

Artificial Neural Network Analysis for Prediction of Community Care Design Research in Spatial and Environmental Areas in Korea

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Abstract

This study aims to empirically confirm the effect and impact of community care design research centered on domestic space and environment on health promotion, diagnosis treatment, disease management, rehabilitation, and mitigation through the year of publication and perspective. To this end, based on 1,227 space and environment design studies from 2,144 community care design research data conducted for about 20 years from 2002 to 2022, when care services began in earnest through the long-term care system for the elderly, SPSS 26.0 was used to create a 'Multi-layer Perceptron' artificial neural network structure model was predicted and neural network analysis was performed. Research Results First, as a result of checking studies in each field of health care by year, there is a significant difference with the number of studies related to health promotion being the highest. Second, the five perspectives are region, time, dimension, function, and content perspective. As a result of inputting these variables as independent variables and analyzing their importance in the artificial neural network, the function perspective had the most influence, followed by the region > content > dimension > time perspective.

Keywords: Community Care Design, Space and environment Design Studies, Health-care Field, Artificial Neural Networks, Prediction and Impacts

1. INTRODUCTION

As Korea entered an aging society at the fastest pace in the world, social discussions on population issues began in earnest. In particular, as the perception of the burden of care and support due to aging shifted from family and individual to public responsibility and social care, the Korean government also tried to solve this problem with a universal social security policy through the social service system. However, compared to other advanced countries that have prepared various systems through community care since the early 2000s, the situation in Korea is still insufficient. As a researcher, I faced this situation in Korea.

The Importance of Community Care Design in South Korea [1, 2] :

►Effective Communication and Visible Sharing of Predictable Outcomes: Community care design aims to efficiently deliver solutions to issues by promoting effective communication among community members and

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enabling visible sharing of predictable outcomes.

►Integration of Design Methodology at All Stages: Community care design maximizes the practical and experiential effects when design methodology is incorporated in all stages of preparation, planning, and decision-making processes.

►Emergence of Diverse Types of Care Demand in the “Untact Era”: The COVID-19 pandemic has exposed the limitations of the existing institution-centered public health system, even in advanced healthcare countries. This highlights the need for various types of care demand in the "untact era," where remote and contactless services are increasingly required.

Community care design in South Korea is crucial to address the evolving needs and challenges brought about by societal changes and crises. By incorporating design principles and methodologies throughout the process, it enhances the effectiveness of community care interventions and enables more meaningful and inclusive participation from stakeholders. It allows for the development of responsive and adaptable care services that can better meet the needs of individuals and communities [3].

1.1 The concept of Community Care Design in Korea

Community care design in Korea refers to a design approach that assists all individuals to fulfill their care needs and realize their self-identities within their communities, living alongside other residents. Beyond typical everyday care, it is a design that flexibly responds to the demands of untact (contactless or non-face-to-face) care in sudden, urgent situations. Perspectives on care have shifted from patients to general individuals (potential patients), from hospitals to living spaces, from doctors to medical information, from limited consultation hours to 24-hour availability, and from disease treatment to preventive care or everyday management. This shift has led to a change in the central focus within the healthcare sector [3, 4, 5].

This shift spreads to the establishment and utilization of existing medical welfare and local infrastructure, leading to the diffusion of deinstitutionalization, non-face-to-face medical services, mental care, disaster and accident information dissemination, and social network design [2].

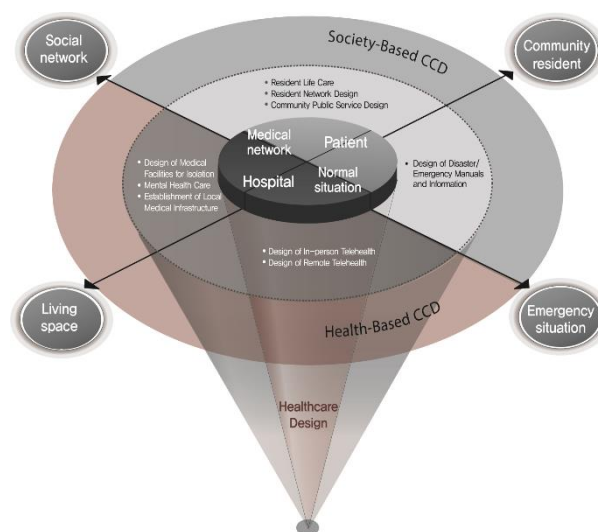


Figure 1. Areas of Community Care Design Concept

1.2 Research Objective

The objective of the research is to empirically analyze and validate the effects and impacts of community care design, focusing on space and environment, in the field of health care in South Korea. Specifically, the research aims to examine the effects and influences of community care design on health promotion, diagnosis and treatment, disease management, rehabilitation, and palliative care. The analysis will be conducted using artificial neural network analysis, considering both the temporal trends and key perspectives, in order to provide empirical evidence, validation, and predictions in the field of community care design [3].

