



PROPOSED KITCHEN DESIGN FOR COMPLYING ELDERLY NEEDS

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ABSTRACT

The risk of accidents rises with advanced age, with the kitchen being one of the most risky areas for the elderly. Places of care for the elderly such as nursing homes, then, need to consider kitchen design as part of their overall risk prevention measures. The purpose of this research was to design a comfortable and safe kitchen for the elderly by using a design thinking approach, which utilizes customer opinion to make a decision. Interviews and focus groups were used to elicit opinions from elderly residents of a nursing home on their experience with the existing kitchen. Based on their input, a new kitchen was designed with racks near the sink, handrails in several places, seats to facilitate washing the dishes and cooking, and appropriate storage for food and walking aids. The proposed kitchen was also designed without any stairs. The Wilcoxon signed-rank test showed a significant difference in the perception of the new design compared to the previous design, suggesting that the proposed changes cater to the elderly residents of the nursing home.

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1. Background

In the Republic of Indonesia, the elderly are legally defined as people aged 60 (sixty) years or above (Hasanah & Pagar, 2018). The number of elderly people in Indonesia is approximately 21 million (Setiati et al., 2019). This population has the highest risk of accidents when carrying out certain activities (Petersen et al., 2018). Bergen et al. (2016) reported that 29 million elderly had accidents in 2014, with accidents leading to 29 thousand deaths in 2016 (Johnston et al., 2019). Nursing homes are one of the places where accidents involving the elderly often occur. With 80–90% of the elderly's time spent at home or in a nursing home (Petersen et al., 2018; Smith et al., 2017; Zhang et al., 2016), it is crucial that family members or others who care for the elderly pay attention to the risk of accidents.

The kitchen is one place where home accidents involving the elderly occur (Yapici et al. (2019). According to Sahin and Erkal (2016), the number of elderly people who had accidents in the kitchen reached 31.7%. Accidents involving the elderly could cause trauma and physical disability (Mortazavi et al., 2018). In the kitchen, accidents causing burns are common (Bamzar, 2019), and can even cause death (Kumar & Verma, 2016). Another problem while using the kitchen is discomfort while reaching and bending and difficulties involved in cleaning and slippery floors (Özalp, 2020).

Bonenberg et al. (2019) stated that a good kitchen design is a design that can adjust for users who have limitations like the elderly so that they do not have any difficulties in their activities. Several studies related to kitchen facilities and equipment have been carried out. Kameridou (2017) conducted a study related to comfortable and ergonomic furniture for the elderly. Wang (2020) researched kitchen layout design for the elderly, while Zubaidi (2019) researched the manufacture of kitchen utensils in the form of cutting boards that are easy and safe to use by the elderly. Gullà (2016) proposed the creation of a smart system to help the elderly perform kitchen tasks, Asghar (2017) studied the manufacture of tools for the elderly to find lost items in the kitchen, and Wang and Ning (2020) examined the design of a smart kitchen application for the elderly.

Based on the problems mentioned above, this research study has been conducted to

design a nursing home kitchen by using design thinking. The design thinking method was chosen because this concept includes the thoughts of the consumers in the decision-making process (Reine, 2017). In this process, the thoughts of the users are analyzed to determine the problems experienced (Shamsuddin et al., 2020). One of the advantages of design thinking is that there is repeated testing of the prototype by users until they are satisfied (Levine et al., 2016). The use of design thinking has been proven to solve problems in handicraft products (Ardian & Jomponingsih, 2019), urban development (Kumar et al., 2019), smart city innovations (Lee et al., 2016), and the development of future homes for the elderly (Tymkiewicz & Zasadzka, 2016). The difference between this study and previous research is that this research focuses on designing integrated facilities that facilitate cooking and washing dishes while seated and safety facilities for the elderly that take into consideration the layout of the facilities.

2. Method

2.1 Subjects and objects

The research subjects were the elderly who lived in nursing home in Yogyakarta with the following criteria: (1) male and female; (2) aged 60–70 years; (3) in good health as indicated by a doctor's certificate. The object of research is the kitchen used in the nursing home.

2.2 Population and sample

The population in this study were the elderly living in a nursing home in Yogyakarta, Indonesia, by the number up to 21 people. The sample used in the study amounted to 10 people. The sampling technique used is a purposive sampling technique which resulted in a study group with the following characteristics: (1) does not have any disabilities; (2) able to walk without wheelchair assistance; and (3) have complete and usable limbs.

