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Abstract

More than 90% of people's lives unfold within the confines of buildings, underscoring the pivotal role of house design quality in the health and well-being of its inhabitants. Research indicates that features like adequate daylight, proper ventilation, and desirable views in housing design can simultaneously bolster mental and physical health. The World Health Organization (WHO) defines health holistically as "a state of complete physical, cognitive, and social well-being and not merely the absence of disease or infirmity. Studies in health-related fields underscore the crucial role that windows play in buildings. For older adults, windows can serve as a gateway to the world, particularly for those who spend significant time at home. This research focuses on identifying indicators that affect the mental health of older individuals and examining how windows can enhance their mental health in the Sistan region. The research methodology involved a comprehensive review of texts and articles alongside the design of a questionnaire, which was developed using the Laoche method based on expert opinions. Analyses were conducted using the SECA analysis, a multi-objective nonlinear programming model. The research findings reveal that among all components involved in window design affecting the mental health improvement of elderly individuals in the Sistan region, the view and landscape exert the most significant influence. In contrast, window shape has a lesser impact.

Keywords: Window, Mental Health, Elderly, Sistan

۱. Introduction

The rising trend of the elderly population underscores the increasing importance of their health. Globally, the proportion of individuals aged 60 years and above is projected to reach approximately 22% by 2050 (WHO, 2007). According to Iran's 1390 census, the country is home to 3.4 million elderly individuals aged 65 and above, constituting 5.7% of the total population. Demographic forecasts indicate that by 1430, the number of elderly individuals aged 65 and over in Iran will surge to 18 million, with their population share reaching around 20% (Sadeghi, 2013). In Iran, due to the significant increase in life expectancy in recent years, 60 years is considered the beginning of old age for retirement, and the provision of integrated elderly services and care is set to commence at this age.

Most individuals spend about 90% of their time inside buildings (Ampollini et al., 2029), so every building significantly impacts our daily lives. Overall, the quality of home design is a key factor in determining the health and well-being of its residents. Research indicates that elements of housing design, such as the amount of natural light, adequate ventilation, and pleasant views, can simultaneously contribute to improved mental and physical health (WGBC, 2016). Windows, as the primary source of daylight and a visual connection to the outside world, are standard architectural features that have attracted interest from experts in various fields, including architecture, lighting, photobiology, and psychology (Veitch & Galasiu, 2012). This study aims to investigate and analyze the impact of windows on enhancing the mental health of older adults in the Sistan region.

۲. Theoretical Framework

۲-۱. Health concept and its different dimensions in housing

Home is where we live, sleep, and rest; our children have many of their best formative experiences in this space, so we often become emotionally attached to our homes. We spend time and money making houses comfortable, safe, and personal. So, we have a strong connection with our residential buildings, differentiating the house from other types of buildings. (WGBC, 2016). Being healthy is one of the most basic human needs and the basis of human progress and civilization. In Maslow's model of needs, this issue is placed on the first level of the pyramid. The health of societies is created from the health of each family and its members, and housing is where the family spends most of its time. Therefore, housing conditions can positively or negatively affect people's health (Salehi, 2010). The World Health Organization is one of the agencies of the United Nations, whose most important goal is to coordinate and improve the public health situation in the world. Based on the definition of this organization, health is defined as the provision of complete physical, mental, and social well-being, which is not limited to the absence of disease and organ defects (Osborn, 1967). According to the World Health Organization (WHO, 2007), it can provide all three dimensions of health, i.e., physical, mental and social health for its residents.

١-Home is the most important space where people spend most of their time.

٢-The necessity of society's health is considered the most critical factor in improving the quality of life of individuals and society, the housing of all strata of society and different ages, and if it is unhealthy, it affects a wide range of people.

٣-It is necessary to discuss disease prevention in health and hygiene and consider healthy housing as a means to prevent various diseases.

٤-Paying attention to health issues in housing and applying its principles and rules will result in economic savings due to the high cost of treatment at the scale of the family, society, and country. Therefore, housing is an environment with multi-dimensional functions and has different physical, economic, social, financial, psychological and medical dimensions (Cullingworth, 2004). Among them, windows, as providers of daylight and a view to outer space, are standard and have received attention in the specialized fields of architecture, lighting, photobiology, and psychology. Energy and environmental concerns and health and well-being goals have each drawn new attention to the value of windows as a topic of discussion in practical life in these areas (Veitch & Galasiu, 2012).

