research can provide a basis for urban design and architectural decision-making aimed at enhancing citizens' mental well-being.

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INTRODUCTION

As one of the fundamental components in the perception of urban space, the soundscape reflects the complex interaction between the physical body, land use and the behavior of citizens (Kang, 2023). In metropolises, the soundscape goes beyond mere “sound” and includes all the elements that, through the auditory channel, define the identity and quality of space for human beings (Shafiei & Zamani, 2023). The main problem in dense urban fabrics such as Tehran is the dominance of noise pollution arising from traffic and human activities over the perceptual quality of the environment, which has led to a reduction in the level of citizens’ mental well-being (Rahimi et al., 2023). Despite the importance of the physical body in shaping auditory experiences, many architectural interventions in Tehran have focused merely on visual aspects and have neglected the role of architectural components in regulating and improving the soundscape (Shahabian & Larimian, 2016). This is while social–architectural design, by drawing on soundscape approaches, can transform urban spaces into calming and restorative environments (Hong & Chong, 2023). In this context, the concept of “mental well-being”, as one of the key indicators of urban quality of life, plays a pivotal role in evaluating the consequences of the built environment. Mental well-being refers to an individual’s evaluation of their psychological state, sense of satisfaction with life, emotional balance and positive experience of the surrounding environment, and is not regarded as a merely individual variable; rather, it is strongly affected by environmental conditions and the quality of urban spaces (Mousavi et al., 2018). Research shows that acoustically stressful environments, through increasing mental fatigue, irritability and reduced concentration, lead to a decline in citizens’ positive perception of space and consequently to a reduction in the level of mental well-being (Babadi et al., 2019). By contrast, spaces that possess quality, diversity and legibility from the standpoint of the soundscape can strengthen the sense of security,

calm and place attachment in individuals and act as psychologically restorative environments (Xiao et al., 2022). Hence, as one of the main mediators between the architectural body and human mental experience, the soundscape has a determining role in shaping citizens’ mental well-being. Mental well-being is not merely the consequence of reducing the sound level, but the result of the perceptual quality of sound, its meaning, harmony and fit with the function of the space (Schulte-Fortkamp & Jordan, 2016). Therefore, a sole focus on controlling noise pollution, without attention to the perceptual and architectural dimensions of sound, cannot lead to a genuine enhancement of mental well-being (Farshidianfar & Oliazadeh, 2011). Within this framework, analyzing the relationship between the architectural components of soundscape and mental well-being makes it possible to identify the indirect pathways through which architecture affects citizens’ psychological health (Lynette, 2023). At the macro level, by focusing on the areas of Tehransar and Hashemi Street in the metropolis of Tehran, which are located in the vicinity of the take-off and landing runways of Mehrabad Airport, this research seeks to analyses the soundscape not merely as a side consequence of urban land uses, but as a structural and effective component in the quality of environmental perception. The proximity of these areas to flight paths has created conditions different from those of other urban fabrics, owing to the high intensity, regular periodicity and relatively uncontrollable nature of aircraft noise conditions that can continuously affect citizens’ auditory experience and make it necessary to examine their consequences for environmental perception and mental well-being (Schulte-Fortkamp & Jordan, 2016).

Within this framework, the soundscape is presented as an active and architectural element that, through the manner of physical organization, the management of reflective surfaces, the arrangement of land uses and the provision of buffer spaces, can affect the quality of live abil-

ity and residents' satisfaction. Nevertheless, the absence of an integrated approach in analyzing and designing these components has caused citizens to face a kind of auditory inequality and perceptual disorder in their living environments (Ali, 2020). The continuation of such a situation in the long term can lead to a weakening of the sense of satisfaction with the environment and a reduction in the level of mental well-being an issue that becomes more evident in busy streets and public spaces with dense land use (Rahimi et al., 2023). The importance and necessity of this research lie in the existing theoretical and practical gap in the metropolis of Tehran. While noise pollution is recognized as an environmental challenge (Farshidianfar & Oliazadeh, 2011), the necessity of a transition from "pollution control" to "soundscape design" for the enhancement of citizens' mental well-being has still received little attention in urban policy-making and architectural interventions (Schulte-Fortkamp & Jordan, 2016). The present research seeks, through a precise understanding of the causal relationships between the architectural components and citizens' perception, to present patterns in which architecture acts as an active instrument in regulating the auditory experience and enhancing psychological health. The main aim of this research is to explain and analyses the causal relationships between the architectural components of soundscape and the mental well-being of citizens in the metropolis of Tehran, in the areas adjacent to the take-off and landing runways of the airport. In line with the realization of this aim, the research questions are as follows: Which architectural components of soundscape are effective in urban spaces, and how can they be classified? To what extent and in what manner do the acoustic qualities of urban spaces affect the various dimensions of citizens' mental well-being? What is the causal model of the relationships between the architectural components of soundscape and mental well-being on the basis of the meta-synthesis technique, and what priority does this model offer for design interventions? The present article rests on the

assumption that, in a subject such as the soundscape of metropolises, which simultaneously depends on conceptual, empirical, design-related and normative evidence, meta-synthesis is the most appropriate way of moving beyond the dispersion of data and arriving at a design-oriented model. On the whole, relying on a qualitative approach, this research attempts to establish a coherent link between citizens' perceptual experience and architectural decisions and, through the systematic analysis of the relationships between sound, space and mind, to provide the ground for enhancing mental well-being in urban spaces. This approach can serve as a scientific basis for rethinking the role of sound in architectural design and for realizing justice in access to high-quality urban environments.

MATERIALS AND METHODS

In contemporary urban studies, the concept of sound has been elevated from a merely disturbing and physical factor to a qualitative, perception-oriented element in human environmental experience (Shahabian & Larimian, 2016). This change of attitude has been accompanied by the introduction of the concept of "soundscape" a concept that analyses sound in connection with human perception, the spatial setting and the socio-cultural context (Eslami et al., 2023). In this approach, sound is regarded not only as an acoustic phenomenon but as part of the lived human experience of space (Bayramzadeh & Majdi, 2020). The soundscape, as the acoustic environment perceived or experienced in a specific context, is the result of the interaction between sound sources, the physical characteristics of the space and the mental interpretation of users (Kang, 2023). Domestic research shows that the acoustic quality of Iranian urban spaces, especially in dense fabrics, is directly dependent on citizens' perception, the type of activities and the spatial organization of the environment (Shahabian & Larimian, 2016). The soundscape has multiple dimensions that have been explained in a complementary manner in various studies.