2.3 Facility design

The facilities designed in this study were kitchen facilities consisting of dish racks, handrails, seats for washing and cooking, food storage areas, and cooking areas. This study involved a facility design that was designed based on the elderly needs.

2.4 Research procedures

2.4.1 Preparation

The preparation stage involved examining the condition of the nursing home's kitchen, determining the sample, surveying the population in nursing homes, and preparing the elderly participants to become prospective members of the focus group discussions (FGD).

2.4.2 Data collection

Data were collected from all participants related to the location of the kitchen and cooking activities. Data collection was carried out by conducting interviews and distributing questionnaires about activities in the kitchen that have the potential to cause accidents and the facilities needed for elderly.

2.4.3 Designing steps

This study used the Stanford D School design thinking model with five stages: empathize, define, ideate, prototype, and test (Noel, 2017). Specifically, the steps involved were the following: (1) Empathize - Collecting data by conducting interviews with participants related to the problems they experienced while using the kitchen; (2) Define - Using FGD I, determining the core problem obtained from the identification of data from the empathize step; (3) Ideate- Determining the best solution or idea, which was carried out through FGD II; (4) Prototype - Making a prototype design to incorporate the ideas suggested in FGD II, which will be used to solve problems identified at the define stage; (5) Test- Testing the prototype.

2.4.4 Hypothesis and statistics test

The design test used a perception of differences test which was conducted to determine the differences in the level of satisfaction between the previous kitchen design and the proposed kitchen design using the Wilcoxon test. The variables used for testing were completeness of facilities, security, ease of mobility, layout, and aesthetics of the kitchen. The results of the test will be used to make a final decision on the prototype. The following are the steps used for analysis:

a. Research hypothesis

$H_0: \mu_1 = \mu_2$: There is no significant average difference between satisfaction with the old

kitchen design and the proposed kitchen design for the elderly.

$H_1: \mu_1 \neq \mu_2$: There is a significant average difference between satisfaction with the old kitchen design and the proposed kitchen design for the elderly.

b. Significant level: $\alpha = 0,05$

c. Statistics test:

Conclusions are drawn using the following conditions:

Asymp. Sig. $< \alpha$ means that there is an average difference or H_0 is rejected.

Asymp. Sig. $> \alpha$ means there is no difference in average or H_0 is accepted.

3. Results and Discussion

A team consisting of the research team, the elderly in the nursing home, and the workers in the nursing home was formed to conduct FGD I and II. The characteristics of the FGD team members were 29% male and 71% female, with an average age of 60 years $\pm$ 8 years.

3.1 Empathize

In interviews focusing on the discomfort of the elderly at the nursing home, several complaints were made about using the kitchen: discomfort in the knees when they had to climb the stairs from the sink, discomfort in the legs because of the bad layout that required having to walk a long way, and the lack of a place to store personal food. Based on these complaints, several features will be designed to cater to the needs of the elderly, including repairing stairs that cause discomfort, adding personal food and plate storage areas, and enhancing the layout of the facilities.

3.2 Define

In FGD I, the problems identified at the empathize stage were discussed. The issues that were agreed to be addressed in the design of the new kitchen include the following:

1. There are no handrails, which can easily lead to falls. Many elderly need handrails as a support tool to minimize the risk of falling (Kato et al., 2020).
2. There is a difference in the kitchen height surface with stairs that increases the risk of falling. Physical weakness makes it difficult for many older people

to support themselves while climbing stairs (Kato et al., 2020).

3. The personal food storage area is physically unsafe. Therefore, a new food storage area aims to provide facilities for the elderly to store their personal food.
4. There is no convenient dish rack in the kitchen, so dishes are scattered in several areas.
5. The layout of kitchen furniture is not ergonomic, which has caused accidents.

In addition, the elderly feel uncomfortable when they have to walk a long way or stand for a long time.

The previous kitchen design in the nursing home is shown in Figure 1. The kitchen is 4.5m x 11m and is equipped with cupboards, refrigerators, sink, shelves, stoves, large buckets, and washing machine.

