Redesign of elderly beds as an effort to overcome degenerative diseases using a participatory approach

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ABSTRACT

The utilization of beds among the elderly, especially those with degenerative diseases, presents health and comfort challenges. To address these issues, this research aims to redesign elderly beds using a participatory ergonomics method at Madania Potonoro Nursing Home. By involving the elderly and caregivers in the process, the research findings highlight the need for bed improvements. The proposed design includes additional features such as a folding table, bookshelf, cane holder, assistive standing devices, and a drink holder, based on identified needs. Anthropometric dimensions, including Shoulder Width (SW), Height (H), Popliteal Height (PH), Elbow Height in Sitting (EHS), Elbow Height in Standing (EHS), Seat Depth (SD), and Maximum Grip Diameter (MGD), serve as guidelines for bed design. Analyzing these dimensions at the 5th, 50th, and 95th percentiles, adjustments are made to accommodate additional attributes or features on the bed. The recommended design not only provides optimal comfort and safety for the elderly but also improves their overall quality of life. This research emphasizes the importance of involving users in the design process to ensure solutions align with their needs and preferences.

1. Introduction

Elderly (elderly) is a complex human aging process from a biological, psychological and sociological point of view. The elderly are individuals aged over 60 years who look different from other age groups (Senjaya, 2016). The elderly are those who are in the final stages of their lives (Palupi et al., 2021). In developing countries, the population over the age of 60 is expected to increase to 20% between 2015 and 2050. In various countries, including Indonesia, the number of elderly arrivals will continue to increase. The elderly population in Indonesia is projected to double over the next 20 years in line with increasing life expectancy (Sarima et al., 2017).

According to BPS 2020, elderly people in Indonesia reached 9.92% or around 26.82 million. This signals a transition to an aging population. If the population aged 60 years and over exceeds 10%, an aging population structure will occur. The increase in the number of elderly is caused by development, especially in the health sector (Indrayani & Ronoatmodjo, 2018). Although improving health facilities has the potential to increase Life Expectancy (UHH), this can also cause changes in epidemiology with an increase in degenerative diseases in the elderly (Lestari et al., 2019).

Degenerative diseases are a serious problem for the elderly, influenced by physical weakness and an increase in the incidence of disease with increasing age (Nisak et al., 2018). Types of degenerative diseases involve hypertension, diabetes mellitus, stroke, cancer and Parkinson's (Pramody, 2019). Deterioration of cognitive abilities in the elderly can increase the risk of accidents, even though cognitive factors have no direct influence (Sudiartawan et al., 2020).

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Parkinson's disease, as a type of degenerative disease of the central nervous system, can damage the patient's movements and disrupt the coordination of body movements (Suharti, 2020). Elderly people who suffer from Parkinson's have a high risk of experiencing accidents, especially falls in their environment, due to limited mobility (Sudiartawan et al., 2020).

Some people see nursing homes as a solution to better care for the elderly, reduce loneliness, and increase social interaction (Hakim & Hartati, 2017). However, there are problems in nursing homes, especially for elderly people who suffer from degenerative diseases (Setiyorini et al., 2018). Therefore, it is necessary to adapt nursing home facilities, especially bedrooms, to suit the anthropometric needs of the elderly (Rahmawati et al., 2020). Anthropometry is the measurement of body dimensions related to design and wearer or users (Hidayat, 2017). Basically, every human body size is different, therefore to achieve the goal of an ergonomic product, a medium for measuring all dimensions of the human body is needed. This aims to obtain products that suit the dimensions of the human body and are comfortable to use (Prabowo & Agung, 2019).

The bed facilities currently used generally do not take into account the anthropometric data of the elderly group, and the additional facilities are not tailored to the needs of the elderly. The beds used by the elderly are usually the same beds they have been using since their younger days, or they use standard adult-sized beds available in the market, or they continue using their old single beds. Due to these issues, there is a need for a bed facility design that can meet the needs of the elderly and enable them to be more independent, without relying on the younger generation. (Sarvia et al., 2022).

The design of elderly beds must consider the high level of activity in bed, such as eating and reading (Hidayat, 2017). A participatory ergonomics approach, involving older people in planning, implementing, and evaluating bed designs, could be a solution (Sukapto, 2007). Participatory methods, such as FGDs and direct interviews with the elderly, are expected to produce ergonomic bed designs and meet the needs of the elderly at the Madania Potorono Elderly Home.

