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Study on Inclusive Design of Fitness Equipment for Rural Elderly People: A Case Study of Zhejiang Rural Areas

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Abstract. Up against the aging society, this paper applies the concept of inclusive design to conduct in-depth research on public fitness equipment in rural elderly communities, which aims to provide them with more comfortable community fitness equipment, improve the enthusiasm of the elderly people to exercise, and then enhance their physical fitness. Selecting rural elderly people aged 60-75 who have the ability to take care of themselves in Taishun County, Wencheng County and Cangnan County of Zhejiang Province, this study probes into the special needs of elderly people through questionnaire surveys. The results show that the rural elderly people prefer training on endurance, coordination and flexibility, but not keen on strength training. The shortage of fitness facilities, especially rehabilitation, aerobic and flexibility equipment, has been a major obstacle to keeping fitness. Elderly people emphasize the safety and accessibility of equipment, calling for diversified, comfortable and humanized fitness equipment design. This study puts forward a set of design paths based on the inclusive design of public fitness equipment for rural elderly people, so as to effectively improve the fitness willingness and physical fitness of elderly people.

Keywords: Industrial Design; Concept of Inclusive Design; Rural Elderly People; Public Fitness Equipment.

1. Introduction

With the accelerating global population aging, the health and well-being of elderly people have increasingly been the focus of social attention. According to *Trends and Characteristics of Population Aging in China in 2024*, the severity of aging in China will keep deepening, which poses severe challenges to China's social, economic and medical systems. Thus, the World Health Organization proposed the concept of healthy aging in 1887, which emphasized that elderly people should not only live long, but also lead a healthy and dignified life [1]. With great importance attached to this concept by the Chinese government, the National Work Conference on Aging and Health in 2024 was held, which marks the national attention paid to the health issues of elderly people and the formulation of handling strategies.

However, according to extensive literature research, the existing research focuses on the health problems of elderly people in cities, with relatively rare research on the fitness needs and fitness equipment of elderly people in rural areas. Due to limited resources in rural areas, elderly people lack adequate fitness facilities and social opportunities [1]. It not only limits their physical activity, but also affects their mental health. In addition, as their children go to cities for work, elderly people in rural areas encounter more serious loneliness and social isolation.

To fill the gaps in existing research, this study aims to explore and design fitness equipment more in line with physical characteristics, exercise habits and psychological feelings of rural elderly people through an in-depth understanding of their fitness needs and habits. This study also aims to stimulate rural elderly people's interest in exercising, improve their fitness enthusiasm and persistence, and promote their physical and mental health.

For these ends, this study will adopt the concept of inclusive design, considering special needs and characteristics of rural elderly people, so as to design safe and easy-to-use fitness equipment, promote their participation in fitness activities, and enhance their community cohesion.

The importance of this study lies in its innovation and application. First of all, by designing fitness equipment meeting needs of rural elderly people, they are encouraged to do sports more actively, enhance physical fitness, improve cardiopulmonary function, and delay aging. Secondly, this study can provide scientific basis and technical support for building fitness equipment in rural communities, improve the equipment and quality of rural fitness facilities, and enhance cultural and sports atmosphere of rural communities. Finally, this study applies inclusive design to the design of rural fitness equipment, which boosts the efficiency of fitness equipment and sheds light on inclusive design of other groups.

2. Application of the Concept of Inclusiveness in the Design for Elderly People

Inclusive products refer to the design of mainstream products or services that can be easily used in various situations by as many people as possible on a global scale, without special adaptation or specialized design [2]. This chapter mainly explores how to incorporate the principle of inclusiveness into the design to meet elderly people's special needs. Such an issue is of great significance in the current aging society.