The physical–acoustic dimension includes the intensity, frequency, continuity and diversity of sounds, which form the basis of quantitative acoustic measurements and the assessment of noise pollution (Ali, 2020). This dimension has been identified in many Iranian cities as one of the factors threatening urban health. The physical–architectural dimension refers to the role of the form of space, materials, vegetation, the mass-to-space ratio and the manner in which land uses are located in shaping the auditory experience (Mohsen Haghighi et al., 2017). International studies also show that the design of the built environment can directly alter the quality of the acoustic perception of space (Dokmeci Yorukoglu & Kang, 2016). The perceptual–psychological dimension of the soundscape focuses on feelings such as calm, annoyance, security and acoustic desirability, which are directly related to individuals' psychological state (Shafiei & Zamani, 2023). The social–functional dimension relates to patterns of activity, social presence, the type of use of space and the cultural expectations of users (Jabbarpour Mehrabad, 2025). On the other hand, as one of the pivotal concepts in the evaluation of quality of life, mental well-being refers to individuals' cognitive and affective evaluation of their own lives (Habibpour Gatabi, 2022). This concept has a multidimensional nature and includes satisfaction with life, positive emotions, psychological calm and a sense of meaning and belonging (Mousavi et al., 2018). Domestic research shows that mental well-being in Iranian urban society is strongly affected by environmental conditions and the quality of the everyday experience of urban spaces (Habibpour Gatabi, 2022). Foreign studies have also emphasized the role of the built environment, sensory experience and the quality of public spaces in strengthening or weakening mental well-being (Hong & Chong, 2023).

The relationship between the soundscape and mental well-being is multidimensional and dependent on the quality of environmental design (Kang, 2023). Urban sounds, if undesirable, can

lead to increased tension, mental fatigue, reduced concentration and a decline in cognitive performance (Rahimi et al., 2023). Studies conducted in areas affected by dominant sounds, such as the vicinity of airports, show that negative acoustic perception has a direct effect on the affective and cognitive dimensions of residents' mental well-being (Babadi et al., 2019). By contrast, a desirable quality of soundscape can increase the sense of calm, security and environmental satisfaction (Zhou et al., 2023). In this context, architecture and urban design, as mediating factors, play a key role in moderating the effects of the soundscape on mental well-being (Schulte-Fortkamp & Jordan, 2016). Architectural components such as the form of space, functional organisation, the use of natural elements and landscape design can affect both the physical characteristics of sound and its mental perception (Pouya, 2017). Domestic research has also emphasized the capacity of the design of green spaces and urban parks to enhance the quality of the soundscape (Zare, 2024). Hence, the soundscape is not merely an unintended consequence of the city, but a designable phenomenon that can be employed to enhance citizens' mental well-being (Kang, 2023).

Given the literature outlined above and the explanation of the concepts of soundscape and mental well-being, an examination of the studies conducted in domestic contexts is necessary. Es-lami et al. (2023), in a study entitled "Evaluating the soundscape in the domain of sacred places", used a survey method with the aim of measuring users' acoustic perception. The findings showed that the quality of the soundscape has a significant role in the sense of calm and environmental satisfaction, which is related to the dimensions of mental well-being. Babadi et al. (2019), in the study "Investigating noise pollution and noise annoyance in residential areas affected by airport noise", showed that aircraft sounds increase annoyance and reduce residents' psychological calm; these results are directly related to the problem of the present research. Shahabian and

Larimian (2016), in the study “Investigating the soundscape of Valiasr Street in Tehran”, focusing on people’s perception, showed that the spatial organization of the street and the type of activities affect the quality of acoustic perception. Mohsen Haghighi et al. (2017), in the article “Evaluating the components effective in acoustic comfort”, using factor analysis, extracted the physical and perceptual indicators effective in acoustic comfort, which are applicable in formulating the variables of the present research. Habibpour Gatabi (2022), in the study “Evaluating the state of mental well-being among Iranian youth”, showed that environmental factors have an important role in psychological satisfaction and calm, and this reinforces the link between the urban environment and mental well-being. Likewise, a review of foreign research makes it possible to compare approaches and findings at the international scale. These studies, by presenting diverse theoretical and empirical frameworks, have contributed to a deeper understanding of the role of the soundscape and architectural design in enhancing mental well-being and clarify the position of the present research in the global literature. Dokmeci Yorukoglu and Kang (2016), in a study entitled “Analyzing the sound environment and architectural characteristics of libraries within the framework of the indoor soundscape”, aiming to examine the role of architecture in acoustic perception, used field analysis and a questionnaire. The results showed that the physical characteristics of space have a direct effect on users’ auditory experience (Dokmeci Yorukoglu & Kang, 2016). Schulte-Fortkamp and Jordan (2016), in the article “When soundscape meets architecture”, with an analytical approach, examined the interaction between architectural design and acoustic experience. The findings show that conscious design can enhance the quality of the soundscape and users’ sense of calm (Schulte-Fortkamp & Jordan, 2016). Pouya (2017), in the study “The role of landscape architecture in the soundscape experience”, showed that natural elements and landscape design can

strengthen positive acoustic perception and users’ well-being (Pouya, 2017). Zhou et al. (2023), in the study “The effect of visual landscape factors on the evaluation of the soundscape in old residential fabrics”, showed that visual perception can moderate the mental evaluation of sound and indirectly affect mental well-being (Zhou et al., 2023). Kang (2023), in the article “Soundscape in the city and the built environment”, by examining old built environments, explained the capacities of the soundscape approach in enhancing the quality of life and the mental well-being of citizens, which is regarded as the theoretical basis of the present research. On the whole, the theoretical and empirical literature shows that the soundscape is a multidimensional phenomenon that is formed from the interaction of physical characteristics, spatial organization, social activities and mental perception, and that it can affect various indicators of mental well-being such as psychological calm, satisfaction with the environment, concentration and a sense of belonging.

EXTRACTION OF THE THEORETICAL FOUNDATIONS

A review of the literature shows that the soundscape in urban environments is a multidimensional and designable phenomenon that is formed from the interaction between the physical characteristics of sound, the physical organization of space, patterns of activity and the mental perception of users (Kang, 2023; Schulte-Fortkamp & Jordan, 2016). In domestic and foreign research, it has been emphasized that the quality of the soundscape depends not only on the level and intensity of sound, but also on its meaning, legibility, diversity and fit with the function of the space (Shahabian & Larimian, 2016; Eslami et al., 2023). Hence, the focus of the present research on the “architectural components of soundscape” is directed towards that group of physical and spatial factors that can, directly or indirectly, affect citizens’ acoustic perception and consequently their mental well-being (Pouya, 2017;

Hong & Chong, 2023). The analysis of the related studies shows that the architectural components effective on the soundscape can be classified into four main conceptual clusters. This classification has been made by drawing on the patterns presented in domestic research (Mohsen Haghighi et al., 2017; Mohammadi Dehcheshmeh et al., 2018; Jabbarpour Mehrabad, 2025) and matching them with international theoretical frameworks (Dokmeci Yorukoglu & Kang, 2016; Kang, 2023). These four components are: the physical-spatial component, the functional-land-use component, the perceptual-qualitative sound component, and the social-behavioral component.

The physical-spatial component

This component refers to the physical and architectural characteristics of space that play a role in shaping and moderating the propagation of sound. The form of space, the mass-to-space ratio, the height and continuity of the walls, the type of materials and the presence of natural elements are among the factors effective in the reflection, absorption or guidance of sound (Mohsen Haghighi et al., 2017; Dokmeci Yorukoglu & Kang, 2016). Research shows that the conscious design of the physical body can reduce the perceived intensity of sound and improve the quality of the auditory experience (Schulte-Fortkamp & Jordan, 2016). On this basis, the indicators of this component include: form and spatial enclosure; the type and quality of building materials; the presence and role of natural elements (green space, water); and the mass-to-space ratio and the height of the walls.