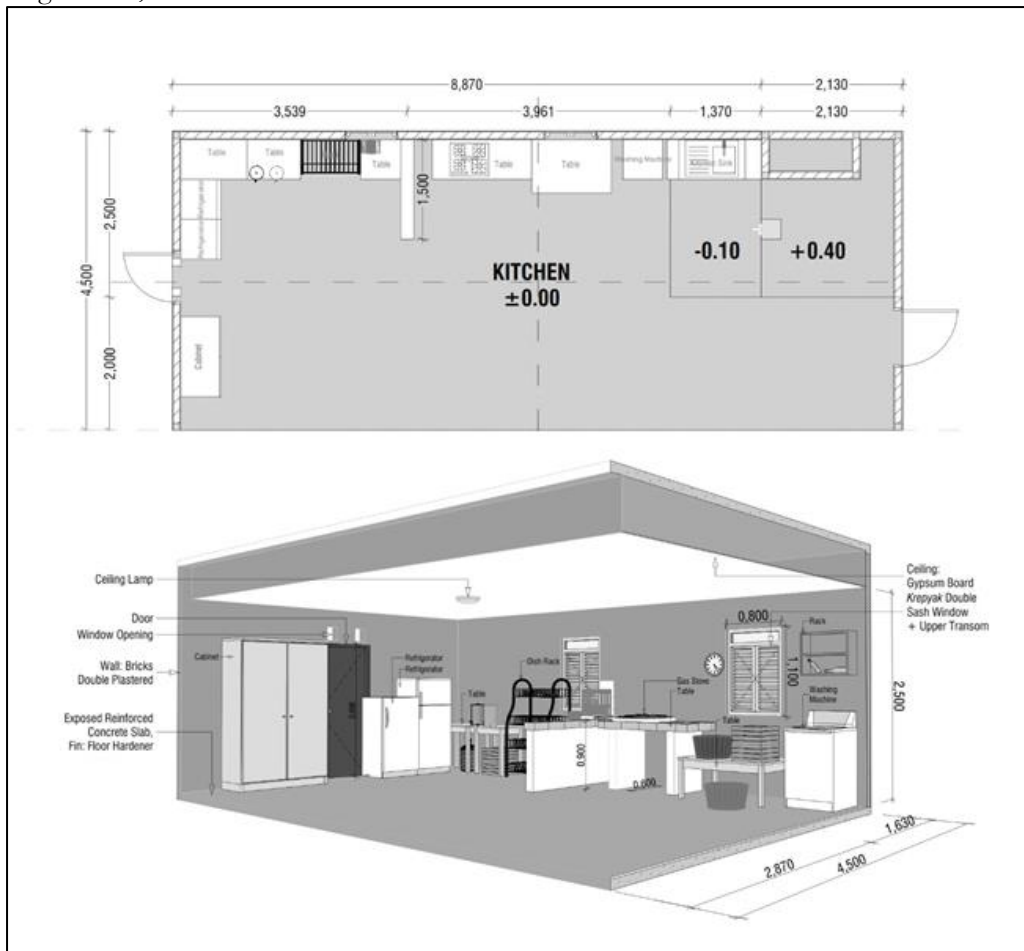


Figure 1. Previous Kitchen Design

The percentage of participants that complained when using a kitchen facility is shown in Table 1 below.

Table 1. Facility Complaints

No.	Facility	Percentage of complaints	Risk Impact
1	Dish storage bucket	66% complained that the storage of plates in the form of a bucket was inappropriate.	Dishes piled on the bucket can cause the plates to be damaged or broken, which may cause the elderly to suffer injuries if exposed to sharp pieces.

2.	Dish washing place	33% complained that they have to use stairs to access the dishwasher.	The elderly experience knee pain if they have to climb stairs routinely. Knee pain adds to the risk of falling while standing or walking.
3.	Dish rack	66% felt that the dish rack was just too far from the sink.	Pain in the feet due to unnecessary extra walking distance may cause the inability to support body weight for a prolonged time.