This research aims to create a specialized bed for the elderly using participatory ergonomics methods at the Madania Potonoro Nursing Home. The goal is to design a bed with various features that cater to the specific needs of the elderly, involving their active participation and considering the aspects of anthropometry. The expected outcome is to make it easier for the elderly to use the bed, thereby preventing the progression of degenerative diseases that often worsen with age.

2. Methods

2.1 Research Design

The method used is qualitative and the type of data is quantitative by analyzing and seeking conclusions and calculating anthropometric data with the aim of solving problems. There are several ways to collect data, namely:

1. Primary data is direct data collection from the field carried out by interviews, focus group discussions (FGD).
   - Interviews were conducted with 10 elderly people and 2 caregivers with output of complaints and problems the elderly had regarding the beds they used
   - *Focus group discussion*(FGD) was carried out three (3) times with seven participants, 10 elderly people and 3 caregivers, with the output of complaints, wishes, ideas for bed designs, suggestions and evaluation of designs, as well as agreement on the final design.
2. Secondary data is information taken from previous research, books, journals, the internet, and anthropometric data banks that can help the research process.

2.2 Time and Place of Research

This research was conducted at Panti Madania Potonoro, Banguntapan, Yogyakarta.

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2.3 Conceptual Framework

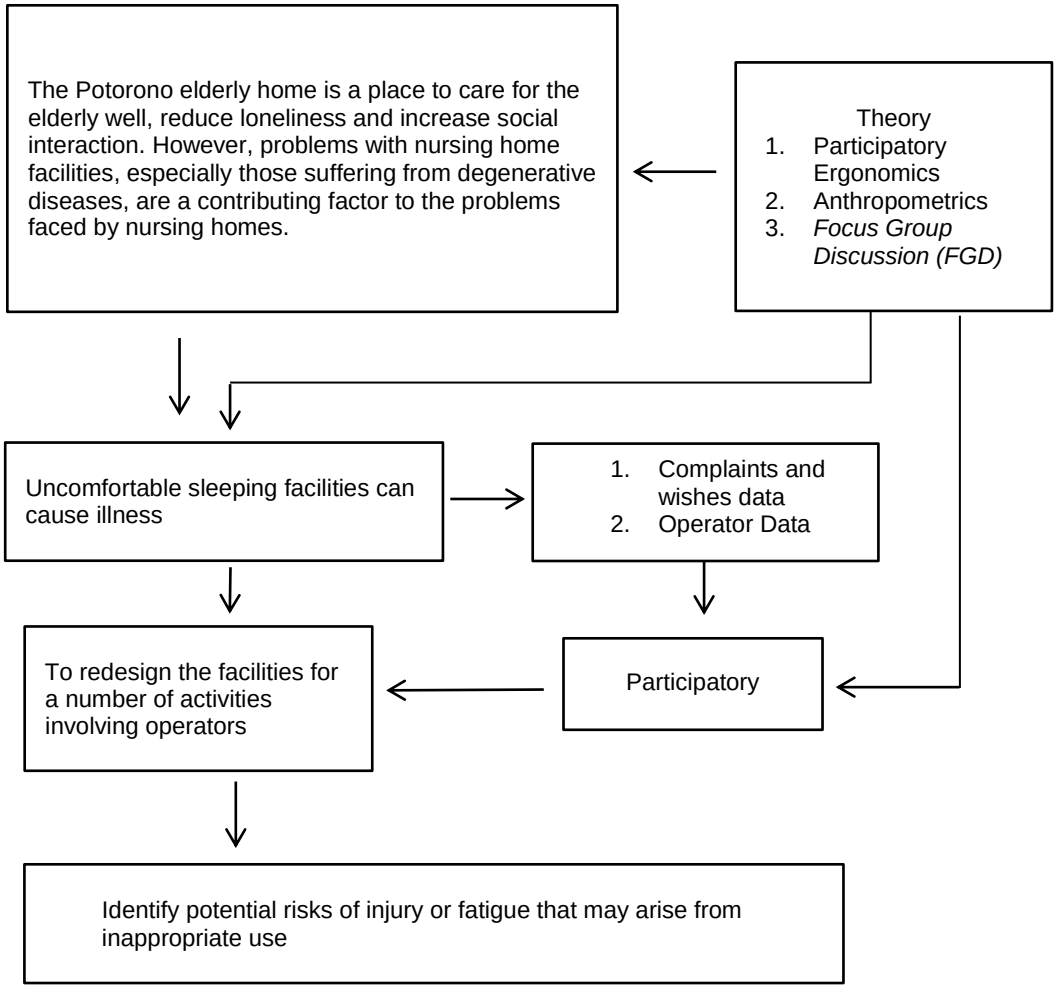

Fig. 1 Research concept framework.