The functional-land-use component

The organization of land uses and the functional patterns of urban spaces play an important role in producing or controlling sound sources. The adjacency of noise-generating land uses, the intensity of human activities and the fit of the function of the space with users' acoustic expectations are among the factors determining the quality of the soundscape. Studies conducted in

busy urban fabrics in Iran show that a lack of fit between land use and the acoustic capacity of the space leads to increased annoyance and dissatisfaction among citizens (Shahabian & Larimian, 2016). The indicators of this component are: the fit of the land use of the space with acoustic conditions; the intensity and type of human activities; the adjacency and mixing of noise-generating land uses; and the provision of buffer and transitional spaces.

The perceptual-qualitative sound component

This component addresses the perceived quality of sound from the users' standpoint and includes feelings such as calm, annoyance, desirability and acoustic legibility. Research has shown that mental well-being, rather than being affected by the physical level of sound, depends on its perceptual and semantic quality (Shafiei & Zamani, 2023; Kang, 2023). Natural and familiar sounds can play a psychologically restorative role, whereas discordant and unpredictable sounds increase mental tension (Zhou et al., 2023). The indicators of this component include: the degree of acoustic calm or annoyance; the legibility and predictability of sound; the diversity and balance of sound sources; and the harmony of sound with the identity and function of the space.

The social-behavioral component

This component addresses the manner in which users make use of space, the patterns of social presence and human interactions within the acoustic context of the environment. The soundscape is not only the result of the physical body, but also the product of the social behaviors and cultural expectations of users (Jabbarpour Mehrabad, 2025; Lynette, 2023). Various studies show that a desirable acoustic quality can strengthen presence, the sense of security and place attachment, and consequently enhance citizens' mental well-being (Eslami et al., 2023; Habibpour Gatabi, 2022). The indicators of this component are: the degree of presence and persistence in the space; the sense of security and

psychological comfort; the possibility of positive social interactions; and the sense of belonging and satisfaction with the environment. On this basis, the theoretical framework of the present research, relying on four main components and sixteen indicators as extracted in Table 1, is used as the basis for analyzing the causal relationships

between the variables. This framework makes it possible to identify the effective and effect-receiving components and provides the ground for prioritizing architectural interventions with a view to enhancing citizens' mental well-being. (Tab. 1)

Table 1: The theoretical framework of the research: the architectural components of soundscape and their indicators (Source: Authors)

Main component	Indicators	Theoretical documentation
Physical-spatial	Form and spatial enclosure	Mohsen Haghighi et al., 2017; Dokmeci Yorukoglu & Kang, 2016
	Type and quality of building materials	Schulte-Fortkamp & Jordan, 2016
	Presence and role of natural elements (green space, water)	Pouya, 2017; Zare, 2024
	Mass-to-space ratio and height of the walls	Kang, 2023
Functional-land-use	Fit of the land use of the space with acoustic conditions	Shahabian & Larimian, 2016
	Intensity and type of human activities	Ali, 2020
	Adjacency and mixing of noise-generating land uses	Mohammadi Dehcheshmeh et al., 2018
	Provision of buffer and transitional spaces	Schulte-Fortkamp & Jordan, 2016
Perceptual-qualitative sound	Degree of acoustic calm or annoyance	Shafiei & Zamani, 2023
	Legibility and predictability of sound	Kang, 2023
	Diversity and balance of sound sources	Zhou et al., 2023
	Harmony of sound with the identity and function of the space	Eslami et al., 2023
Social-behavioural	Degree of presence and persistence in the space	Lynette, 2023
	Sense of security and psychological comfort	Habibpour Gatabi, 2022
	Possibility of positive social interactions	Hong & Chong, 2023
	Sense of belonging and satisfaction with the environment	Eslami et al., 2023

Methodology

This study is of the qualitative meta-synthesis type and draws on the seven-step logic of Sandelowski and Barroso: defining the question, systematic searching, screening and selection, data extraction, coding and synthesis, quality control, and presentation of the final model (Sandelowski & Barroso, 2007). For transparency of reporting, the ENTREQ principles were also employed in composing the text, and the CASP checklist was used to appraise the adequacy of the sources. In the field of urban planning and urban geographical studies, meta-synthesis can be used to analyses empirical data from different

urban projects, field studies and simulation models. These methods can identify general patterns that are repeatedly observed across different projects and contribute to a better understanding of urban processes. The method of this research is meta-synthesis, which involves combining the specific features and factors of the research literature. Meta-synthesis is in some cases known as qualitative meta-analysis and seeks to analyses the research covered, resolve the contradictions within it and, while integrating the results, identify the main topics for future research (Cooper & Hedges, 2009). Accordingly, the research domain

comprises all the scientific articles in reputable international databases and the doctoral theses of reputable universities of the world in the field of the soundscape of citizens in metropolises and their mental well-being. Likewise, for gathering the required information, tables and forms designed by the researcher were used (Fig. 1).

Drawing on the qualitative meta-synthesis method and based on the model of Sandelowski and Barroso, this study systematically examined the architectural components of soundscape effective on citizens' mental well-being. First, a search was conducted in several reputable and commonly used databases, including Google Scholar, Scopus and Harvard, with an emphasis on several main keywords related to the research. These keywords were: architectural, metropolises, soundscape and mental well-being; these keywords in effect constituted the inclusion criteria and the manner of selecting the related articles and theses. The time span of the articles covered approximately the last ten years, and the scope of the sciences and fields of the meta-synthesis emphasized architecture, urban planning, environmental sciences, technical and engineering fields, urban management, sound and psychology. An effort was made to select the titles of the journals as related to the subject of the research, and the expertise of the authors such that at least one architect, urban planner and so on was among the authors. The items mentioned in fact constitute the exclusion criteria and the limitation of the search outputs (Tab. 2). In the stage of analysis, the data extracted from the selected studies were examined through a triple coding process. First, the initial codes were identified. These codes were then classified into axial categories, and finally the main fields of the research were extracted. To ensure the reliability of the analyses, various mechanisms were used, including the calculation of the coefficient of agreement between coders, independent review by experienced researchers and the holding of collective critique sessions. The quality appraisal of the studies was carried out with the standard

CASP instrument (McHugh, 2012; Sandelowski & Barroso, 2007), in which precise criteria such as methodological transparency, the appropriateness of sampling and the validity of the analyses were taken into account. This screening process led to the final selection of forty qualitative studies that possessed the highest methodological standard. In all stages of the research, the ethical principles of research, including respect for authors' rights, precise citation and transparent reporting, were carefully observed.

