


Confirmatory Analysis And AHP In Measuring Community Welfare Indicators

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Article Info	ABSTRACT
Keywords: Confirmatory Analysis, AHP, Welfare Community,, City, CFA	The objective of this study was to measure the level of community welfare using a Confirmatory analysis and the Analytic Hierarchy Process (AHP). The research focuses on key welfare indicators, including material well-being, safety, and self-actualization. The study was conducted in the regions of Padangsidempuan Utara and Padangsidempuan Selatan with a sample of 165 households. Data were collected through questionnaires and interviews and analyzed using the confirmatory factor analysis (CFA) method to validate the welfare indicators. The results indicate that the main factors contributing to community welfare are housing, health, income, and savings. Housing emerged as the most influential factor, followed by health and income. The AHP method further emphasized that the quality of housing materials, particularly flooring, plays a significant role in determining welfare. These findings suggest that targeted policies addressing housing quality and healthcare can significantly improve community welfare.
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INTRODUCTION

Community welfare is primarily determined by the budgetary capacity of each individual. This capacity is attained at a certain income level, making material income one of the key determinants of a person's welfare (Yulhendri & Susanti, 2017). In measuring welfare, several scholars, particularly in the field of economic research, have proposed two main approaches: the utility approach and the marginality approach. Welfare indicators are expressed in terms of affection, service, and money (Rettig & Margaret, 1983). Based on Maslow's hierarchy of needs (Maslow & Abraham, 1954; Yulhendri & Susanti, 2017), the categories of human needs are: 1) physical needs such as shelter, hunger, thirst, sleep, oxygen, and other bodily needs; 2) safety needs such as security, protection, and health; 3) social needs including the need for belonging, affection, and friendship; 4) esteem needs, which encompass respect; and 5) self-actualization needs such as education. Additionally, from the government approach, welfare levels can be measured by family savings and knowledge improvement (Cahyat, 2004).

The dominant factors determining community welfare can be identified through factor loadings derived from confirmatory analysis. Confirmatory factor analysis is a multivariate method used to test the multidimensionality of a theoretical construct and is also referred to

as a validity test. This analysis tests whether the welfare indicators are valid determinants of community welfare based on the community's assessment (Solechan & Hakim, 2014). Subsequently, to create a decision-making model, the AHP method can be applied. AHP is a method that incorporates hierarchical analysis in decision-making systems. The variables analyzed are given priority values, and then criteria and alternatives are evaluated through pairwise comparisons (Kaluku & Pakaya, 2020). The AHP decision-making model was developed by Thomas L. Saaty to solve complex hierarchical problems (Saaty, 2016). The hierarchy in the AHP model is structured based on levels of each indicator and alternative, with the first level representing the problem's goal, followed by the second level comprising criteria and sub-criteria, and the last level representing the alternatives.

The purpose of this study is to measure the level of community welfare using a confirmatory analysis approach and the AHP method. Through this combination, the factors influencing community welfare are identified, providing targeted policy recommendations for urban development.

METHODS

This research is a quantitative study, with the population consisting of household heads who are employed or unemployed (traders/unemployed) aged over 40 years, residing in North Padangsidempuan and South Padangsidempuan. The sample size in this study is 165 respondents, with 100 cases meeting the criteria for analysis.

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was conducted using Lisrell software version 8.3 for Windows. CFA is an analytical tool used to analyze the relationship patterns and outputs from the hypotheses. Model fit is evaluated based on the GFI value, chi-square value, and a higher p-value indicates better results. The variables analyzed include material well-being, safety, affection and love, and self-actualization. The criteria for validity are a standardized loading factor >1.96 and a standardized loading factor >0.50 (Yulhendri & Susanti, 2017). Data collection was carried out by distributing questionnaires to respondents, while interviews were conducted for respondents who were unable to read and write.

Analytic Hierarchy Process (AHP)

The AHP analysis was performed by following the workflow from Kaluku & Pakaya (2020) and Saaty's method (2016). The AHP method involves the following steps::

1. Identifying the problem and solution.
2. Determining the priority of elements (pairwise comparison matrices are assigned values from 1 to 9 as per the established criteria)
3. Calculating the weight of each element
4. Calculating the consistency index
5. $CI : (\lambda \text{ maks}-n) / (n-1)$
6. Calculating the consistency ratio

CR : CI/IR

Note : CR = Consistency ratio

CI = Consistency Index

IR = Index Random Consistency

If the CR value obtained from the pairwise comparison matrix is less than 0.1, the consistency is acceptable; if greater than 0.1, recalculation is required.