٢-٢. Mental health definition

The psychological aspect of health in housing includes all the mental and psychological effects of the physical environment on its residents. Low-quality houses lead to a decrease in the mental health of their residents (Shaw, 2004), and on the other hand, improving the quality of the home environment has a positive effect on improving their mental and psychological health (Thomson & Petticrew, 2005).

٢-٣. Window's effect on mental health

The Encyclopedia defines a window as "an opening in the wall of a building to obtain light and air." This definition may show a simple diagram of one of the most complex components of a building, while in actual operation, the window has multiple functions. Therefore, it is impossible to agree on the exact role of the window because it has been designed to serve different functions throughout history, and its leading role has changed over time. However, with more emphasis on energy conservation, the window is recovering its multifunctional features by providing daylight and movement for natural ventilation (Kheira & Tabet, 2012). Therefore, windows "in the 20th century are machines that combine several environmental features and should not be considered only as transparent parts of the wall but form a multifunctional element in the home" (WGBC, 2016).

Moreover, beyond these statistics, the house is the permanent residence of a large group of people in society: children, mothers, older adults, disabled people, or people who have limited mobility. Therefore, the quality of the home environment is the most important. The place in our life is worthy of reflection (Gifford, 1987). Quality elements in the environment: The house is a

"window" which strongly affects the residents' emotional, emotional and psychological dimensions (Masoudi najad, 2013).

The window that connects the inside and the outside area fulfils the needs of the residents from the outside area: the need for natural light, the need for fresh air, the need to get information from the outside environment, and the need for a good view, especially in today's houses. As the window is the only way for the residents to communicate with the outside world and the only house opening to the city, the window has always been considered in terms of urban planning and architecture. Especially in recent decades, the window has been considered one of the most sensitive architectural design elements, and its design principles and criteria have been established (Tahbaz, 2014). Research in the fields related to the effects of health and well-being emphasizes that windows play a significant role in buildings. Empirical research also tells us that daylight through windows lets us see critical physiological functions in daily cycles and promotes positive emotions and alertness. The presence of windows in architectural spaces makes the spaces look pleasant. In addition to providing a tool to discover and perceive the environment, they also help the user's safety and comfort. The priority of windows is often related to the function of the space and even the resident's needs. If these variables are not congruent, people will change their space to fit their needs. Therefore, understanding the complexity of human-window interactions is essential in maximizing the fit between living and working spaces and those occupying them (Veitch & Galasiu, 2012).

۲-۳-۱ Natural light

Windows that provide daylight and views of the natural environment are prominent features of the physical environment that promote occupant satisfaction and well-being. Regarding biological factors, the intensity and timing of light exposure can alter circadian rhythms. Body clock synchronization potentially improves peak cognitive performance and work activities in a process known as circadian resetting (Roberts, 2010). By changing circadian rhythms, exposure to light can increase body temperature, lower blood pressure (Badia et al., 1991), and decrease heart rate (Smolders et al., 2012). On an emotional level, people enjoy the feeling of well-being in daylight and sunlight. Prolonged lack of daylight can have psychological effects: for example, at the other end of the spectrum, some people are affected by conditions such as seasonal affective disorder (SAD) during dark winters (WGBC, 2016).

۲-۳-۲ Circadian rhythm

The circadian rhythm (also known as the human body clock) gives people a sense of what time of day it is so that when it is morning, a person is potentially feeling tired but ready to start their day, for the evening is a sense of calmness and a moment that moves downwards. This rhythm is how people live naturally and healthily, and this is why having natural light is essential because windows allow the circadian system to work usually and consistently for humans (Zanier, 2021). Statistics show that people who spend most of their time in environments with artificial light may be more prone to mood disorders and sleep disorders. Therefore, having windows that bring natural light into our indoor spaces is vital to maintaining health (Boyce, 2003)

۲-۳-۳ Natural ventilation

Natural ventilation can be beneficial because it can bring fresh air from outside into the space while recirculating stale air. Moreover, it is essential because a space's air quality can affect its occupants' health. Although the building code for the window sector focuses more on windows that provide natural ventilation, it is essential to note that having access to fresh air is generally a mandatory rule. Windows help ventilate indoor spaces, reduce the risk of respiratory problems, improve cognitive function, and enhance safety (Zanier, 2021).

۲-۳-٤ Visual vision

Visual vision is an essential and beneficial aspect of windows that allow people to understand life outside the space. This aspect is one of the main components of windows that is hard to argue against, as people want a connection with the outside and a reminder of existing life. The sense of life outside the space in which one is located is essential because it gives one a sense of reality (Farley & Veitch, 2001).