Definition of meta-synthesis

Meta-synthesis, which in the literature of the social sciences has various equivalents such as research review and systematic review, is normally used to create general generalizations from empirical research. The main aim of this process is to integrate research findings and analyses them critically, identify contradictions and discover central issues for future research (Cooper & Hedges, 2009). In particular, meta-synthesis seeks to discover all the available evidence and to analyses it impartially. This process also includes statistical analyses for the integration of results, which is referred to as meta-analysis (Cooper & Hedges, 2009). Likewise, research synthesis means combining and integrating the results of different studies within a common framework, which helps researchers to analyses different results in an orderly and conceptual manner. This process is of particular importance in qualitative research, which is diverse and multidimensional. The main advantage of using these methods is the ability to gain a better and more comprehensive understanding of the complex human phenomena that are normally examined in qualitative research (Sandelowski & Barroso, 2007). This methodological approach made possible the systematic combination of dispersed findings and the production of new knowledge in the field of environmental psychology. Among the salient features of this method, one may mention the ability to discover hidden patterns in previous research, the possibility of the generalizability

of findings and the presentation of an integrated framework for understanding the complexities of the subject. In particular, the emphasis on the qualitative and interpretive aspects of the data distinguishes this study from the quantitative research customary in this field. Two major approaches in meta-synthesis include aggregative approaches and non-aggregative approaches. In this type of research, hypotheses are tested and validated so that future research may be better designed (Weed, 2005). In this regard, the soundscape is related not only to the physical and structural aspects of metropolises, but also to the social, economic and institutional dimensions; and in order to analyses all these dimensions, var-

ious methods, including meta-synthesis (qualitative synthesis), are employed. To analyses the data and extract the concepts and components of the soundscape of metropolises and citizens' mental well-being, the seven-step method of Sandelowski and Barroso was used (Sandelowski & Barroso, 2007), comprising: (1) considering the focus of the study and formulating the research question to guide the study; (2) systematic review of the texts; (3) searching for and selecting appropriate sources; (4) extracting and retrieving the information of the sources; (5) analyzing and synthesizing the findings present in the sources; (6) quality control and presentation of the findings; and (7) the results of the analytical process.

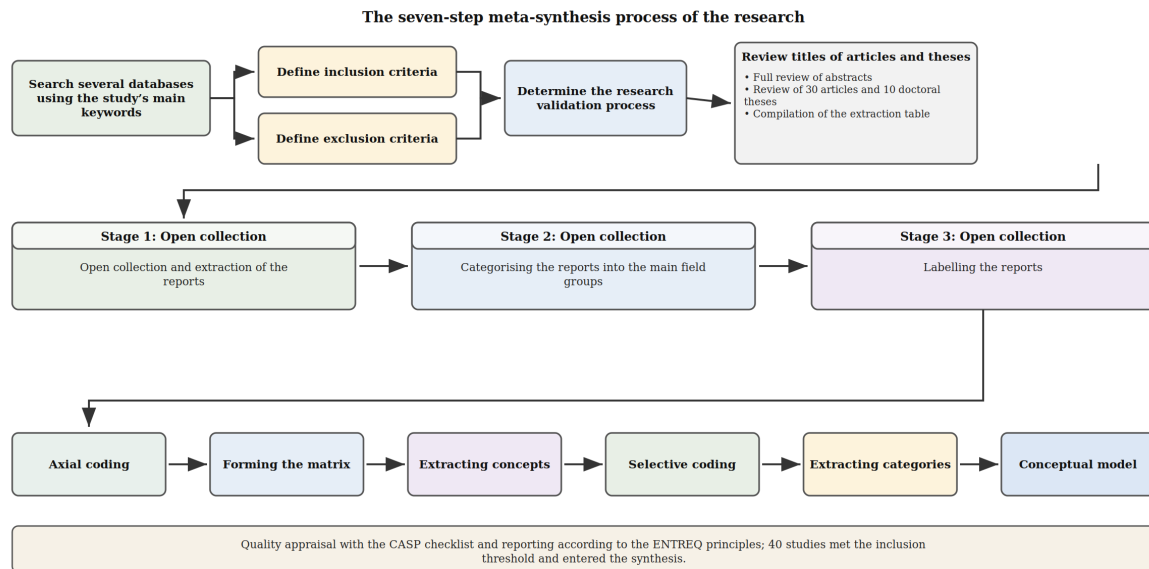


Figure 1: The meta-synthesis process of the research (Source: Authors)

FINDINGS AND DISCUSSION

In this section, the process of conducting the research and the results of the qualitative analysis of the data are addressed in seven stages.

Considering the focus of the study and formulating the research question to guide the study

Well-being is an important construct in research related to the interpretation of personality and

has been defined as a positive evaluation of life and a balance between positive and negative affect. The soundscape can simply be defined as an acoustic composition that results from the voluntary or involuntary overlapping of various sounds of physical or biological origin (Farina, 2014). By removing unpleasant sounds and reducing background sounds, the role of the evocative components can be made more promi-

ment (Haghighi & Ghalenoei & Ghaffari, 2017). An unpleasant soundscape reduces an individual's acoustic perception, physiological health and the mental health of the members of society; this is while, if unpleasant soundscapes penetrate the work, residential or educational environments, they can bring about many negative consequences such as divorce, quarrelling, aggression, academic decline, depression and so on. Hence there is a necessity to help resolve this challenge with an architectural solution. Therefore, the main question of this research seeks to find the architectural components of the soundscape that will be effective on individuals' mental well-being.

Systematic review of the texts

A search in reputable databases was carried out with the keywords "architecture, soundscape, mental well-being, architectural components" in order to find related articles and theses. The focus was on the publications of the last ten years and on the fields of architecture, urban planning, environmental sciences, technical and engineering fields, soundscape and psychology. The selection

of the articles was made on the basis of the relevance of the journal title and the expertise of the authors (at least one architect in the field of environmental psychology and so on). These items determined the inclusion and exclusion criteria of the search.

Searching for and selecting appropriate sources

The statistical frequency of the research population, according to the inclusion and exclusion criteria, was initially about 1,500 articles; the titles of the articles and theses were mostly examined, and after the refinement carried out and the removal of a number of the outputs, about 200 articles were selected and their abstracts were examined in full. Then, upon re-examination, a number were removed and about 50 articles remained; and by examining the whole of these 50 articles and doctoral theses from reputable universities of the world, 40 valid studies, related and close to the domain of the research, were arrived at. The 40 selected articles and theses were subjected to content analysis by the coding method (Tab. 2).

Table 2: The selected articles and the extracted codes (Source: Authors)

No.	Author	Title of the article	No. of statements
1	Papatya Nur Dökmeci Yörükoğlu, 2025	The effect of the indoor soundscape workshop on the sound awareness of interior architecture students	12
2	Zhiyu Zhou, 2023	The effect of visual landscape factors on the evaluation of the soundscape in old residential neighborhoods	18
3	Joo-Young Hong, 2023	Designing urban soundscapes through social architecture and soundscape approaches: a reflective review of an architectural design studio	16
4	Bikos Lynette, 2023	Harmonizing urban spaces: examining social architecture and soundscape approaches in architectural design	11
5	Thitikorn Suksomboon, 2023	Soundscape and architecture	16
6	Ashti Yaseen Hussein, 2023	Self-reported evaluation of the well-being of architecture students based on the quality of the learning environment in the design studio	13
7	Jian Kang, 2023	Soundscape in the city and the built environment: current developments and design potentials	26