RESULTS AND DISCUSSION

Dominant Welfare Factors

The welfare variable is constructed from five measurable variables: material well-being, safety, affection and love, esteem, and self-actualization. However, among these five variables, the reliable indicators based on their loading factors (≤ 0.05) are material well-being, safety, and self-actualization. Therefore, the primary focus of this study is on welfare, with the criteria for determining the validity of the measured variables being a standardized loading factor > 1.96 and a standardized loading factor > 0.50 . Based on Table 1, the Goodness of Fit (GOF) index shows that three variables are in the good category, with a Chi-square value of 11.75 ($P = 0.038$), GFI 0.97 > 0.90 , CFI 0.99 > 0.090 , and IFI 0.99 > 0.90 . Additionally, the loading factor values for each measured variable are analyzed against the latent welfare variable.

Table 1. Evaluation of Goodness of Fit Index Criteria for Welfare Variables

Goodness of Fit Index	Cut off value	Output	Criteria
χ^2 (Chi-Square)	Kecil	10.55	Good
Probabilitas	≥ 0.05	0.040	Not good
AGFI (Adjusted Goodness of Index)	≥ 0.90	0.93	Good
GFI (goodness of fit)	≥ 0.90	0.96	Good
NNFI (Non-normed fit index)	≥ 0.90	0.99	Good
IFI (Incremental fit index)	≥ 0.90	0.98	Good
RMSE	≤ 0.08	0.095	Not good

The t-value of the loading factor is greater than the critical value of > 1.96 , indicating the reliability of the welfare measurement. Based on Table 2, the variables of affection and love, as well as esteem, do not meet the reliability measurement criteria. Their loading factor values are smaller than the critical value (1.96) and the loading factors (0.50), specifically -15.20 (affection and love) and -12.30 (esteem), which are below the threshold for the consistency of latent construct measurements. Therefore, these variables can be removed from the modeling process during data analysis.

Table 2. Loading Factor for Measuring Welfare Level Variables

Variable	Loading factor	t-value	Interpretation
Material	0.18	2.16	> 1.96 significant
Safety	0.84	13.24	> 1.96 significant
Affection	-1.20	-15.20	< 1.96 not acceptable
Esteem	-1.00	-12.30	< 1.96 not acceptable
Self-actualization	0.78	11.16	> 1.96 significant

Based on the confirmation results, the variables of affection and esteem do not meet the criteria to be considered as measures of welfare level. Therefore, these variables were removed from further analysis. Subsequently, to determine whether the CFA variables have

good reliability, Construct Reliability (CR) must be calculated following the method of Yulhendri & Susanti (2017). If the CR value is ≥ 0.70 the model's reliability is considered good, and the variables can be deemed reliable. Based on the calculations, the CR value = $0.80 > 0.70$, indicating that the variables are reliable.

Analytic Hierarchy Process (AHP)

Based on the results of the confirmatory analysis, the reliable welfare variables are material well-being, safety, and self-actualization. Therefore, in the AHP analysis, the welfare factors considered are the elements of these indicators (material well-being, safety, and self-actualization), which include health, income, education, housing, and savings, with a sample size of 10 respondents.

Calculation of the Average Weighting for Each Element and Factor

In this group AHP calculation, the geometric mean of the ratings provided by all group members (10 respondents) is used. This geometric mean is considered the result of the group evaluation (Table 3).

Table 3. Normalization Matrix and Row Averages for Level 2 Elements

Element	Health	Income	Education	Housing	Savings	Weight
Health	0.2588	0.2794	0.2746	0.3141	0.1345	0.2523
Income	0.2179	0.2352	0.1074	0.3245	0.2650	0.2300
Education	0.0900	0.2092	0.0955	0.0708	0.0556	0.1043
Housing	0.1820	0.1601	0.2982	0.2209	0.4144	0.2552
Savings	0.2510	0.1157	0.2240	0.0695	0.1304	0.1582
Total	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

Table 4. Calculation of Level 2 Element Weights

Element	Weight	Percentage	Ranking
Health	0.2523	25.23%	II
Income	0.2300	23.00%	III
Education	0.1043	10.43%	V
Housing	0.2552	25.52%	I
Savings	0.1582	15.82%	IV
Total	1,0000	100%	

Based on Tables 3 and 4, out of the five welfare indicators for the people of Padangsidimpuan, the Housing element ranks the highest (25.52%), followed by Health (25.23%), Income (23%), Savings (15.82%), and Education (10.43%). Furthermore, within the Housing element itself, the people of Padangsidimpuan generally prioritize the main flooring materials, followed by the roof and walls (Tables 5 and 6).