۳-Background research

In a research titled Meta-analysis of the factors affecting the mental health of older adults, Arabzadeh examined all the research of quarterly journals and scientific research journals in the field of mental health of seniors during the years 2005-2015 and individual, social, psychological and demographic factors are among the indicators (Arabzadeh, 2016). It has been mentioned as effective for older adults. An article called The Biophilic Approach as an Approach to Improving the Quality of the Living Environment of Residents of residential complexes stated that improving the quality of the living environment also means providing appropriate and diverse responses through the environment to the different physiological and psychological needs of the users of that space (Bitraf et al., 2017).

Suppose we want to talk about the evolutionary process of the role of the window in the present era, as it has been discussed since the past. In that case, we can say that one of the effective approaches in recent years is the multi-purpose optimization of the window to provide the user's comfort. In an article titled "The impact of windows, daylight and views of nature on health and well-being in healthcare facilities" Heidi Salonen's team states that the window is one of the most critical factors for designing the physical environment. (Salonen et al., 2014). Today, excellent research has been done in multi-purpose window optimization to provide thermal and visual comfort and energy. Among others, Jiahe Wong, in their study, has provided a multi-purpose framework of thermal and daylight optimization in residential apartments based on window design and natural ventilation, and the results show that natural ventilation is adequate in simultaneously optimizing the goals and improving it (Jiahe et al., 2020). Also, in an article by Mohammadi and Shemirani, the multi-objective optimization of the window shape has been done to simultaneously provide visual comfort and energy efficiency in educational buildings through a genetic algorithm (Mohammadi & Shemirani, 2020).). In an article published in 2020, Pilechiha and his colleagues presented a multi-objective optimization framework of daylight, energy, and quality of view in window design of office spaces. Saleh Nasser, in his research, Optimized visibility and light to improve human comfort in the educational process, has been investigated (Saleh, 2021). In an article in 2012 titled "Window design and performance, light, visual comfort,

well-being", Aniseh Khaira refers to the role of windows in the quality of life and well-being, considering the conditions of energy optimization. Yingni Zhaia and his colleagues researched the multi-purpose optimization method for window design, considering energy consumption, ambient temperature, and visual performance (Yingni Zhaia et al. 2018). Most of the conducted researches try to optimize light, reduce energy consumption, and provide thermal comfort in the architectural space, while according to Kevin Steamer, "to truly improve human well-being, building design needs to move beyond the optimal Creating single parameters such as temperature, light and humidity and has a more comprehensive approach that shows its signs in human behaviour (Steemers. k, 2015). Therefore, by reviewing the background of the research, we will reach the point that many studies have been conducted in the field of optimizing and examining the window from the approach of thermal, visual, and climatic comfort, stability, etc., and few studies have investigated the role of the window on mental health.

٥-Methodology

Regarding the nature and purpose of this research, it is practical, and its method is based on correlation. The research data was collected in a field study using questionnaires to influence the factors involved in window design on the mental health of older adults in the Sistan region.
In the first step, the factors involved in window design were extracted from the articles and research, and according to the opinion of architectural experts and experts' Delphi method, 12 effective indicators in window design were extracted. Then, an analytical matrix was formed, from which a questionnaire with 132 questions was prepared and adjusted. Finally, the scores were analyzed by the arithmetic mean integration method in the SECA analytical matrix system (Tab. 1).

criteria's			Mental health indicators										
			Anxiety	Depression	Sleep quality	Mental and physical security	Stress	Privacy	Communication with outside	Sense of wellness	Cultural and religious beliefs	Physical health	Quietness
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
window Design Criteria	Window Material	A1	2.815	2.815	3.074	3.852	2.963	3.778	2.407	3.259	3.000	3.037	3.778
	Window ratio to wall	A2	3.444	3.630	3.407	3.963	3.185	4.259	4.037	3.852	3.481	3.630	3.889
	Window dimension	A3	3.630	3.556	3.556	4.074	3.481	4.111	4.222	4.000	3.593	3.889	4.111
	Window location	A4	3.444	3.370	3.593	3.889	3.481	4.333	4.111	3.667	3.963	3.333	4.037
	Window direction	A5	3.778	3.815	4.037	4.074	3.778	5.815	3.963	4.148	3.926	3.963	4.185
	Openability	A6	3.519	3.593	3.556	4.037	3.704	4.000	4.296	4.000	3.333	3.741	3.815
	view and scape	A7	3.963	4.074	3.889	4.259	3.741	4.407	4.444	4.296	3.852	4.000	4.185
	Awning	A8	3.111	3.148	3.704	3.741	3.111	3.556	3.593	4.074	3.037	3.630	3.778
	Glass panes	A9	3.259	2.926	3.407	4.111	3.407	3.741	3.519	3.444	3.148	3.444	3.852
	Window form	A10	3.148	2.852	2.704	3.185	2.815	3.074	3.222	3.074	3.222	2.778	3.333
	Glass color and texture	A11	3.741	3.556	3.407	3.852	3.333	4.111	3.852	3.704	3.741	3.148	3.630
	Sill level	A12	3.815	3.815	3.741	3.926	3.667	4.519	4.481	3.667	4.222	3.889	4.148