8	Elina Hytönen, 2022	Sounds of learning: soundscapes – teachers' perceptions of acoustic environments in Finnish open-plan classrooms	16
9	Jieling Xiao, 2022	Perspectives on the opportunities of the soundscape approach for revitalizing acoustics education	17
10	Abbas Ghaffari, 2021	Explaining the acoustic behavior and the soundscape quality of the bazaar rows of Tabriz based on objective and subjective evaluations	19
11	Ugur Beyza Ercakmak, 2019	The role of the indoor soundscape methodology: from the architectural design process to the formulation of regulations	16
12	Alessia Milo, 2019	Designing spaces and soundscapes: integrating audio previews into architectural modelling software	15
13	Sima Pouya, 2017	The role of landscape architecture in the experience of soundscapes	21
14	Josep Llorca-Boñ, 2019	Generating architectural designs using soundscapes: an educational case study	6
15	Özlem Kandemir, 2019	An experience in an architectural design workshop around the concept of soundscape	15
16	Gunnar Cerwén, 2017	Soundscape actions: a tool for treating noise based on three workshops in landscape architecture	8
17	Neela Jirge, 2017	Soundscape in architecture	9
18	Jian Kang, 2016	Analyzing the sound environment and architectural characteristics of libraries through the indoor soundscape framework	9
19	Brigitte Schulte-Fortkamp, 2016	When soundscape meets architecture	16
20	Nastaran Seyed Esmaeili Ghomi, 2025	The role of motivational beliefs, self-determination and mental well-being in predicting students' academic flow	19
21	Mohsen Jadidi, 2025	Explaining the causal relations between mindfulness and self-regulation with mental well-being in psychologists and counsellors based on the mediating role of meaning in life	24
22	Homeira Shabani, 2024	Investigating the effectiveness of mentalization therapy on cognitive flexibility, mental well-being and anxiety in adolescent girls	15
23	Fardin Foroughi Souha, 2024	The relationship of employees' creativity with mental well-being and spiritual intelligence in the teachers of Namin County	17
24	Seyed Davoud Hosseini Nasab, 2024	The effectiveness of mindfulness training on pain perception, cognitive functioning and mental well-being in patients with migraine	10
25	Seyed Alireza Tahvildari, 2024	The beliefs underlying mental well-being in adolescence: a qualitative study	16
26	Iraj Safaei Rad, 2024	Comparing the effectiveness of emotional-intelligence training and self-compassion on academic vitality and mental well-being of upper-secondary students	12
27	Farzaneh Mikaeili Manie, 2023	Predicting job burnout based on mental well-being, psychological capital, and job demands and resources in nurses	14
28	Mahdi Amirkafi, 2023	Investigating the effect of social capital on mental well-being	19

29	Maryam Ghalambor Dezfouli, 2023	Explaining a proposed model for the qualitative assessment of the soundscape with a contextualist approach in the urban fabric using fourfold matrices	11
30	Seyed Abdolmajid Bahreinian, 2023	The effect of self-awareness on the creativity of upper-secondary students of Namin County with the mediation of mental well-being	15
31	Roksana Nakhaei, 2023	The effectiveness of mindfulness on mental well-being, attachment styles and health anxiety in patients with chronic pain	11
32	Karam Habibpour Gatabi, 2022	Evaluating the state of mental well-being among Iranian youth	17
33	Majid Saffarinia, 2022	The role of lifestyle on mental well-being with the mediation of health hardiness in women with multiple sclerosis	19
34	Alireza Merati, 2022	Comparing the mental well-being and interpersonal communication of students from the standpoint of handedness (left-handedness and right-handedness)	9
35	Farshid Khosropour, 2022	The relationship of the five personality factors and emotion-regulation strategies with students' mental well-being	20
36	Seyedeh Zinat Hadian, 2022	Predicting mental well-being based on action control and psychological hardiness in adolescents	13
37	Zahra Naghsh, 2022	Investigating the effect of cognitive self-compassion training on the mental well-being and social adequacy of students with depression	13
38	Abbas Ghaffari, 2022	Explaining the desirability of the soundscapes of the timchehs of Tabriz Bazaar based on objective and subjective evaluations	19
39	Seyed Hashem Mousavi, 2021	Energy, flourishing and mental well-being: a moderated mediation model	24
40	Mahdieh Salehi, 2019	Modelling mental well-being based on the educational, social, emotional, physical and security climate of the school with the mediation of emotional self-regulation	14

Extracting and retrieving the information of the sources

After the complete study of the finally selected research, a table was first formed comprising the title of the article or thesis, the name and organizational affiliation of the authors, the place of publication, the full abstract, then the statement of the problem (the domain of the research, other knowledge), the research area, the research questions, the aim of the research, the framework (approach) of the research, the hypothesis if any, the background of the research, the review of the literature, the innovation, the process and method of the research, the research system, the strategy, the tactic of the examination (the research instrument), the

validation, and finally the findings, the discussion and the result, and even the application of the research in the outside world and future research. The aforementioned table for extracting the material from the selected articles and theses is as follows. (Tab. 3)

Analyzing and synthesizing the findings present in the sources

The aforementioned table was completed, and the important and related statements were again identified; after completion, together with the source of the statements, they were extracted and listed for each article or thesis. Up to this point the first stage of open coding was carried out. To complete the open coding, in the second

stage the classification of the fields into six sections was addressed. The fields were divided into the categories of the main category, causal conditions, contextual conditions, intervening conditions, strategies and consequences. The statements extracted in the previous section, a number of which were obtained for each article and thesis, are now placed in the related field;

with the classification of about 611 statements, the main category with 152 statements, the causal conditions with 121 statements, the contextual conditions with 84 and the intervening conditions with 76 statements, the strategies with 83 and finally the consequences with 95 statements were completed. (Tab. 4 to 8)

Table 3: The framework for extracting and analyzing the articles (Source: Authors)

Main section	Indicators	Description
1. Bibliographic information	Name of the authors, year of publication, title of the article/thesis, type of source (article/thesis), name of the journal or university, website or DOI	Basic information for identifying and accessing the source of the research.
2. Introduction of the research	Abstract, keywords, domain of the research, related discipline or fields of knowledge	A general view of the subject, the main content and the scientific domain of the research.
3. Problem and necessity of the research	Statement of the problem, research gap, importance of the subject	Statement of the main problem, the research space and the reasons for conducting the research.
4. Aims and questions of the research	Main aim, sub-aims, research questions or hypotheses	What the research seeks to attain or to answer.
5. Theoretical foundations	Theoretical framework or approach of the research, background of the research, key concepts	The scientific and theoretical foundations on which the research rests.
6. Innovation of the research	Innovative aspects, added value relative to previous studies	What distinguishes this research from other studies.
7. Methodology	Research process, research method, research system, research strategy, tactic or instruments of data collection	How the research is conducted and the instruments and methods applied.
8. Validity and quality of the research	Validation method, reliability and validity (if any), evaluation criteria	Examination of the validity, reliability and scientific quality of the research.
9. Findings and analysis	Main findings, discussion and interpretation of the results	The results obtained and their analysis and interpretation.
10. Conclusion and applications	Conclusion, practical applications in the real world, executive recommendations	Summing up the results and presenting the practical outcomes and applications of the research.
11. Recommendations for future research	Limitations of the research, recommendations for future studies	Improvable points and the paths suggested for subsequent research.