3.3 Ideate

To brainstorm solutions for the problems encountered by the elderly while using the old kitchen, FGD II was held. The following points are some ideas generated during FGD II that will be used for prototyping (letters refer to labels used in Figure 2):

1. Install handrails within the kitchen to help the elderly stand and walk around (B). Handrails will be installed for easier access to personal food storage, the sink, and cooking area. Body dimensions considered when designing the handrails are the fifth percentile of maximum hand grip diameter and standing elbow height.
2. To avoid the need to use stairs, all equipment inside the kitchen area must have the same surface height (E).
3. Create a food storage shelf, allowing the elderly in the nursing home to store their own personal food (D). Body dimensions considered during the manufacturing and installation of the storage shelf are the fifth percentile of the distance between handgrip and the upper back and shoulder height in a standing position.
4. The dish rack must not be located far away from the sink to prevent water dropping on the floor when carrying dishes after washing. Wet and slippery floors may cause falls (Mortazavi et al., 2018). The body dimension considered in the procurement of dish racks is the fifth percentile of the distance from the handle to the upper back.
5. Provide a seat in the cooking and washing area to minimize leg pain due to

prolonged standing (C). Pain and soreness of the legs may increase the risk of falls in the elderly (Awale et. al., 2017). The body dimension considered when designing the seating is the fifth percentile of the knee-fold height.

6. Create a storage space to easily put away walking sticks while the elderly are using the sink or cooking (F). A lot of elderly people experience a decrease in their ability to maintain balance while standing, which is usually managed by using walking aids such as canes or crutches (Dogru et. al., 2016). The body dimension considered in the installation of the walking stick storage space is the fifth percentile of the distance between the handle and the upper back.

3.4 Proposed Kitchen Design.

The improvement made during this study was the installation of handrails in some parts of the kitchen. Handrails were installed to reduce the elderly's risk of falling while carrying out activities in the kitchen. The installation was done while considering room dimension and also the layout of all the furniture in the kitchen. Anthropometric tools were used to determine body dimension and size. The following anthropometric data were acquired from all the elderly in the nursing home:

- (1) Shoulder height in a standing position
- (2) The distance from the handgrip to the back in the forward hand position
- (3) Knee folding height
- (4) Elbow height in sitting position
- (5) Maximum grip diameter