2.4 Data Processing

The data that has been obtained from the results of data collection, will then be processed data to complete the objectives of this research. The steps in data processing are as follows:

a) Participatory Ergonomics

The participatory ergonomics approach is a macro ergonomics method. Participatory is a concept that actively involves stakeholders through involvement activities, one of which is Focus Group Discussion (FGD) to solve problems using an ergonomics approach (Ikasari et al., 2018). Improvement and redesign of products using participatory ergonomics will create appropriate and conducive collaboration and be created in accordance with user wishes (Idkhan et al., 2021). The FGD stages are divided into three stages, namely:

1. Identify existing and appropriate problems and accept proposals for improvement from each party involved,
2. Discusses the design alternatives presented as well as additional suggestions for the design,
3. Discuss the final design and additional proposals if there are additional proposals.

b) Anthropometrics

Anthropometry is a science that is closely related to aspects of human body size. The human body or side of the body is not only a measure of length, but also the weight of a human being. Anthropometry includes methods for measuring and modeling the human body or physical

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dimensions, as well as design implementation techniques (Indrawan et al., 2019). Testing of anthropometric data includes (Sinaga et al., 2021):

1. Normality test
   The aim is to determine the distribution of data in a normally distributed population, whether the data is normal or not. The normality test was carried out using the Kolmogorov-Smirnov test in SPSS with the following hypothesis

   Ho: Significant value > 0.05, then the data is normally distributed

   H1 The significant value is <0.05, then the data is not normally distributed .....(1)

2. Data Sufficiency Test
   Testing with the aim of ensuring that the sample size is objectively met. The formula used in this test is:

$$BKA = \bar{X} + 3\sigma$$
$$BKA = \bar{X} - 3\sigma \quad \text{.....(2)}$$

3. Data Uniformity Test
   The testing process used to measure data is uniform and within the Upper Control Limit (BKA) and Lower Control Limit (BKB). The formula used is:

$$N' = \left[\frac{^{k/s}\sqrt{N\sum X^2 - (\sum X)^2}}{\sum X}\right]^2 \quad \text{.....(3)}$$

4. Percentile
   In the percentage concept, those who are physically large or small are used to limit the size of the user population that will be accommodated by the design. The large percentile reference that is usually used is the 95th percentile, while the small percentile that is usually used is the 5th percentile (Sokhibi, 2017).

where:
N' = The amount of data that should be (real)
N = Number of observations
Xi = Measurement data
s = Degree of accuracy to be used
k = Confidence level
BKA = Upper Control Limit
BKB = Lower Control Limit
$\bar{\bar{X}}$ = Sample Average Value
σ = Standard Deviation

3. Results and Discussion

3.1 Participatory Ergonomics

In participatory ergonomic data, data was collected using interviews with several parties, namely 10 elderly people and 2 caregivers and a focus group discussion (FGD) was carried out with 7 elderly people to determine the main problems in elderly beds. The following is a recapitulation of the complaints and desires of the elderly based on the results of interviews and FGD I:

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Table 1 Recapitulation of complaints and desires of the elderly

No	Complaint	Desire
1	Bed Which too narrow	Widening the bed mattress
2	There is no table to eat	Added a table as a feature
3	There is no place put things away	Added shelves as a feature
4	There is no place to put down the stick	Added cane and crutch holder
5	Requires a large room	The added features are combined in one bed
6	There are no cots	Adding a cot for the mattress

Attributes or features added to the design, based on discussions in interviews and FGD I. Based on complaints, elderly people need a bigger room. However, in Panti Madania's bedroom it was not possible to expand the room, so the initiative was to combine various features into one to save space and space. The folding table in this feature is used because the elderly need a table for eating. This is also because 9 out of 12 elderly people at Panti Madania prefer to eat in bed. Because the table in the bedroom takes up a lot of space, it can be added to one with the bed.

The bookcase in the feature is used to place items. Elderly people have books or glasses which are usually lying around carelessly in the bedroom, so the initiation of making a bookshelf is used to place items such as books or glasses. Then a cane holder was also added to be one with the bed because 6 out of 12 elderly people need a cane to walk. Then the bed in the proposed design will also change size according to the desired width of the mattress.