Table 4: The second stage: classification of the fields (Source: Authors)

No.	Fields
1	Main category
2	Causal conditions
3	Contextual conditions
4	Intervening conditions
5	Strategies
6	Consequences

Table 5: The classification of the fields and their labels (Source: Authors)

Fields	Labels
Main category	Soundscape – auditory environmental resources – keynotes – signals – soundmarks – the relationship between the human being and the environment – noise measurement – understanding auditory meaning – social interactions – facilities – calm of the environment – satisfaction with life – positive relations with others – self-leadership – self-actualization – purposefulness – self-acceptance – balance of emotions
Causal conditions	Mental well-being – strengthening positive emotions – individual adequacy – resilience – success – individual and social growth – spatial and geometric factors – physical and green context – users' perceptual behavior – a limiting stimulus – sound – an enhancing factor
Contextual conditions	Active design – acoustic mapping – attention to functional spatial dimensions – enhancing the auditory experience – presence – quality of life – the social function of architectural and urban spaces – self-awareness – self-regulation – communication skills – creativity – enhancing academic performance – occupational advancement – enhancing meaning
Intervening conditions	Emotion regulation – healthy lifestyle – cultivating compassion – psychological hardiness – self-confidence – persistence in facing challenges – prevention of psychological harm – architectural design – adding the auditory dimension – urban design – user participation – meaningful perception – mental imagery – quality of the auditory experience
Strategies	Active and strategic design of the soundscape – use of field and perceptual data – structured auditory training – an engine of ideation in the design process – enhancing architectural creativity – environmental facilitating factors – the affective–cognitive dimensions of the quality of mental health – environmental inhibiting factors – healthy lifestyle
Consequences	Individual and professional growth – reduction of burnout – development of individual creativity – enhancing self-regulation – enhancing emotional intelligence – enhancing self-compassion – emotion management – enhancing well-being – soundwalking – soundscape training and workshops – masking strategies – physical improvement and governance – auditory presence – spatial meaning-making – the quality of the acoustic experience of indoor and urban spaces

Table 6: The shared classifications (Source: Authors)

Shared labels (classifications)	Soundscape – soundscape in architecture and the city – active design – sound – architectural design – an enhancing factor – emotion regulation – emotional balance – mental well-being – strengthening emotion – emotion management
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Table 7: A sample labelling table for the field of contextual conditions (Source: Authors)

Label title	Extracted codes	Sources	No. of codes
Active design	Forms of space – noise pollution – landscape architecture – auditory soundscape – sound – noise – stress – acoustic measurement – deep soundscape – the experiential and aesthetic dimension of sound – architectural design	Neela Jirge, 2017; Brigitte Schulte-Fortkamp, 2016; Zhiyu Zhou, 2023; Gunnar Cerwén, 2017	11
Functional spatial dimensions	Sound mapping – highly noise-polluted areas – sound waves – visual landscape – sound sources – the origin of sound and the overall acoustic composition – pleasant soundscapes – acoustic concepts – acoustic architecture – sound-recording criteria – active acoustic training – physical structure – open plan – acoustic information	Brigitte Schulte-Fortkamp, 2016; Zhiyu Zhou, 2023; Özlem Kandemir, 2019; Jian Kang, 2016; Josep Llorca-Bofi, 2019; Jieling Xiao, 2022; Elina Hytönen, 2022; Sima Pouya, 2017	14
Acoustic mapping	Spatial characteristics – soundwalking – knowledge of acoustic space – open plan – noise control – noise removal – the interdependence of the human being and sound – acoustic data – the social-behavioural aspects of the environment – sound sources – acoustic effects – physical conditions – reduction of the sound level – improvement of the quality of life – safe havens – unwanted sounds	Jieling Xiao, 2022; Elina Hytönen, 2022; Alessia Milo, 2019; Joo-Young Hong, 2023; Jian Kang, 2023; Sima Pouya, 2017	17
Auditory experience	Hearing – situated listening – creation of a sense – pleasant soundscape – pleasant acoustic landscape	Gunnar Cerwén, 2017; Jieling Xiao, 2022; Abbas Ghaffari, 2022; Maryam Ghalambor Dezfouli, 2023	5

Table 8: The labelling of the field of contextual conditions by degree of importance (Source: Authors)

Label title	Degree of importance								
Active design	35	41	40	38	34	37	39	36	33
Acoustic mapping	22	26	20	18	14	24	17	35	32
Functional spatial dimensions	12	19	13	15	11	16	2	6	31
Auditory experience	4	9	7	10	3	27	1	5	8

After the axial coding of the categories of each field, by placing them together in a matrix we arrive at statements which, after being shared and prioritized, yield the axial phrases in each matrix. Thereafter, the point of commonality and the importance of the axial phrases of each field are obtained, and at the end we arrive at one final axial phrase in each field and six general phrases. In what follows, a sample of axial

coding with the formation of the matrices is displayed (Fig. 2).

Quality control

In the process of advancing the research, an effort was made to provide a transparent explanation for each stage. For the control and preservation of quality, the validity and reliability of the extracted codes were examined.

To assess validity, the Critical Appraisal Skills instrument was used; by preparing a checklist and answering these ten questions namely (1) the aims of the research, (2) the logic of the methodology, (3) the research design, (4) the sampling method, (5) data collection, (6) reflexivity, (7) ethical considerations, (8) the precision of the data analysis, (9) the clear and explicit statement of the findings, and (10) the value of the research scoring from 1 to 5 was carried out on the selected research, and those items whose qualitative score was higher than 30 were selected and the rest removed. In the end, 40 articles from reputable universities of the world were subjected to meta-synthesis. To

obtain reliability, while providing the process and the general framework of the research, the final sources of the meta-synthesis together with the open codes obtained were given to six experts in the domain of the research, and they were asked to carry out the continuation of the coding while examining the process; the results were compared with those obtained by the researcher, and five of them agreed with the researcher on the axial codes, concepts and categories. With the calculation of a reliability coefficient equal to 83 per cent, the extraction of the codes enjoys an acceptable reliability coefficient.