Tab. 1: Analytical matrix and average responses of older adults to the indicators and criteria of the questionnaire

٥-١-١ SECA analytical method

This technique was initially introduced by Mehdi Keshavarz Ghorabaee and his colleagues in 2018. The SECA method represents a novel approach to weighting criteria and ranking options simultaneously, employing a multi-objective nonlinear mathematical model to achieve this objective. To develop the mathematical model, two types of references are defined for the criteria weight. The first type is based on the variation information within the criteria, determined by the standard deviation. In contrast, the second type is linked to the variation information between the criteria, determined based on the degree of correlation. The multi-objective model aims to maximize the overall performance of each option and minimize the deviation of the weight criteria from the reference points. Unlike other methods, the SECA method calculates the decision matrix for weighting the criteria and ranking the options concurrently (Keshavarz Ghorabaee et al., 2018).

٥-١- Location and time of research

The research's statistical population comprises residential houses in District One of Zabol in the Sistan region, where 80 elderly individuals reside. According to the necessity of determining the sample size, a minimum of 66 individuals were determined through the sample size estimation table of Krejcie and Morgan. To account for potential decreases in respondents, 72 elderly

individuals with moderate to high mental health were randomly selected and allocated for participation.

٦. Findings

In the current research, data related to the criteria, including factors involved in the design of the window, denoted as A, and options related to the mental health indicators of seniors, denoted as C, have been collected and presented (Tab. 2).

Following the formation and normalization of the decision matrix, a nonlinear optimization model was constructed and solved using Lingo software. This model was implemented for β values ranging from 0.1 to 7. In each implementation, the criteria weights and option scores were determined. The scores of the options (A) for different values of β are provided in (Tab. 3)

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	0.710	0.691	0.761	0.904	0.784	0.650	0.537	0.759	0.711	0.759	0.903
A2	0.869	0.891	0.844	0.930	0.843	0.732	0.901	0.897	0.825	0.907	0.929
A3	0.916	0.873	0.881	0.957	0.922	0.707	0.942	0.931	0.851	0.972	0.982
A4	0.869	0.827	0.890	0.913	0.922	0.745	0.917	0.853	0.939	0.833	0.965
A5	0.953	0.936	1.000	0.957	1.000	1.000	0.884	0.966	0.930	0.991	1.000
A6	0.888	0.882	0.881	0.948	0.980	0.688	0.959	0.931	0.789	0.935	0.912
A7	1.000	1.000	0.963	1.000	0.990	0.758	0.992	1.000	0.912	1.000	1.000
A8	0.785	0.773	0.917	0.878	0.824	0.611	0.802	0.948	0.719	0.907	0.903
A9	0.822	0.718	0.844	0.965	0.902	0.643	0.785	0.802	0.746	0.861	0.920
A10	0.794	0.700	0.670	0.748	0.745	0.529	0.719	0.716	0.763	0.694	0.796
A11	0.944	0.873	0.844	0.904	0.882	0.707	0.860	0.862	0.886	0.787	0.867
A12	0.963	0.936	0.927	0.922	0.971	0.777	1.000	0.853	1.000	0.972	0.991