First of all, Huang (2016) [3] and Sankat & Khare [4] investigated the application of inclusive design for elderly people from the perspective of public fitness equipment and living environment design respectively. Huang proposed a design plan for public fitness equipment based on the care needs of elderly people, emphasizing functional positioning, ease of use and safety [3]. Sankat & Khare analyzed 20 environmental issues faced by elderly people in India when it comes to residential settings by environmental- behavioral research tools, from which they provided guidelines for designing interventions [4]. Secondly, Sampaio et al. (2019) [5] examined the application of digital technologies in elderly people, especially in promoting social interaction among elderly people through digital inclusion courses. It is found that this technology can significantly boost the social inclusion of elderly people and the social relationship between family and friends [5]. In the field of education, Fraga da Costa et al. (2020) [6] explored the social inclusion of elderly people during education, which emphasized the importance of education in promoting the social participation of elderly people. Their paper mentioned that by redefining the role of elderly people in education, their social inclusion can be further improved [6]. In addition, after reviewing the evolution of inclusive design in the UK, Clarkson & Coleman (2015) [7] noted that inclusive design is a broad design approach to meet the needs of the widest range of people, not just elderly people or people with disabilities. The promotion of this design concept will better consider the needs of elderly people in the design [7].

According to a comprehensive analysis of this literature, the application of inclusive design in elderly people focuses on the living environment, public facilities, digital technology and education. These studies not only highlight the functionality and safety of the design, but also pay attention to the social participation and psychological needs of elderly people. However, they lack the design based on the needs of the rural elderly people and ignore the needs and prospects of this group. Therefore, this study proposes a design for fitness equipment for rural elderly people based on the concept of inclusive design to meet the needs of elderly people and improve their health and happiness.

3. User Research

Elderly people selected in this paper refer to rural elderly people with self-care ability who are 60-75 years old. Compared with the older group, most elderly people aged 60-75 can still participate in moderate physical activities and are more willing to engage in research, and provide more accurate and reliable feedback. This study adopts quantitative research to collect data. The quantitative research of this study mainly adopts a convenience sampling survey and distributes structured questionnaires to collect data, so as to understand the actual fitness needs of rural elderly people in Taishun County, Wencheng County, and Cangnan County in Zhejiang Province and their pain points when using fitness equipment. The survey duration is from February to June, 2024. After arriving at

Taishun County, Wencheng County, and Cangnan County in Zhejiang Province, the local fitness equipment and the health conditions of middle-aged and elderly people in the village were obtained, with questionnaire surveys on farmer households with elderly people. In this survey, 128 valid questionnaires were collected.

From the perspective of gender and age distribution, men accounted for 56.15% and women accounted for 43.85% of the respondents to the questionnaire survey. Thus, there are slightly more male respondents than females. The age group is mainly concentrated in the range of 60-65 years old with the highest proportion, reaching 43.85%, which may reflect that elderly people in this age group pay more attention to health problems and are more willing to participate in questionnaires. From the perspective of living environment and health status, nearly half of the respondents live in towns and rural areas, which provides data on the fitness needs of elderly people in specific areas for the study. Meanwhile, there is a high proportion of elderly people with chronic diseases such as hypertension, diabetes, and arthritis, which proves that the health status and special needs of these elderly people need to be considered when designing fitness equipment. From the perspective of exercise frequency and activity preference, 40.86% of elderly people do physical exercise 2-3 times a week. Hence, a certain proportion of elderly people maintain regular exercise habits. With regard to fitness activity preferences as seen in Figure 1, endurance training, coordination training, and stretching/flexibility training are more popular, while strength training is relatively less popular. From the perspective of the demand for fitness equipment, 71.43% of elderly people believed that there was a lack of rehabilitation training equipment, and 64.45% insisted on insufficient aerobic exercise equipment and flexibility training equipment, which demonstrated the shortcomings of fitness equipment in rural areas and the demand for solutions. From the perspective of fitness barriers and design needs, physical condition constraints and insufficient equipment are the biggest obstacles faced by rural elderly fitness. According to Figure 2, elderly people pay the most attention to the safety and accessibility of equipment, which emphasizes that the design of fitness equipment should emphasize ease of use and adaptability. As for opinions of equipment design improvement, diverse equipment design is considered to be key to meeting fitness needs, accounting for 27.91%. Comfortable fitness environment, equipment suitable for different physical conditions and humanized design are also heeded by elderly people. From the perspective of outlook of future fitness equipment, as shown in Figure 3, the words with the highest frequency in the Word Cloud Map include “elders”, “use”, “mutual support” and “fitness equipment”, which reflects elderly people’s expectations for fitness facilities to be supportive, easy to use, and designed specifically for their group.