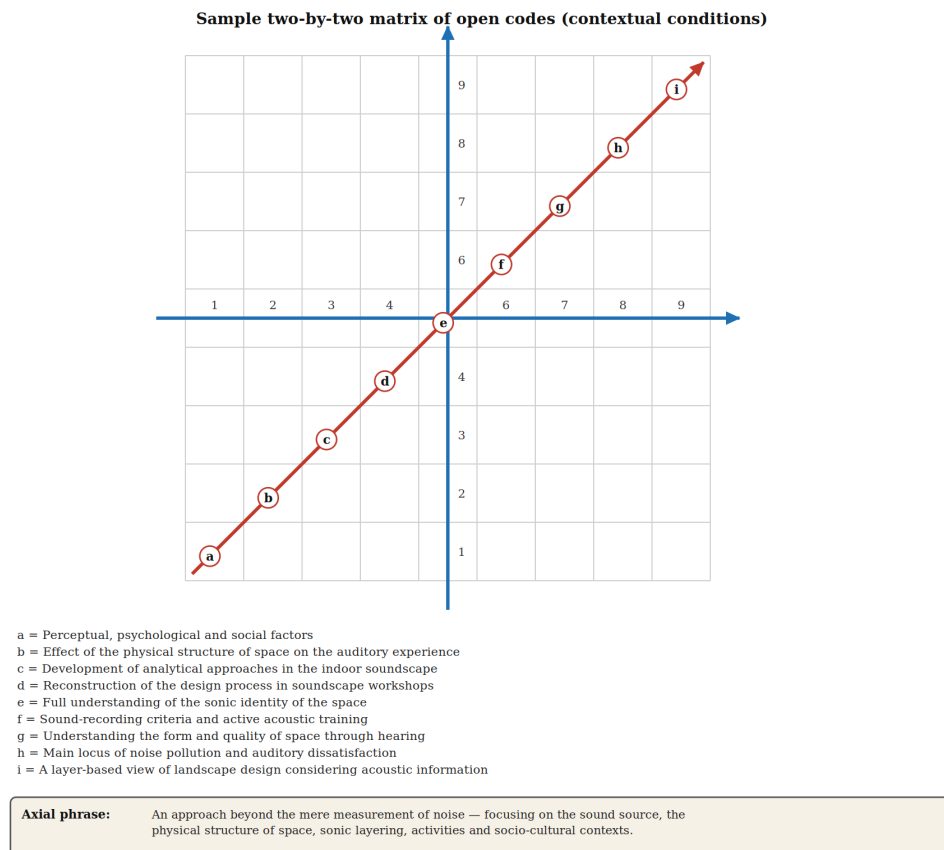


Figure 2: A sample two-by-two matrix of the open codes of the labels with one another (contextual conditions) (Source: Authors)

Presentation of the findings and the results of the analytical process

According to the figure below, the architectural categories effective on the soundscape were obtained in three stages of open, axial and se-

lective coding: the concepts and the raw data, through open coding, became open codes; then, through axial coding at two levels, they became axial codes; and subsequently, through selective coding, they became categories. (Fig. 3)

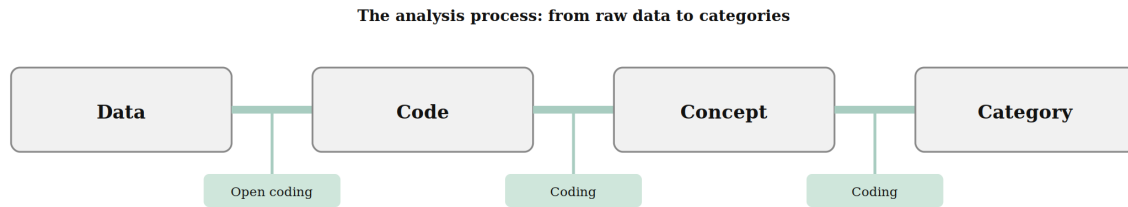


Figure 3: The analysis process (Source: Authors)

These are presented in the table below in four groups: physical-spatial, functional-land-use, perceptual-qualitative and social-behavioral. (Tab. 9)

Table 9: The multilevel coding of the architectural factors effective on the soundscape (Source: Authors)

Selective codes	Category	Classification
Form and spatial enclosure – type and quality of building materials – presence of natural elements (green space, water) – mass-to-space ratio and height of the walls	Active design	Physical-spatial
Fit of the land use of the space with acoustic conditions – intensity and type of human activities – adjacency of noise-generating land uses – buffer and transitional spaces	Spatial dimensions	Functional-land-use
Degree of acoustic calm/annoyance – legibility and predictability of sound – diversity and balance of sound sources – harmony of sound with the identity of the space	Acoustic mapping	Perceptual-qualitative sound
Presence and persistence – sense of security and psychological comfort – positive social interactions – sense of belonging and satisfaction with the environment	Auditory experience	Social-behavioral

By systematically analyzing 40 scientific sources, this study addressed the identification of the architectural factors of the soundscape effective on mental well-being. The findings showed that the soundscape, as an organized set of auditory environmental resources that is formed through keynotes, signals and soundmarks, reflects the dynamic relationship between the human being and the environment and, beyond the mere measurement of noise, emphasizes auditory experience, understanding and meaning. In

architecture and the city, as a dynamic system formed from the interaction of spatial and geometric factors, physical and green contexts, the acoustic fabric and the layering of sounds, and the behavior and perception of users, it shows that sound can be both a limiting stimulus and an enhancing factor. Likewise, through the active and strategic design of the soundscape, the use of field and perceptual data, structured auditory training, and the employment of sound as an engine of ideation in the design process,

acoustic satisfaction, the quality of learning, architectural creativity and the auditory legibility of public and educational spaces can be significantly enhanced; and by employing instruments such as soundwalking, soundscape training and workshops, masking strategies, and physical improvement and governance, auditory presence, spatial meaning-making and the quality of the acoustic experience of indoor and urban spaces can be significantly enhanced.

RESULTS AND DISCUSSION

The present research was conducted with the aim of explaining the causal relationships between the architectural components of soundscape and the mental well-being of citizens in the area adjacent to the airport. Using the meta-synthesis technique to analyses the effect and effect-receiving of four main components (physical-spatial, functional-land-use, perceptual-qualitative sound, and social-behavioral) and sixteen related indicators, this study sought to identify the chain of influence of the built environment on the auditory experience and ultimately on the psychological and behavioral health of citizens. The key findings of the research showed that, in the soundscape-mental well-being system, the “physical-spatial component” is the principal causal and effective factor, whereas the “social-behavioral component” has the greatest effect-receiving role. Among the indicators, “form and spatial enclosure” and “the mass-to-space ratio and the height of the walls” play the strongest causal role, and “the sense of security and psychological comfort” and “presence” appear as the final consequences. Likewise, the indicator “the degree of acoustic calm/annoyance”, with the highest value of interaction, is regarded as the central node connecting the physical body to the psyche of citizens. These findings emphasize that, without reforming the spatial structure and urban form, functional interventions or sound management cannot lead to a sustainable improvement of mental well-being. The results of the present research are consistent with the

findings of Eslami et al. (2023) regarding the role of the soundscape in creating calm and environmental satisfaction; but beyond that, they show that in fabrics dominated by aircraft noise, the “enclosed form”, unlike in sacred places, can turn into a sound trap. Likewise, with the research of Babadi et al. (2019), who confirmed the acoustic annoyance arising from Ahvaz Airport, our finding concerning the effect-receiving nature of “the adjacency of noise-generating land uses” is in agreement; yet it shows that the main origin of annoyance is not the adjacency itself, but the inappropriate physical structure. In comparison with Shahabian and Larimian (2016), who emphasized the role of human activities in the soundscape of Valiasr Street, the present research shows that in areas affected by the dominant sound of aircraft, human activities, rather than being a cause, are the effect of the acoustic conditions. Likewise, the findings of Mohsen Haghighi et al. (2017) regarding the importance of physical indicators in acoustic comfort have been reproduced and deepened in our research with the emphasis on the causal role of “form and enclosure”. Moreover, the findings of the present research are in full agreement with those of Habibpour Gatabi (2022), who emphasized the role of environmental factors in the mental well-being of young people, concerning the complete effect-receiving of the social-behavioral component from the physical and perceptual conditions.