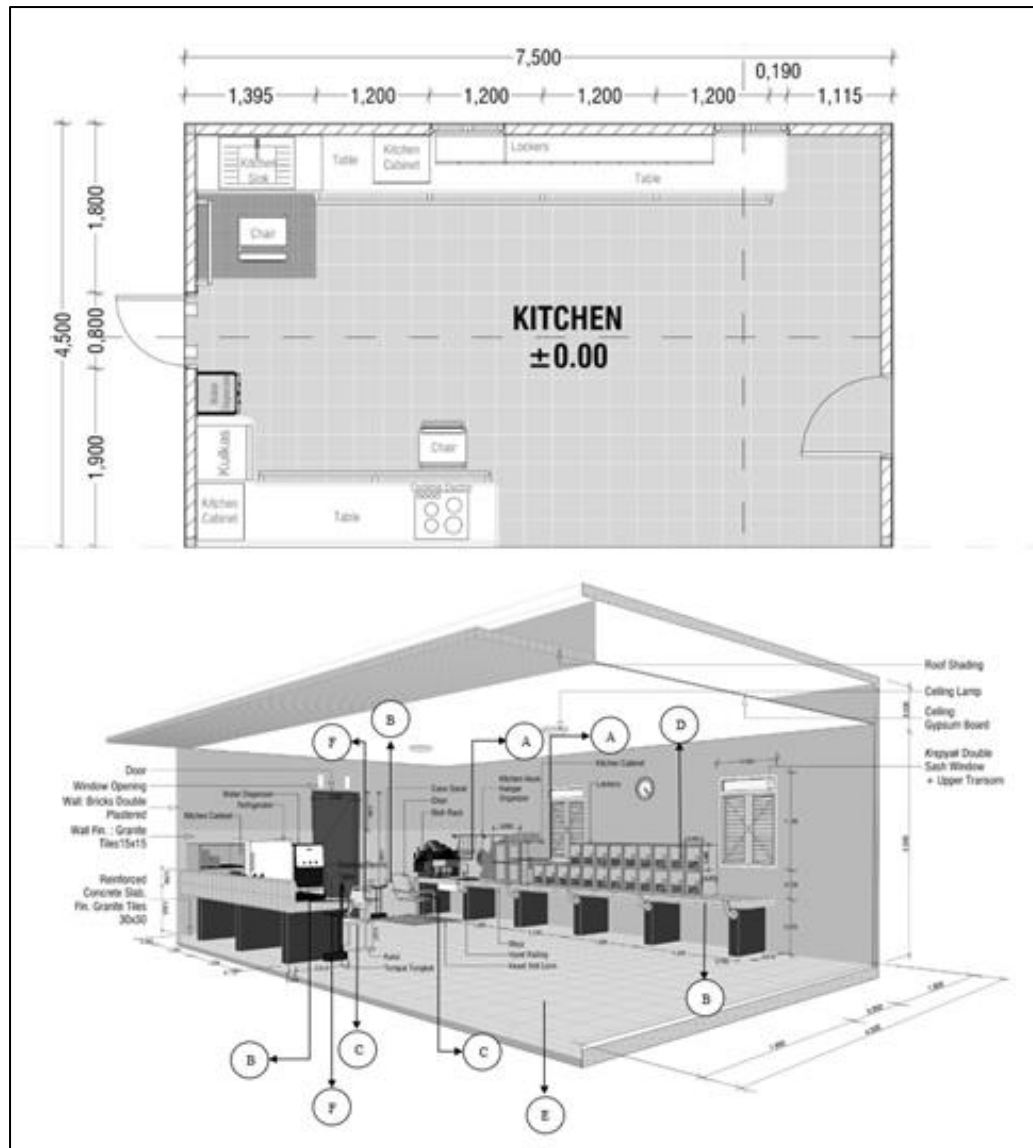


Figure 2. Proposed Kitchen Design

Utilizing anthropometric data acquired from this research, the following measurements were used in designing a new kitchen for the elderly: handrail (B) height is at 86.53 cm, with a hand grip diameter of 3.38 cm; the food storage shelf (D) height is 116.98 cm from ground surface, and the shortest distance to nearest handrail is 42.28 cm; the dish rack (A) height is also the same as the food storage shelf at 116.98 cm, with the nearest handrail 42.28 cm away; the height of the walking stick storage (F) and seating (C) are both 37.01 cm.

Using anthropometric data to design the proposed kitchen dimensions is supported by several prior studies that show that compatibility between anthropometric data and designed

facility dimensions resulted in enhanced comfort and ease of use (Stellon et. al., 2017). Vinu (2017) also confirmed similar findings that anthropometric data is indispensable while designing ergonomic products.

3.5 Statistics Test

To statistically analyze comfort, the Wilcoxon signed-rank difference test was performed. This test was carried out to determine whether the differences felt by the users between the old and new proposed kitchen were statistically significant. The variables used for testing the comfort level of the kitchen were facilities, security, ease of mobility, layout, and appearance. The data was analyzed using IBM

SPSS (Statistical Package for the Social Science) Software.

From the new kitchen design, a prototype of the handrail was installed, then several tests were carried out to evaluate user satisfaction. The results of the satisfaction difference test of the comparison of the proposed kitchen design and the old kitchen using the Wilcoxon signed-rank difference test showed satisfactory results. All variables in the comfort test namely, completeness of facilities, security, ease of mobility, layout, and beauty of the kitchen showed that there is a significant average difference between satisfaction with the old kitchen design and the proposed kitchen. All tested variables had Asymp values Sig. of 0.000, which means Asymp. Sig. $< \alpha$, indicating that there was an average difference. In other words, H_0 is rejected. The average level of satisfaction with the proposed kitchen design was also of greater value compared to the old kitchen design, which shows that the proposed kitchen prototype design has succeeded in catering to the needs of the elderly. This research result is supported by prior research, such as that conducted by Potra et al. (2018), who found customer's perception to be crucial to product development. Rahimi & Kozak (2017) also stated that increased customer satisfaction is directly correlated to better results.

4. Conclusion

The proposed kitchen design for the nursing home offers several solutions to solve ongoing problems experienced by the elderly residents when using the old kitchen. These solutions elicited during FGD II are (1) procurement of a dish rack placed close to the sink; (2) installation of handrails in several parts of the kitchen to facilitate standing and walking; (3) procurement of seating to facilitate sitting while washing and cooking; (4) installation of a food storage area to store personal food; (5) ensuring a constant surface height in the kitchen; (6) creation of a storage space for walking sticks. The perception of differences test on all variables (facilities, security, ease of mobility, layout, and beauty) indicated a significant average difference of comfort between the old and new proposed kitchen design for the elderly.

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