After data analysis, it is found that rural fitness equipment should have safety and accessibility to adapt to elderly people’s physical conditions. A variety of equipment can be set up, including rehabilitation training, aerobic exercise and flexibility training equipment. A comfortable fitness environment and humanized design are required to improve elderly people’s fitness experience. In addition, the design should take into account the social needs of elderly people, encouragement of mutual support and community participation.

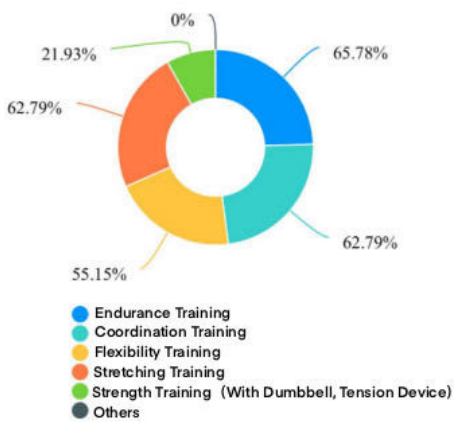

Figure 1. Types of Fitness Activities that Rural Elderly People Tend to Participate In

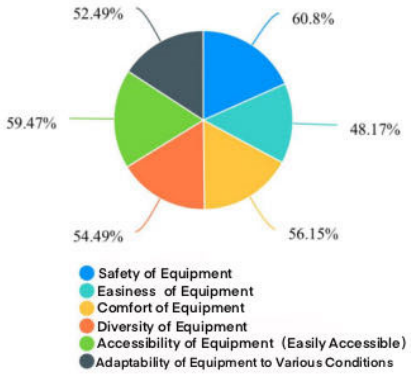

Figure 2. Factors Valued by Rural Elderly People When Choosing Fitness Equipment

Figure 3. Word Cloud Map of Rural Elderly Peoples' Expectations for Future Fitness Equipment

4. Application and Design Path of Inclusive Design in Rural Community Fitness Equipment

Inclusive design is integral to the development of fitness equipment for elderly people. It requires designers to consider three aspects of users, abilities and psychology [8] to achieve comprehensive inclusiveness for different user groups and respect the laws of human life, thus removing obstacles in use through innovative design and user experience improvement.

(1) User Inclusiveness

According to the investigation, traditional community fitness equipment often ignores the needs of elderly people, a special group. With the aging physical functions, elderly people face more challenges in using these devices. Therefore, it is crucial to design fitness equipment suitable for elderly people. It can not only meet their fitness needs, but also provide convenience for people with sports disabilities, so as to achieve wider user inclusiveness and reduce design exclusion [8].

However, elderly people tend to be conservative about changing old perceptions and habits, especially as their dependence on old habits becomes more entrenched as they age [8]. By observing the situation of rural elderly people using the community spacewalk machine, it is found that many elderly people have improper posture during use. These problems not only affect the fitness effect, but may also bring potential safety hazards. To solve this problem, we refer to the design of an environmental protection street lamp based on human kinetic energy. It can convert the kinetic energy generated by elderly people during exercise into electrical energy, which is environmentally friendly and meets the psychological needs of elderly people eager to be needed and recognized. On this basis, interactive modules are further added to prompt users in real time, so as to correctly exert force, help elderly people correct their posture, and improve their fitness effects.

This innovative design concept not only provides a more humanized and safe fitness environment for elderly people, but also stimulates their enthusiasm for participation, so that they can contribute to the sustainable development of the community while enjoying fitness. Meanwhile, it embodies the spirit of inclusive design and provides new ideas and methods for building a harmonious community.

(2) Capability Inclusiveness

Aging and death are the inevitable natural laws of life. Therefore, from an inclusive perspective, designing a set of fitness equipment suitable for elderly people can not only solve the inconvenience in their daily life, but also improve the health of young people in the future. Sport is a process of comprehensive application involving various abilities. In addition to the cooperation of various senses such as vision, smell, and hearing, it also requires the coordination of limbs and brain commands.

An inclusive research perspective enables us to discover and understand users' needs and behaviors at different stages, pay attention to users from multiple perspectives, and improve the design to meet more diverse needs. When designing fitness equipment, we should consider rural residents of different age groups and physical conditions, so as to ensure that the equipment can be applied to a wide range of user groups. Rural residents with vision or hearing impairment can be assisted in using equipment through multi-sensory feedback such as touch, sound or vibration, thus improving their convenience and safety.