Tab. 2: The creation of the decision matrix

criteria	β											
	0.1	0.2	0.3	0.4	0.5	1	2	3	4	5	6	7
A1	0.7750	0.7588	0.7535	0.7510	0.7479	0.7400	0.7361	0.7348	0.7341	0.7337	0.7335	0.7333
A2	0.8833	0.8846	0.8840	0.8838	0.8813	0.8739	0.8702	0.8690	0.8684	0.8680	0.8677	0.8676
A3	0.9275	0.9258	0.9242	0.9235	0.9198	0.9088	0.9033	0.9015	0.9006	0.9000	0.8996	0.8994
A4	0.9172	0.9055	0.9013	0.8992	0.8957	0.8862	0.8815	0.8799	0.8791	0.8787	0.8783	0.8781
A5	0.9604	0.9574	0.9575	0.9577	0.9583	0.9602	0.9611	0.9614	0.9616	0.9617	0.9618	0.9618
A6	0.8999	0.9054	0.9066	0.9071	0.9041	0.8944	0.8895	0.8879	0.8871	0.8866	0.8863	0.8860
A7	0.9822	0.9840	0.9840	0.9841	0.9806	0.9700	0.9647	0.9629	0.9620	0.9615	0.9612	0.9609
A8	0.8247	0.8298	0.8336	0.8356	0.8332	0.8246	0.8202	0.8188	0.8181	0.8176	0.8174	0.8172
A9	0.8527	0.8417	0.8382	0.8366	0.8326	0.8215	0.8160	0.8142	0.8132	0.8127	0.8123	0.8120
A10	0.7680	0.7538	0.7471	0.7438	0.7387	0.7251	0.7183	0.7160	0.7149	0.7142	0.7137	0.7134
A11	0.8937	0.8838	0.8795	0.8773	0.8735	0.8632	0.8581	0.8563	0.8555	0.8550	0.8546	0.8544
A12	0.9692	0.9627	0.9600	0.9586	0.9550	0.9451	0.9402	0.9385	0.9377	0.9372	0.9369	0.9366

Tab. 3: Scoring options for different β values

The scores of the options are depicted schematically in (Fig 1). As evident from both the tables and graphs, the graphs converge for values of β greater than 5, exhibiting minimal changes after that. Therefore, β=6 can be deemed as the converged value, and the weights of the criteria and the scores of the options are determined at this value, remaining fixed for the problem.

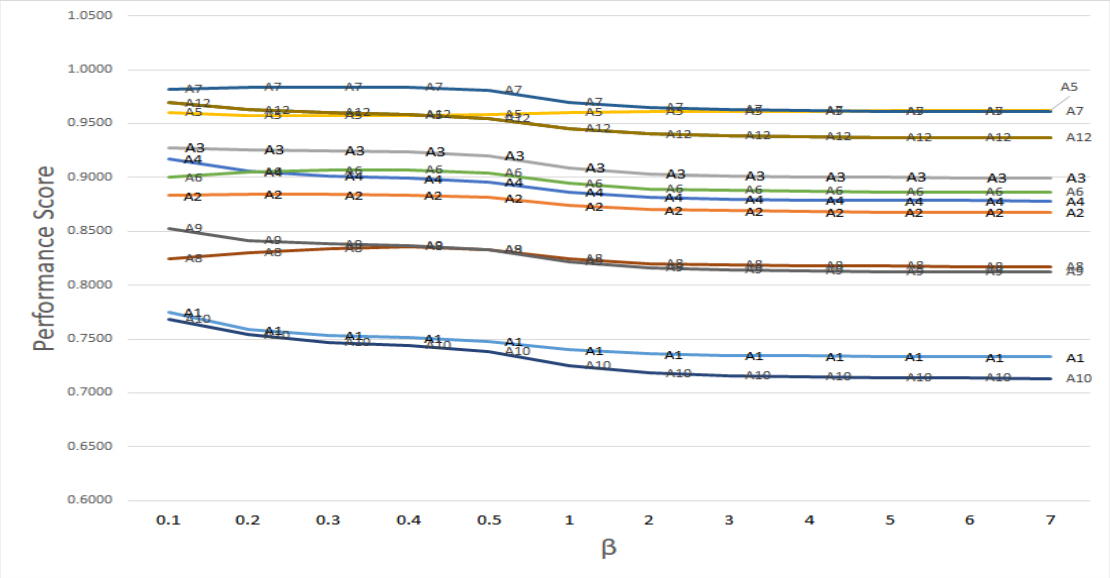

Fig. 1: Weight changes of options for different β values

As determined from the results of the Seka method, at β=6, the scores of the options have been calculated and are provided in (Tab.4), respectively. The results are depicted in (Fig. 2).