Elderly people as end users provide input and suggestions as an evaluation of the solutions needed for concept development. Based on the results of FGD II, there is an evaluation of improvements to the proposed design of attributes or features and elderly beds, which are as in Table 2 follows:

Table 2 Evaluation and Bed Design Solutions

No	Evaluation	Solution
1	Inflexible stick holder	Changed the shape of the cane holder so that it can be used for crutches as well as a cane
2	There is a table Eatthere is no place to put a drink yet	Add feature placedrink
3	Wake-up aids	Added tool features get up

The attributes or features of the folding table and bookshelf have not changed. However, based on evaluation of the stick holder, the previous design was not flexible because it could only be used by a stick. Some elderly people use crutches for daily mobility, so the cane holder attached to the bed is changed to be more flexible. The cane holder in the proposed design can be used to place crutches and canes.

Based on the evaluation, the elderly need a wake-up device which is used to help the elderly from a sleeping position to a sitting position. The assumption in the proposed design is that the wall is on the left side of the body so that the cane holder and folding table are on the right side and the building aids are on the left side next to the wall. This is also because waking aids for the elderly are only used to help them from sleeping to sitting. Then the next feature is a drinking area. Based on the evaluation, the bed has a folding table but there is no place to put a drink. So a drinking place feature was added, to complete the evaluation from the elderly.

3.2 Anthropometric Measurements

The anthropometric data obtained can be used to design or adapt workplaces, social care centres or interior design. Body dimension data was collected through data collection from the Work System Design and Ergonomics Laboratory Data Bank. This data will be input for each design attribute. The following are the dimensions needed for the proposed bed design process:

a. Shoulder Side Width (LB)
b. Height (TB)
c. Popliteal Height (TPO)
d. Sitting Position Elbow Height (TSD)
e. Elbow Height in Standing Position (TSB)

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f. Height in Sitting Position (TD)
g. Sitting Position Elbow Height (TSD)
h. Elbow Height in Standing Position (TSB)
i. Height in Sitting Position (TD)

The following is demographic and dimensional data from operators consisting of several body parts that will be used in product design in Table 3.

Table 3 Demographic data

No	Operator	Age	Type Sex	Dimensions (cm)					
				LB	TB	TPO	TSD	TSB	TD
1	Operator 1	70	Woman	37	118	36	17	75.5	63
2	Operator 2	75	Man	48	112	40	20	103	81
3	Operator 3	81	Woman	35.6	115	34	13	74	64
4	Operator 4	75	Woman	40	121.7	40	18	97	77
5	Operator 5	70	Woman	29	120	36	16	87	69
6	Operator 6	70	Man	40.5	113	36.5	23	94	84
7	Operator 7	68	Man	40.5	113	36.5	23	94	84
8	Operator 8	72	Woman	33	118	35	14	75	62
9	Operator 9	65	Man	30	120.7	31	19	70	68
10	Operator 10	60	Man	37	115	43	20	88	80
11	Operator 11	70	Man	40	118	41	18	91	74
12	Operator 12	71	Woman	37	122	33	24	91	80
13	Operator 13	75	Woman	42	120	39	22	94	75
14	Operator 14	80	Man	40	121.5	41	29	95	78
15	Operator 15	81	Woman	38.5	117	40	26	94.5	77
16	Operator 16	76	Man	30	121	31	17	77	68
17	Operator 17	77	Woman	32	120	30	18	76	66
18	Operator 18	73	Man	38	112	42	23	65	83
19	Operator 19	70	Man	37	120	44	25	103	83
20	Operator 20	70	Man	37	119	47	25	78	76
21	Operator 21	73	Man	48	121	35.7	14	81	68

After the data is collected, a normality test is carried out. The data used for the normality test is data consisting of body dimensions. The confidence level used is 95% or α = 0.05. The following are the results of the normality test using SPSS software:

Table 4 Normality test results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LB	.103	30	.200*	.966	30	.437
TB	.158	30	.053	.930	30	.050
TPO	.118	30	.200*	.976	30	.720
TSD	.105	30	.200*	.969	30	.521
TSB	.161	30	.046	.934	30	.061
TD	.125	30	.200*	.953	30	.207

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

From the results of normality tests of anthropometric dimensional data that have been carried out, it was found that the significance of each dimension was > 0.05. So it is concluded that H0 is accepted and H1 is rejected. If H0 is accepted, the population is normally distributed and the sample taken can be used to represent the existing population. This data can be used for further calculations, namely percentiles. Percentile calculations are carried out to determine the size of the product design based on the population size that has been obtained.