At the international level, the results are consistent with the research of Dokmeci Yorukoglu and Kang (2016), who regarded the physical characteristics of libraries as effective on the auditory experience, but extend its scope to open urban space and to conditions of intense sound. In comparison with the findings of Schulte-Fortkamp and Jordan (2016), who pointed to the intersection of soundscape and architecture, our research has taken a step further by identifying the causal role of form and materials. The findings of Pouya (2017) concerning the role of natural elements in a positive soundscape experience are confirmed in our research with the lower D-R value of natu-

ral elements (+0.379); yet it shows that in fabrics with a dominant airport sound, natural elements alone are not effective and must be designed within the framework of an appropriate spatial form. Likewise, in comparison with the results of Zhou et al. (2023), who showed that visual perception moderates acoustic evaluation, our research adds a deeper layer: the form of space affects both the physical characteristics of sound and its mental perception. Finally, in comparison with the findings of Kang (2023), who regards the soundscape as designable, the present research, by presenting a quantitative causal chain (physical body → function → perception → behavior), offers an operational model for architectural design based on mental well-being. On this basis, the final conceptual model of the research is the result of the systematic integration of the

findings of the meta-synthesis analysis (which revealed the causal relationships between the architectural components of soundscape in the area of Tehransar and Hashemi Street) with the multiple dimensions of mental well-being derived from the foundations of mental well-being (under the influence of the environment), including self-regulation, emotional intelligence, cognitive self-knowledge, mental health, communication skills, meaning, creativity, and academic and occupational performance. This model traces the chain of influence from the physical body of space to the internal experience and outward behaviour of citizens in such a way that priority is given to the causal relations extracted from the field data, and the psychological dimensions are placed in the position of significant mediators.

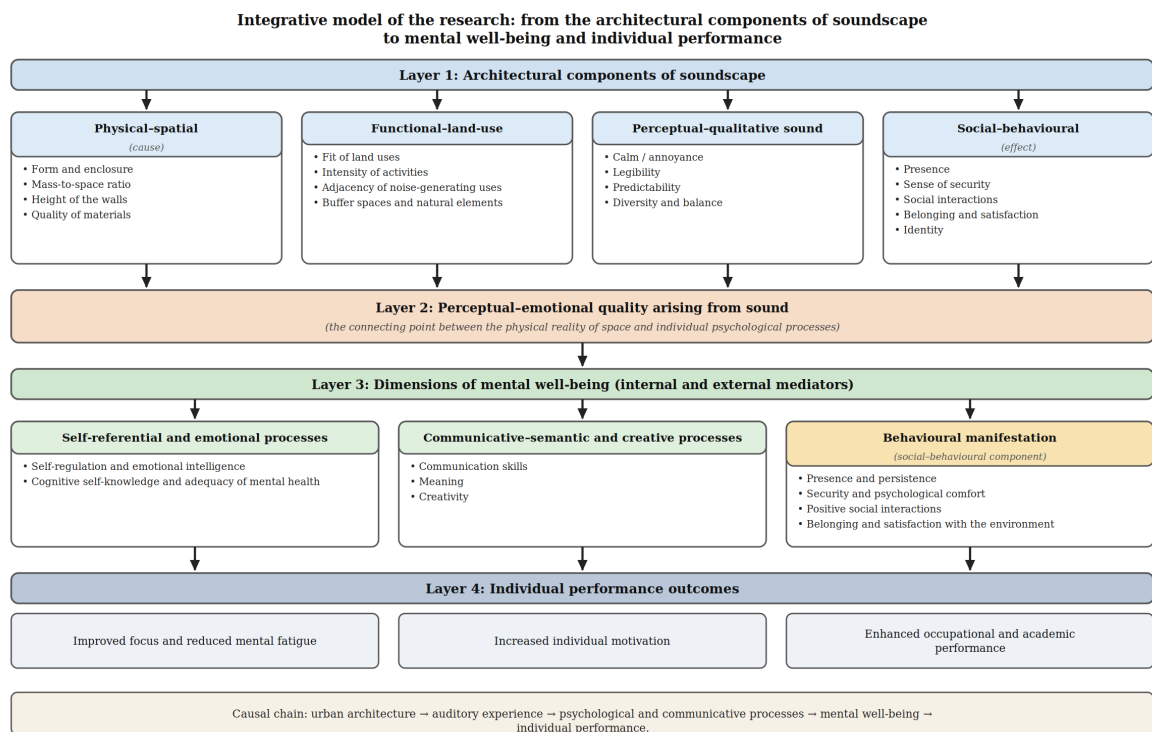


Figure 4: The conceptual model of the architectural components of soundscape effective on the well-being of citizens (Source: Authors).

In answer to the first question of the research, the architectural components of soundscape have been classified into four groups, as observed in

Figure 4; the model consists of four continuous layers. The first layer has been created in answer to the first question of the research and shows

that the architectural components of soundscape comprise four main components: “physical-spatial” (form, enclosure, materials, natural elements), “functional-land-use” (land uses, activities, buffer spaces), “perceptual-qualitative sound” (calm, annoyance, legibility, diversity, harmony) and “social-behavioral” (presence, sense of security, interactions, belonging). Based on the findings of the meta-synthesis, the physical-spatial component has the initiating role and the principal cause, in such a way that the physical structure of space determines the manner of propagation and reflection of sound and affects the other components. By contrast, the social-behavioral component, as the most evident manifestation of mental well-being in the spatial behavior of citizens, is placed at the end of the causal chain.

In the second layer, which has been formulated in answer to the manner and degree of the effect of the quality of sound on the various dimensions of citizens' mental well-being, the perceptual-emotional quality of sound acts as the central node. This layer is both affected by the physical and functional layers and gives direction to the subsequent layers. Indicators such as calm as against annoyance, the legibility and predictability of sounds, the diversity and balance of sound sources, and the harmony of sound with the identity of the space are a direct reflection of how the individual encounters the auditory environment. In the areas studied, the dominance of aircraft sound with periodic and uncontrollable characteristics has led to reduced legibility and increased annoyance. The third question likewise raises the causal model of the relationships between the architectural components of soundscape and mental well-being on the basis of the meta-synthesis technique; and in answer to it, the third layer encompasses the dimensions of mental well-being. This layer shows that the perceptual quality of sound does not lead merely to overt behavior, but is mediated through a set of psychological and functional processes. These dimensions include two

groups: self-referential and emotional processes (self-regulation and emotional intelligence; cognitive self-knowledge and the adequacy of mental health) and communicative-semantic and creative processes (communication skills, meaning and creativity). These dimensions explain why two citizens with identical acoustic conditions experience different levels of mental well-being. In fact, the social-behavioral component, identified in the first layer as the final effect, is the outward manifestation of these very intra-psychic and interpersonal dimensions.

Finally, the fourth layer comprises the functional consequences (academic and occupational performance). Based on the causal logic of the research, the mental well-being resulting from a desirable soundscape (with the mediation of self-regulation, perceived mental health and meaning) can lead to improved concentration, reduced mental fatigue and increased motivation, and consequently affect the academic and occupational performance of citizens. Citizens who possess higher self-regulation and emotional intelligence may evaluate the annoyance of aircraft sound as lower. This feedback, however, has a secondary role in comparison with the causal power of the first layer (the physical body). In this way, the proposed model, for the first time in domestic research, has explained the causal chain “urban architecture → auditory experience → psychological and communicative processes → mental well-being → individual performance” in the fabric adjacent to the airport.

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