2. RESEARCH METHOD

2.1 Scope and Methodology

The study focuses on community care design in South Korea, specifically examining the effects and impacts of space and environment design on health care services. The research covers a period of approximately 20 years, from 2002 to 2022, during which 2,144 community care design research studies were conducted. Among these studies, 1,227 specifically focused on space and environment design.

The data analysis will be conducted using SPSS 26.0, employing a neural network analysis technique known as Multi-layer Perceptron (MLP) artificial neural network. The MLP model will be constructed to analyze the data and identify patterns, relationships, and predictive insights related to the effects of space and environment design in community care.

By utilizing this neural network analysis approach, the study aims to provide empirical evidence and insights into the effects and impacts of community care design, specifically focusing on the role of space and environment design in health care services [5]. The units of analysis are shown in Table 1.

Table 1. Unit of Analysis in Community Care Design Research in Korea

variable	Selected
Subcategories:	
Health Care, Social Welfare, Design	Health Care Field, Space-Environment Design
Field of health care:	
1.Health Maintenance Stage	Care services aimed at promoting and maintaining overall health
2.Diagnosis and Treatment Stage	Care services for accidents, illnesses, and necessary medical interventions
3.Chronic Disease Management Stage	Care services focused on managing chronic conditions
4.Rehabilitation Stage	Care services aimed at facilitating recovery and rehabilitation
5.Palliative Care Stage	Care services providing relief and comfort for individuals with advanced illnesses
Health Promotion Stage	Defined in the National Health Promotion Act as health education, disease prevention, nutrition improvement, and the practice of healthy lifestyles. - It can be further categorized into health education, disease prevention, nutrition improvement, and healthy living.

2.2 Artificial Neural Network Analysis for Time Series Prediction

Artificial neural network analysis aims to model the intelligent behavior of the human brain by simulating the neural cells, enabling the implementation of intelligent systems. This technology is used for various purposes, including time series prediction.

One of the advantages of artificial neural network analysis is its ability to handle incomplete and highly volatile variables. Even with limited or irregular data, neural networks can interpret patterns and make predictions based on

the available information. The power of artificial neural networks lies in their ability to reduce errors through repeated learning from examples. This allows for more precise calculations compared to regression models that are sensitive to data quantity. By utilizing artificial neural network analysis for time series prediction, it becomes possible to make accurate forecasts and capture complex patterns in the data, even when dealing with incomplete or volatile variables.

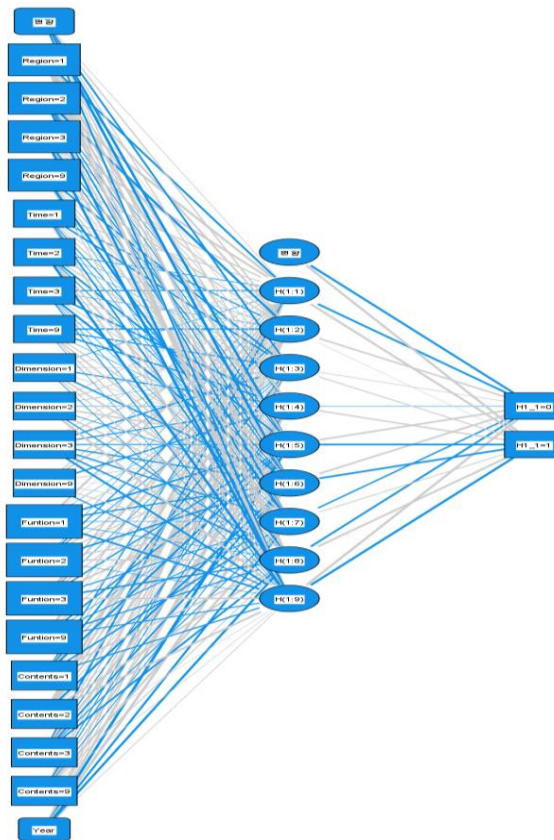


Figure 2. Model of artificial neural network analysis

3. RESULTS

3.1 Trends in Community Care Design in Korea

Analyzing the trends in community care design research over time, it was found that research has been steadily increasing since 2002, with relatively large spikes in 2009 and 2018. In 2009, the establishment of the Urban Regeneration Team led to the full-scale development of community-related research projects, resulting in a noticeable growth trend in the engineering field.