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Table 5 Percentile Value Results

Dimensions	P5	P50	P95	Elementary School
LB	29.34	37.84	46.33	5.17
TB	113.20	118.41	123.63	3.17
TPO	30.38	38.47	46.57	4.92
TSD	13.26	20.32	27.37	4.29
TSB	65.55	86.99	108.42	13.03
TD	62.60	74.80	87.00	7.42
DGMAK	27.9	37.4	46.9	5.8
JKTD	47.25	65.49	83.73	11.09

3.3 Elderly Bed Design Sizes

The anthropometric data in the table above is then used to design the size of the elderly bed attributes. The data is then sorted into the 5th, 50th and 95th percentiles according to the attributes of the bed to be used. The following is data on the size attributes of elderly beds:

Table 6 Design Specifications

No	Items	Measurement	Size Anthropometrics (cm)	Rounding (cm)
1	Mattress	Mattress Length	198.63	200
		Mattress Width	121.33	120
		Distance from Mattress to Lower	71.57	72
2	Cot (Bed)	Long Bed	203.63	204
		Place Width Sleep	131.33	130
		Backrest Height Cot	87	87
		Foot Height Cot	-	4
3	Stick Holder	Location Distance Stick Down	86.99	87
		Diameter Crutch Place	-	2
		Stick Holder Diameter (middle)	-	2
		Long Stick Holder	-	13
4	Folding Table	Foot Height Table	20.32	20
		Table Length	51.33	51
		Table Width	47.25	47
		Foot Diameter Table	-	15
5	Bookshelf	Distance from bookshelf to bottom of backrest Cot	13.26	13
		Shelf Length Book	-	50
		Shelf Width Book	-	40
6	Building Aids	Tool Diameter Help Wake Up	37.4	37
		Tool Height Help Wake Up	23.36	23
		Tool Length Help Wake Up	47.25	47.25
7	Drinking Places	Diameter Drinking places	-	25
		Place Height Drink	-	10

These dimensions are then used as the basis for calculating measurements for each part of the bed and the attributes in the proposed design. The following Fig. 2 until Fig. 4 are display a comparison between the old bed design and the proposed bed design according to size.

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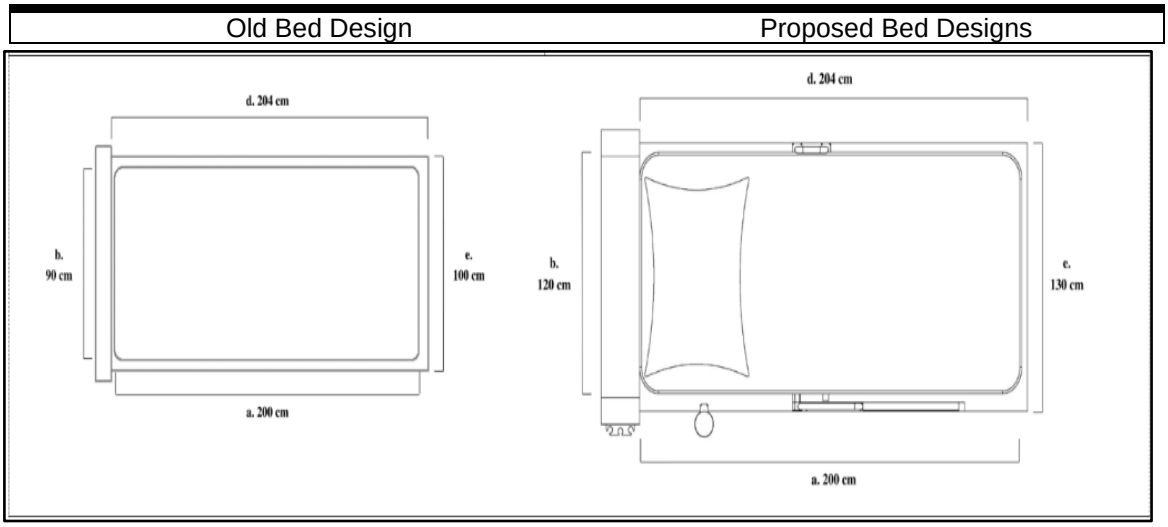

Fig. 2 Top view comparison of bed design sizes.