Option name	Normalized score (Weight)	Option score	Option code	Rank
Window Material	% 7.10	۰,۷۳۳۷	A۱	۱۱
Window ratio to wall	% 8.41	۰,۸٦۸۰	A۲	۷
Window dimension	% 8.72	۰,۹۰۰۰	A۳	٤
Window location	% 8.51	۰,۸۷۸۷	A٤	٦
Window direction	% 9.31	۰,۹٦۱۷	A٥	۱
Openability	% 8.59	۰,۸۸٦٦	A٦	٥
View and scape	% 9.31	۰,۹٦۱٥	A۷	۲
Awning	% 7.92	۰,۸۱۷٦	A۸	۹
Glass panes	% 7.87	۰,۸۱۲۷	A۹	۱۰
Window form	% 6.92	۰,۷۱٤۲	A۱۰	۱۲
Glass colour and texture	% 8.28	۰,۸٥٥۰	A۱۱	۸

Sill level	% 9.08	۰,۹۳۷۲	A۱۲	۳

Tab. 4: Weight and priority of options

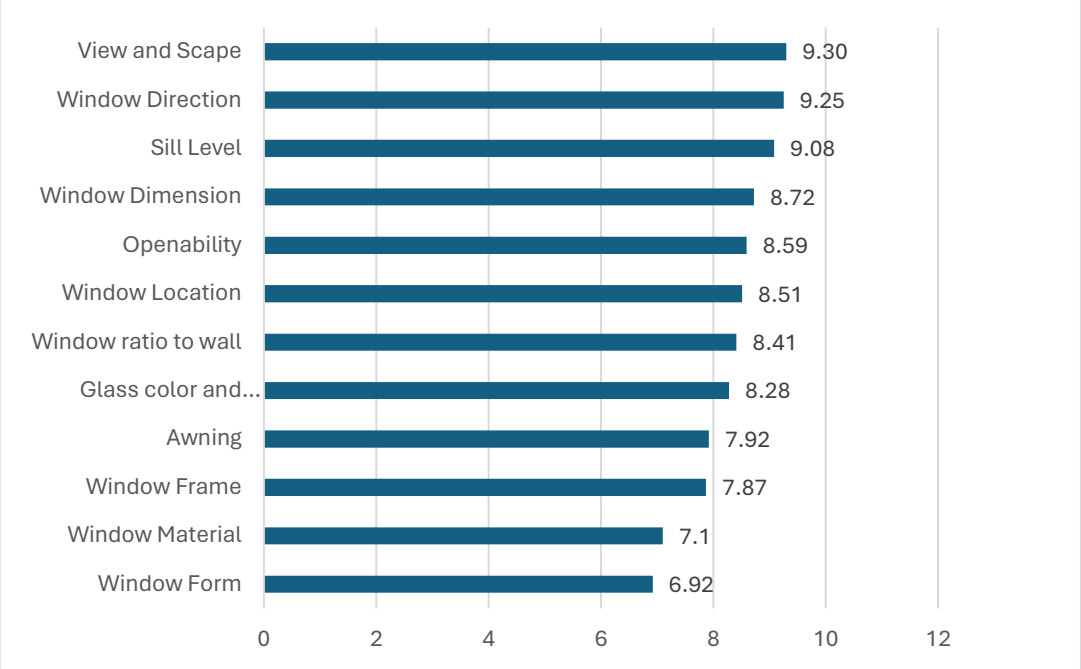

Fig. 2: Final score and rank of options

Regarding the options analysis (factors influencing window design), the view and scape were the first, with 9.30%, and window direction, the second priority with 9.29%. Conversely, the window frame, material, and form received the lowest rankings. The analysis indicates a significant relationship between each criterion involved in window design and the mental health of older adults in the Sistan region. Consequently, it can be inferred that the window design can potentially improve the mental health of senior citizens in the Sistan region.

V. Conclusion

The increasing elderly population in Iran and globally underscores the critical importance of addressing elderly health issues. With Iran's elderly population projected to reach 18 million by 1430, according to population forecasts, the identification and prioritization of the psychological and spiritual needs of this demographic, as well as the provision of elderly care services, have become imperative. Since individuals spend a significant portion of their lives at home, the house and residential environment play a pivotal role in shaping their health and mental well-being. As such, the home environment, often regarded as "the most important place in our life," warrants thorough investigation, particularly considering its profound emotional and psychological impact on residents. Aligning the home environment with the psychological needs of its occupants is paramount.

In light of these findings, prioritizing the factors involved in window design becomes essential for enhancing the mental health of older adults in the Sistan region. Thus, the order of importance

from highest to lowest weight ratio should be as follows: view and scape, window direction, window-to-floor distance (sill level), window dimensions, open-ability, window location, surface-to-window ratio, glass colour and texture, awning, window frame, window material, and window form. In other words, the view and escape emerge as paramount for fostering the mental health of older adults in the Sistan region.

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