In 2018, there was a significant increase in research due to the government's announcement of the “Integrated Community Care” policy, which further emphasized community care. However, there was a temporary decrease in research in 2019, which can be attributed to the outbreak of the COVID-19 pandemic. Nevertheless, in 2021, there was a substantial increase in research, particularly in the field of arts and sports sciences. This indicates a continued interest in community care design across various domains and a surge in research focused on practical implementation of care within the design field.

These trends suggest a growing interest in community care design and an exploration of innovative approaches to implement care in the design field, in addition to sustained interest in other areas of community care design.

3.2 Studies focusing on health care-related environmental and space design

Among the community care design research conducted over the 20-year period, there was an overall increase in studies focusing on health care-related environmental and space design. However, when examining the health care fields (health promotion, diagnosis and treatment, disease management, rehabilitation, and palliative care) across different years, significant differences were observed. The research on health promotion was the most prevalent. Within the health promotion field, studies on health education, disease prevention, nutrition improvement, and healthy living were also identified, but there were no significant differences observed across the years.

In summary, while there has been a considerable amount of research on space and environment design in community care design, specifically in the health care field, most studies have focused on everyday changes rather than directly integrating with or involving the actual health care practice. Considering the crucial role and function of primary health care settings in community care, further research that integrates with the actual health care field is highly anticipated in South Korea.

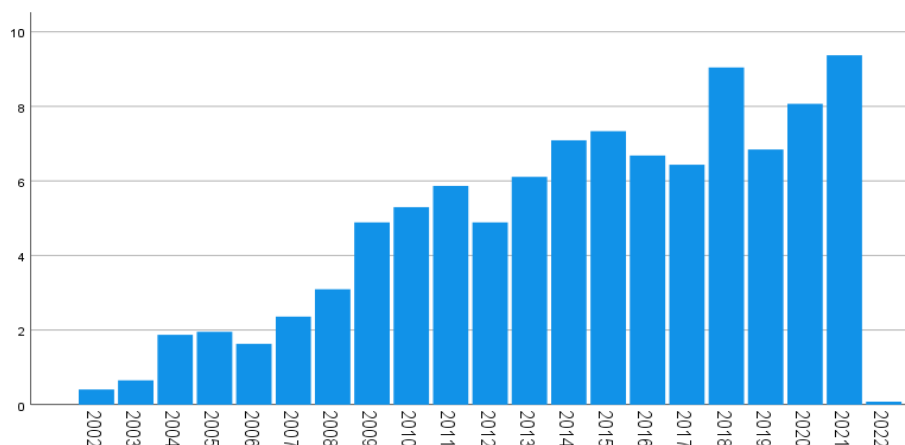


Figure 3. Healthcare-centered environment and space design research by the year

3.3 Results of importance analysis through artificial neural network analysis

Using artificial neural network analysis based on the data from health promotion-related environmental and space design studies, a well-fitted neural network model was generated with excellent model fitness.