Mobility disorders become common due to physical disorders brought about by aging, such as arthritis, osteoporosis, etc. To prevent serious consequences caused by the sudden occurrence of these disorders for elderly people during fitness, the seats need to be arranged reasonably next to the fitness equipment, and the anti-slip armrests should be designed on both sides of the seats to reduce the probability of falling. To this end, the sports and fitness all-in-one machine designed by Wuhan University of Technology [9] provides detailed operation tutorials, posture specifications and tips during exercise by adding a large-screen interactive mode. Elderly people can perform simple operations according to these prompts, obtain scientific and effective fitness guidance, improve fitness efficiency, and reduce exercise risks. In addition, through sports scene simulation, elderly users seem to be in virtual scenes such as forests and obtain a rich sports experience. Through the above measures, elderly people are provided with a safe, comfortable and easy-to-use fitness environment to maintain their physical health and enjoy a high quality of life.

(3) Psychological Inclusiveness

The Dunning-Kruger effect reveals a profound psychological phenomenon, that is, people with insufficient abilities often find it difficult to realize their deficiencies, especially among elderly people. With socioeconomic development, some elderly people have begun to pursue a youthful lifestyle, but such a transformation sometimes leads them to wrongly evaluate their abilities. Thus, they tend to suffer physical injuries during fitness. Research in the *Scandinavian Journal of Sports Medicine* with valuable guidance proposed that the "pyramid before polarization" model is the most effective for improving endurance performance in elderly people among four training models.

Guided by the concept of inclusiveness, the design of fitness equipment should not only pay attention to the physiological needs of elderly people, but also understand their psychological characteristics. Such a design can ensure that the equipment can not only meet the needs of elderly people to improve their endurance, interaction and communication in the community, but also avoid embarrassment or inconvenience caused by improper design, and respect the privacy and dignity of rural elderly people.

After retirement, elderly people have undergone a huge change in their social roles with fewer opportunities to communicate with the outside world, which may trigger negative emotions such as depression, loneliness and loss. Extensive research has shown that socializing has many benefits for elderly people, including maintaining cognitive ability, increasing emotional connection and reducing loneliness. The outdoor equipment design of Xccent Fitness in the United States combines various equipment through modular game chains, which lowers the threshold for elderly people at different fitness levels and stimulates their desire to explore. In addition to allowing elderly people to

participate in exercise activities in a relaxed game based on safety protection and enriching their sports experience, this modular circular game mode also encourages elderly people to participate more in group activities and meets social needs, thus reducing resistance to outdoor sports. By strengthening interaction and facilitating the exchange of information, we can meet the emotional needs of elderly people and help them build more active social networks and improve their life quality.

5. Conclusion

This paper studies how to use the concept of inclusive design to improve public fitness equipment for rural elderly people in an aging society. Selecting rural elderly people aged 60-75 in Zhejiang Province who have the ability to take care of themselves as research objects, this study uses questionnaires and other methods to propose an inclusive innovation path for fitness equipment in rural communities. It includes the perspective of aging issues, inclusive framework, improvement of operational convenience, cognitive load simplification, elimination of barriers for elderly people's use of fitness equipment, information interaction promotion and habit acceptance, etc. These innovative paths help to enhance the efficiency of fitness equipment, meet the diverse needs of elderly people, and boost their health status and life happiness. Meanwhile, this study gives enlightenment for future designers and the Chinese government. Designers should be user-centered, cultivate inclusive thinking, and apply innovative technologies to enhance the interactivity and interest of fitness equipment. The government needs to introduce supportive policies, rationally allocate resources, and strengthen education and training on fitness knowledge and skills for rural elderly people. Although there are limitations regarding sample range, long-term effect evaluation and depth of technology application in this study, it still provides a possible outlook for future research, including expanding the scope of research, interdisciplinary cooperation, technology integration, and long-term follow-up research. These prospects will deepen the understanding of elderly people‘s fitness needs, promote a more personalized and intelligent fitness experience, and improve the health status and life happiness of elderly people.

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