Table 5. Weight Calculation for Level 3 Housing Element

Alternatif	Bahan Langsung Utama Lantai	Bahan Langsung Utama Atap	Bahan Langsung Utama Dinding	Bobot
Main Flooring Material	0.455846366	0.421658346	0.539403722	0.4723
Main Roofing Material	0.410416962	0.379636101	0.302345463	0.3641

Alternatif	Bahan Langsung Utama Lantai	Bahan Langsung Utama Atap	Bahan Langsung Utama Dinding	Bobot
Main Wall Material	0.133736673	0.198705553	0.158250815	0.1636

Table 6. Weight Calculation for Level 3 Housing Elements

Alternative	Weight	Ranking
Main Flooring Material	0.4723	I
Main Roofing Material	0.3641	II
Main Wall Material	0.1636	III

The main flooring materials hold the highest weight of 0.4723, followed by the main roofing materials (0.3641) and the main wall materials (0.1636).

Table 7. Normalization Matrix and Row Averages for Level 3 Health Elements

Alternative	Nutrition	Mobility	Mortality	Maternal Motility	Weight
Nutrition	0.3001874	0.31918740	0.323559692	0.240986621	0.2959
Mobility	0.3181074	0.33824153	0.322893223	0.397742555	0.3442
Mortality	0.1836552	0.20736385	0.197954353	0.202278947	0.1978
Maternal Mortiliy	0.1980498	0.13520719	0.155592732	0.158991877	0.1619

Sumber: Pengolahan Data

Table 8. Weight Calculation for Level 3 Health Elements

Alternative	Weight	Ranking
Nutrition	0.2959	II
Mobility	0.3442	I
Mortality	0.1978	III
Maternal Mortiliy	0.1619	IV

For the Health element (Tables 7 and 8), Mobility holds the highest weight (0.3442), followed by Nutrition (0.2959), Mortality (0.1978), and Maternal Mortality (0.1619). For the Income element, per capita calorie consumption has the highest weight with a percentage of 39.47%, followed by per capita income (33.93%) and Gross National Product (26.60%) (Table 9).

Table 9. Weight Calculation for Level 3 Income Elements

Alternative	Weight	Percentage	Ranking
Income per Capita	0.3393	33.93%	II
Gross National Product	0.2660	26.60%	III
Calori Consumption per Capita	0.3947	39.47%	I

Based on Table 10, the savings element, specifically those who never save (0.4015), significantly impacts welfare, followed by those who have saved (0.3067) and those who save regularly (0.2918). The percentage of those who never save is 40.15%, those who have saved is 30.67%, and those who save regularly is 29.18% (Table 11).

Table 10. Normalization Matrix and Row Averages for Level 3 Savings Elements

Element	Never Saved	Have Saved	Regular Saved	Weight
Never Saved	0.4015	0.3982	0.4049	0.4015
Have Saved	0.3095	0.307	0.3036	0.3067
Regular Saving	0.2891	0.2948	0.2915	0.2918
Total	1.0000	1.0000	1.0000	1.0000

Tabel 11. Weight Calculation for Level 3 Savings Elements

Alternative	Weight	Percentage	Ranking
Never Saved	0.4015	40.15%	I
Have Saved	0.3067	30.67%	II
Regular Saving	0.2918	29.18%	III

For the Education element, semi-formal, formal, and non-formal education hold weights of 0.3406, 0.3387, and 0.3206 respectively (Table 12). Thus, semi-formal education ranks first in determining welfare, followed by formal and non-formal education (Table 13).

Table 12. Normalization Matrix and Row Averages for Level 3 Education Elements

Element	Non-formal	Semi formal	Formal	Weight
Non-Formal	0.315210	0.395420	0.251192	0.3206
Semi Formal	0.268350	0.336637	0.416946	0.3406
Formal	0.416439	0.267941	0.331861	0.3387

Table 13. Weight Calculation for Level 3 Education Elements

Alternative	Weight	Ranking
Non Formal	0.320608	III
Semi Formal	0.340645	I
Formal	0.338747	II

Calculation of Total Weights

After all the weight values for each level are obtained, the alternative welfare level with the highest weight or percentage is determined. The total weight can be calculated by summing the priority weights at level 4 for each welfare measure to produce a total score representing the welfare level. The results of the alternative weight calculation can be seen in Table 14. An example of the total weight calculation is as follows:

$$\begin{aligned} \text{Total Welfare Weight} &= 0,0368 + 0,0280 + 0,0287 + 0,0150 + 0,0368 + 0,0208 + \\ &0,0195 + 0,0100 + 0,0107 + 0,0076 + 0,0411 + 0,0438 + 0,0153 + 0,0365 + 0,0156 + \\ &0,0229 \\ &= 0,3915 \end{aligned}$$

According to Table 14, it shows that the welfare of the people of Padangsidempuan is classified as high at 40.71%, moderate at 20.14%, and low at 39.15%.