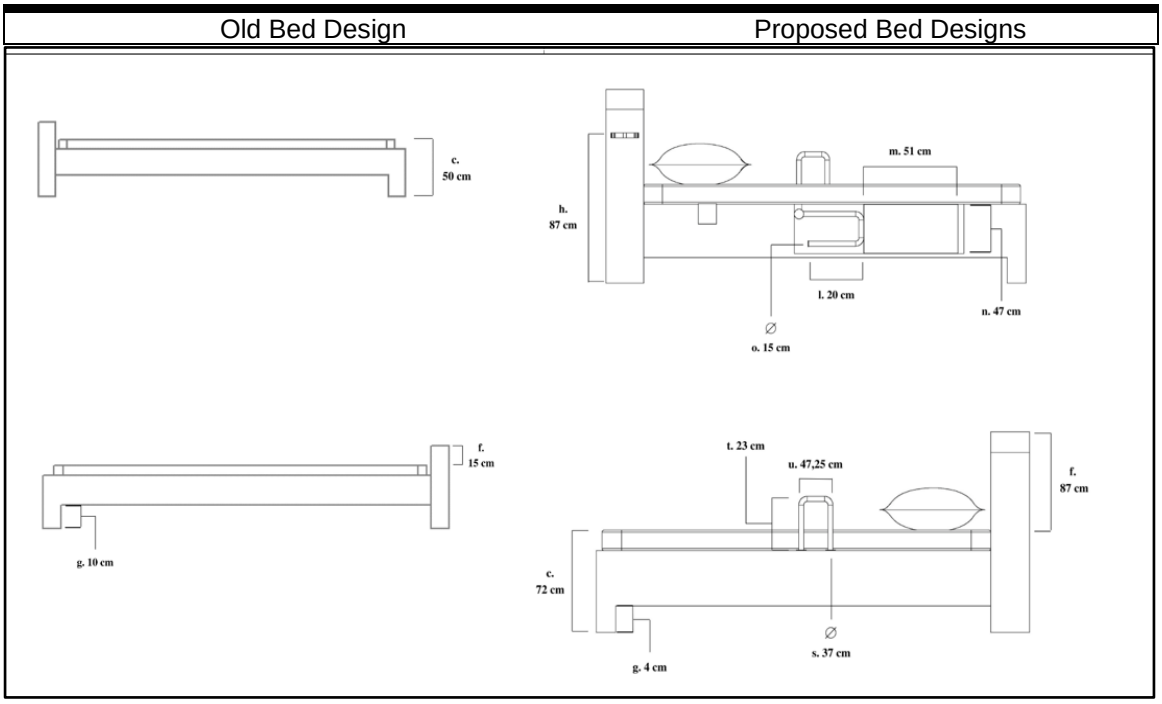

Fig. 3 Side view comparison of bed design sizes.

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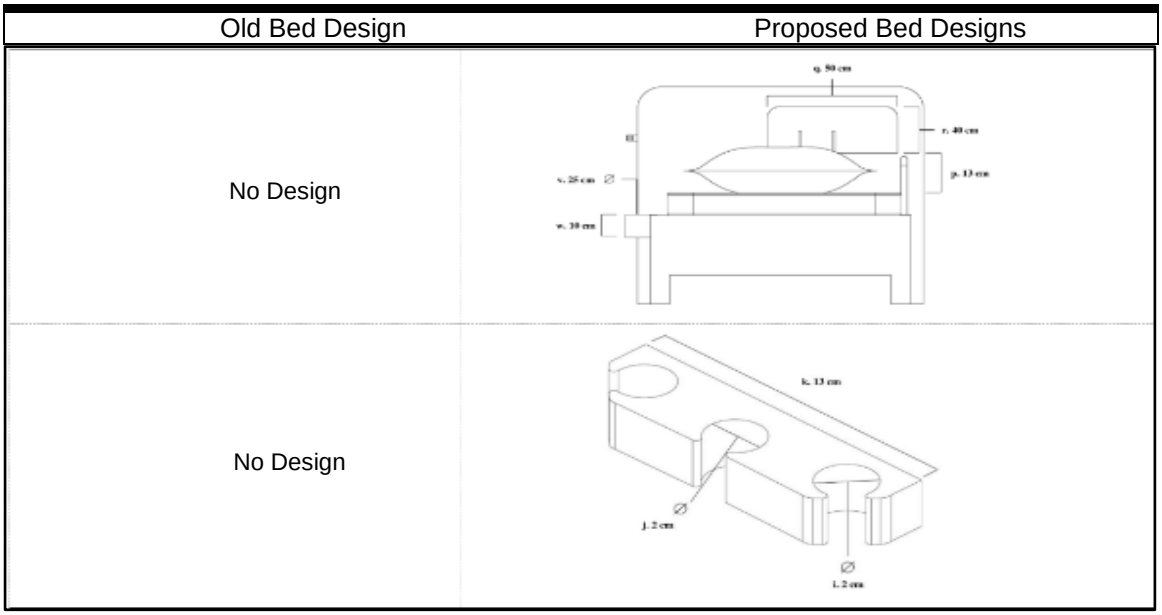

Fig. 4 Front view comparison of bed design and additional products.