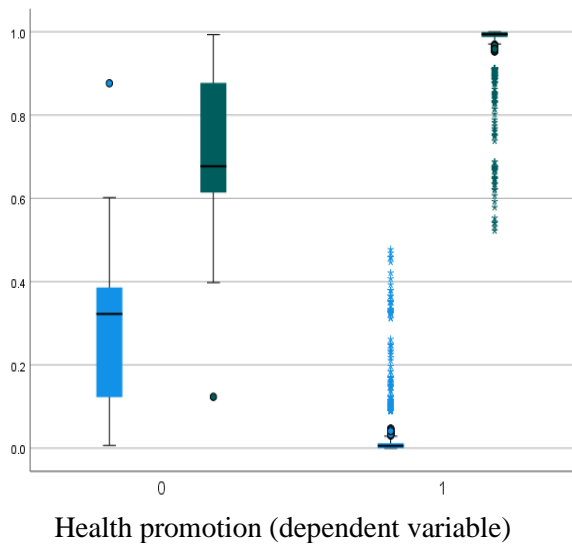


Figure 4. Predicted similar probability

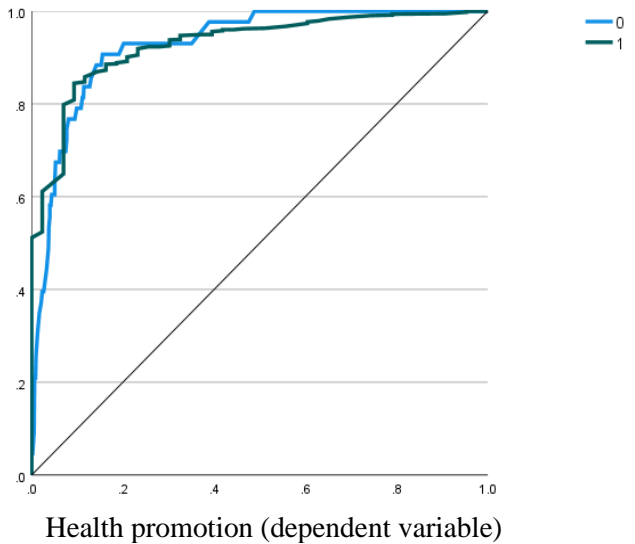


Figure 5. Responsiveness and specificity

The analysis incorporated five perspectives as independent variables: regional perspective (facility-based, non-facility-based, mixed), temporal perspective (regular, emergency, mixed), dimensional perspective (online, offline, mixed), functional perspective (practice-based, policy-based, mixed), and content perspective (residential, utilization-based, mixed).

The importance analysis conducted through neural network analysis revealed that the functional perspective had the most significant impact, followed by the regional perspective, content perspective, dimensional perspective, and temporal perspective.

In summary, based on the neural network analysis using the data from health promotion-related environmental and space design studies, the functional perspective was found to have the most influential impact. This was followed by the regional perspective, content perspective, dimensional perspective, and temporal perspective, in that order.

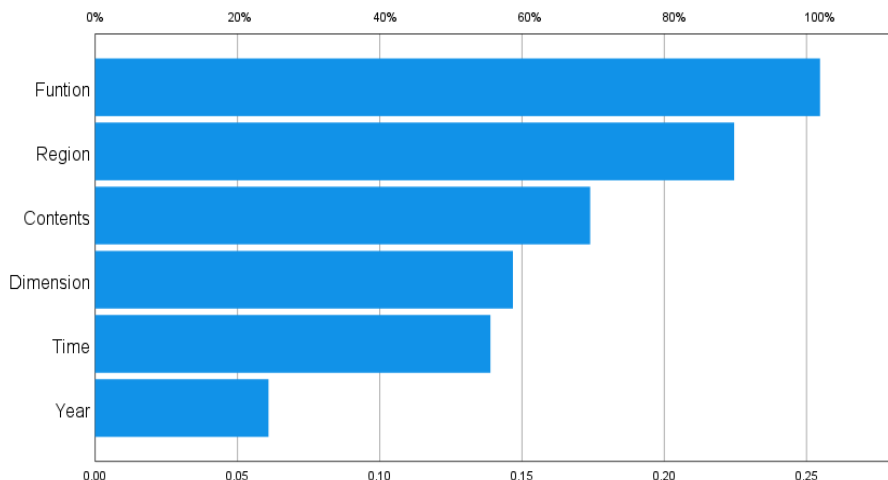


Figure 6. Importance according to perspective using artificial neural network analysis

4. CONCLUSION

Based on research in community care design, health promotion-related environmental and space design studies emphasize the concept and highlight the importance of focusing on the living environment of the individuals rather than traditional facilities or hospitals. Therefore, non-facility-based studies that emphasize the concept of deinstitutionalization have been found to be most effective. However, it is important to note that individuals with diseases or disabilities may face challenges in the deinstitutionalization process, and the role of design in addressing these challenges is crucial.

- ▶ In South Korea, the provision of living environments for community care recipients is crucial as it is related to their basic rights.
- ▶ Considering recent natural disasters and other unforeseen events, there is a need to expand research on space and environmental design from a temporal perspective. This includes addressing urgent schedules, emergency situations, and complex issues that may arise simultaneously.
- ▶ Additionally, research in space and environmental design should actively consider design solutions that can address the needs arising from time-sensitive situations and complex emergencies.

Overall, expanding research in space and environmental design within the context of community care in South Korea will help improve the living conditions and well-being of community care recipients, especially during urgent and challenging circumstances.

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