Table 14. Total Weight Calculation for Welfare Levels

Welfare Level	Weight	Percentage	Ranking
Low	0.3915	39.15%	II

Welfare Level	Weight	Percentage	Ranking
Medium	0.2014	20.14%	III
High	0.4071	40.71%	I

Hierarchy Consistency Calculation

After performing the consistency calculations for each matrix, it is also necessary to test whether the hierarchy constructed is consistent. The total CI of a hierarchy is obtained by weighting each CI with the priority elements associated with the factors being compared, and then summing all the results. The basis for testing the consistency of a hierarchy level is to determine the consistency index results and Eigen vector from a pairwise comparison matrix at a particular hierarchy level. According to Table 15, all elements within the hierarchy were consistently answered by respondents.

Table 15. Hierarchy Consistency Calculation Results

Element	CRH
Nutrition	0.0206
Mobility	0.0622
Mortality	0.0341
Maternal Mortality	0.0591
Income per capita	0.0165
Gross National Product	0.0218
Calorie Consumption per Capita	0.0010
Non formal education	0.0129
Semi formal education	0.0129
Formal education	0.0010
Main Flooring Material	0.0218
Main Roofing Material	0.0218
Main Wall material	0.0591
Never Saved	0.0341
Have Saved	0.0486
Regular Saving	0.0184

Validity Test

The validity test for the welfare measure range using manual calculations is shown in Table 16. The r table value for $N = 20$ with degrees of freedom $df = N - 2 = 18$ is 0.4440, obtained from the Pearson product-moment value for $\alpha = 0.05$. Since the r calculated value $>$ r table, the perception data on product suitability over time is considered valid. Thus, the data results can be seen in Table 16.

Table 16. Validity Test

No	Atribute	rvalue	rtable	explanation
1	Nutrition	0,4738	0,444	Valid
2	Mobility	0,5577	0,444	Valid
3	Mortality	0,5289	0,444	Valid
4	Maternal Mortality	0,5512	0,444	Valid
5	Income per capita	0,6068	0,444	Valid
6	Gross National Product	0,5711	0,444	Valid

No	Atribute	rvalue	rtable	explanation
7	Calorie Consumption per Capita	0,4667	0,444	Valid
8	Non formal education	0,5959	0,444	Valid
9	Semi formal education	0,7453	0,444	Valid
10	Formal education	0,4994	0,444	Valid
11	Main Flooring Material	0,4949	0,444	Valid
12	Main Roofing Material	0,6749	0,444	Valid
13	Main Wall material	0,6228	0,444	Valid
14	Never Saved	0,6088	0,444	Valid
15	Have Saved	0,6472	0,444	Valid
16	Regular Saving	0,4665	0,444	Valid

Through this research, it was found that the order of welfare indicators based on the people of Padangsidimpuan is Housing, Health, Income, Savings, and Education. Research on happiness, welfare, and quality of life acknowledges the various components of happiness (Lee & Kawachi, 2019). Oishi et al. (Oishi et al., 2013) analyzed the definition of happiness in thirty countries and found that the meaning of happiness varies according to culture and over time. The relational welfare approach adopts the promotion of health and well-being for all as its goal (Von Heimbürg & Ness, 2021), and thus inequality becomes a serious barrier (Lous & Graafland, 2022). The 2020 World Social Report (United Nations Department of Economic and Social Affairs) shows that income inequality has increased in most developed countries and some middle-income countries (including China and India) (Kim & Jeong, 2024). This inequality—both real and perceived—has fueled anger and the rise of populism globally (Cramer, 2016; Rodríguez-Pose, 2018).

In psychology, the focus is on the validity and stability of the concept of well-being itself, addressing the challenge of concretely measuring and evaluating this abstract concept. On the other hand, economics approaches well-being as an alternative to utility, using quantitative analysis to examine the relationship between capital and well-being. These scholarly efforts illuminate the multifaceted nature of welfare research (Yamaguchi & Oshima, 2024).

CONCLUSION

The results of this study showed that the importance of specific factors in determining community welfare in Padangsidimpuan. The confirmatory factor analysis and AHP methods demonstrated that housing quality, particularly flooring materials, showed the highest significance, followed by health and income. These elements are crucial in shaping the community's perception of welfare. Based on the results, it is recommended that policy interventions prioritize improving housing conditions and access to healthcare services to enhance overall community well-being. Furthermore, increasing opportunities for income generation and savings will also contribute to elevating the community's welfare standards.

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