Based on the above Figure 2,3,4, there are several functions and benefits of the design of old and new beds, considering the participatory method to facilitate the elderly in their activities on the bed. In a previous study conducted (Hidayat, 2017), designing beds for the elderly took into consideration activities such as reading and adjustable backrest according to their needs. Another study by (Sarvia et al., 2022) suggested that beds for the elderly should include panic buttons, motion sensor lights, UV boxes, and other convenient features in one design. Ensuring comfort and safety for both the elderly and caregivers is crucial, and the most important aspect of this bed design is to meet the customers' desires. By considering previous research and incorporating feedback from Madania Potonoro nursing home, the design was evaluated and considered based on degenerative diseases that may affect the elderly. The results of the design can be seen in Figure 5 below.

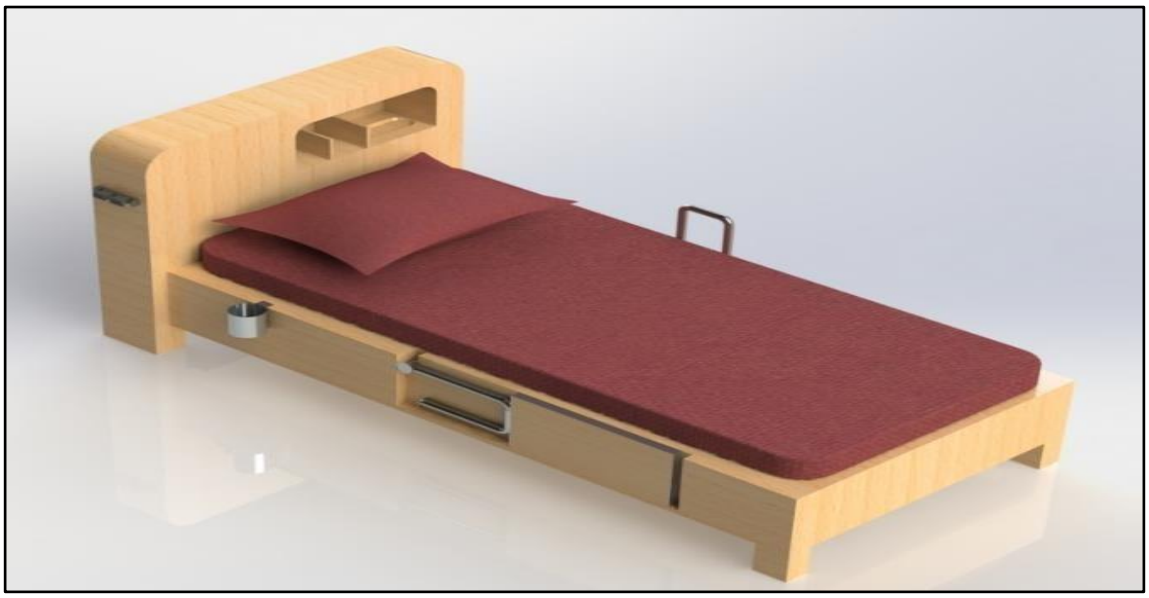

Fig. 5 Final design

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4. Conclusion

The objective of this study is to design elderly beds with various features according to their needs, using participatory ergonomics and anthropometric approaches. The research aimed to create customized beds based on active participation. The findings concluded that proposed improvements for elderly beds at Panti Madania Potonoro include additional features such as a folding table, bookshelf, cane holder, assistive device, and drink holder. Anthropometric dimensions used in the bed design encompass Shoulder Width (SW), Height (H), Popliteal Height (PH), Sitting Elbow Height (SEH), Standing Elbow Height (STEH), Sitting Depth (SD), and Maximum Grip Diameter (MGD). By considering the 5th, 50th, and 95th percentiles of each dimension, bed attributes and features can be adapted. The research aims to contribute to enhancing elderly comfort and quality of life through the design of beds that cater to their specific needs. Based on the conclusions and direct observations, the researchers suggest further development of elderly bed designs. Designs that enhance elderly satisfaction indicate that changes in anthropometric measurements affect their specific needs. With proper design and ergonomics, the elderly can live more independently and improve their quality of life. The research evaluation involves questionnaires or focus group discussions with the elderly, caregivers, and their children. Additionally, future studies should consider the cost and materials used.

References

Hakim, L., & Hartati, N. (2017). Sources of Happiness for the Elderly Seen from Inside and Outside the Nursing Home. Journal of RAP (Actual Research in Psychology, Padang State University), 5(1), 32-42.

Hidayat, R. (2017). Redesign of Beds for the Elderly Using the Kansei Engineering Method and Gerontology Approach. Journal of Industrial Engineering, 7(1).

Idkhan, AM, Baharuddin, FR, & Palerangi, AM (2021). Ergonomic Analysis. Ikasari, N., Lantara, D., Chairany, N., & Bella, A. (2018). Tool Application Analysis

Indrawan, S., Muchlis, M., & Yudiarti, D. (2019). Design of Facilities for Physical Activities for the Elderly in the Elderly Park Based on Ergonomic Aspects. eProceedings of Art & Design, 6(2).

Indrayani, I., & Ronoatmodjo, S. (2018). Factors Associated with the Quality of Life of the Elderly in Cipasung Village, Kuningan Regency, 2017. Journal of Reproductive Health, 9(1), 69-78.

Lestari, NKY, Lestari, TR, Wati, NMN, & Jayanti, DMAD (2019, December). Increasing Community Independence Through Early Detection with Health Education and Screening to Prevent Complications

Nisak, R., Maimunah, S., & Admadi, T. (2018). Community Empowerment Efforts Through Early Detection and Control of Degenerative Diseases in the Elderly in Dsn. Karang Pucang, Ds. Ngancar, District. Pitu Pitu Community Health Center Working Area, Ngawi Regency: Community Empowerment Efforts Through Early Detection and Degenerative Disease Control In Elderly In Dsn. Karang Pucang, etc. Ngancar, District. Pitu Pitu Health Center Working Area Ngawi District. Journal of Health Community Service, 4(2), 59-63.

Palupi, DLM, Widiastuti, A., & Variska, R. (2021, June). The Effect of Ergonomic Exercise on Improving the Sleep Quality of the Elderly. In National Health Information Seminar (SIKesNas) (pp. 371-381).

Pramody, R. (2019). Application of the Forward Chaining Method in an Expert System to Diagnose Degenerative Diseases in the Elderly on a Web-Based Basis. JATI (Information Engineering Student Journal), 3(1), 269-276.

Rahmawati, N., Widyanti, A., & Jiang, BC (2020). Daily Life, Anthropometry, And Bedroom Design of Indonesian Elderly. Journal of Accessibility and Design for All, 10(1), 161-179.

Sarima, A., Abdullah, N., & Hamiyati, H. (2017). The Relationship between Family Social Support and Elderly Productivity. JKKP (Journal of Family Welfare and Education), 4(1), 33-38.

Sarvia, E., Wianto, E., Halim, E. A., & Natalia, E. (2022). Perancangan Desain Tempat Tidur bagi Lansia Menggunakan Penerapan Metode KANO dan QFD. *Jurnal Rekayasa Sistem Industri*, *11*(2), 167-180.

Please cite this article as: Dahlan et al. (2024). Redesign of elderly beds as an effort to overcome degenerative diseases using a participatory approach. *Operations Excellence: Journal of Applied Industrial Engineering*, 16(1), 45-55. doi:http://dx.doi.org/10.22441/oe.2024.v16.i1.101

Senjaya, AA (2016). Elderly teeth. Husada Scale Journal: The Journal of Health, 13(1).

Setiyorini, E., Kep, M., Wulandari, NA, & Kep, M. (2018). Nursing Care for Elderly People with Degenerative Diseases (Vol. 1). Media Nusa Creative (MNC Publishing).

Sinaga, HH, Siboro, BAH, & Marbun, CE (2021). Design of Tables and Chairs Product Design and Innovation Laboratory Tutorial Using the 12 Principles of Ergonomics Method and Anthropometric Approach. Journal of Industrial Engineering Systems, 23(1), 34-45.

Sokhibi, A. (2017). Ergonomic Chair Design to Improve Working Position in the Jenang Kudus Packaging Process. Journal of Industrial Systems Engineering, 3(1), 61-72.

Sudiartawan, IW, Yanti, NLPE, & Wijaya, ANTW (2020). Analysis of Risk Factors that Cause Falls in the Elderly. Widya Husada Nursing Journal, 4(3), 95-102.

Suharti, S. (2020). Pathophysiology of Cognitive Decline in Parkinson's Disease. UMI Medical Journal, 5(1), 1-11.

Sukapto, P. (2007), The Role of Participatory Ergonomics in Technology Transfer and Its Implications for Work Accidents. Bandung: Dissertation, Doctor of Economics, Parahyangan Catholic University

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