The selection of Calcium Milk Products that are appropriate for advanced age using PROMETHEE II Algorithm

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Abstract. The selection of Calcium Dairy Products that are suitable for old age uses the PROMETHEE II Algorithm. This study aims to recommend calcium milk products that are appropriate for elderly people based on consumer selection. This research was conducted in Simalungun district using interview techniques, observation and questionnaires to 350 elderly respondents randomly. This study also uses a quantitative data approach, which is testing four calcium milk products (alternatives) that are considered appropriate for use in old age. The four dairy products are widely used for the elderly, namely: Anlene Gold (A1), Entrasol (A2), Prolansia (A3) and Appeton 60+ (A4). The assessment criteria used in the selection of calcium milk recommendations appropriate for old age are: price (C1), content (C2), side effects (C3) and taste variants (A4). The solution used is to use a decision support system with PROMETHEE II algorithm. The results of PROMETHEE II calculation show that Anlene (A1) is obtained as the first recommendation of the right calcium milk with a value (net flow 0.5) and Appeton 60+ (A4) as the second recommendation with a value (net flow 0.484).

1. Introduction

Milk is an almost perfect natural food. Most nutrients are in milk such as protein, calcium, phosphorus, vitamin A, and vitamin B1. Milk is the best source of calcium, because high calcium levels and lactose in milk help the digestive tract\textsuperscript{[1]}. Fresh milk can be processed into various products that are popular and have a relatively long shelf life. Examples of processed products in the milk processing industry such as homogenized milk, skim milk and cream, butter, sweetened condensed milk, powdered milk, yogurt, sterilized milk, cheese, ice cream, caramel or confectionery, dodol milk, tofu milk and milk crackers\textsuperscript{[2]}. Elderly is an aging process with increasing age of an individual which is characterized by a decrease in the function of organs such as the brain, heart, liver and kidneys and an increase in the loss of the body's active tissue in the form of body muscles. Decreasing the function of organs is a result of the reduction in the number and ability of the body's cells, so that the ability of the body's tissues to function normally disappears, so it cannot survive infection and repair the damage suffered. Astawan and Wahyuni (1988) stated that common changes experienced by the elderly such as (1) decreased fluid in the body, (2) increased fat levels in the body, (3) increased lime levels in the brain and blood vessels which resulted in decreased tissue bone, decreased hormone activity, decreased enzyme activity, and other physical changes\textsuperscript{[3]}. The

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population of elderly aged = 60 years is 10% and is expected to increase in 2050 in a world where the elderly aged = 85 years increase by 0.25% (Holdsworth, 2014). According to the Badan Pusat Statistik (2015) report, the number of elderly people in the world, including Indonesia, is increasing every year. In 2012 the percentage of the population aged 60 years and above was 7.58%, while in 2013 it increased to 8%, in 2014 it increased to 8.2% and in 2015 it increased to 8.5%. Calcium is very important in bone growth, and teeth. Childhood, calcium and food absorption can reach 75%, then shrink to 20-40% as they reach adulthood. Peak bone mass formation occurs at the age of 25 years. Public awareness needs to be raised about the dangers of osteoporosis and people need to be invited to stay active in consuming foods with balanced nutrition, especially those with high calcium from an early age, so that they can ultimately improve the quality of life [4]. Efforts to maintain nutritional status or health status of the elderly are the impact of increasing Life Expectancy. The health condition of the elderly is determined by the intake of food and beverages both in terms of quantity and nutritional value.

The number of calcium milk products currently makes many choices for the elderly in consuming calcium milk products because the elderly are strongly advised to consume milk in order to meet the nutritional needs of the body. Not only for fulfilling nutrition, milk is also very much needed by the elderly to maintain their health. Based on these problems, the purpose of this study is to recommend the best calcium milk products for the elderly based on consumer choice. There are many branches of computer science (artificial intelligence) that can solve complex problems that are related, including datamining [4]-[6], decision support systems [7], artificial neural networks [8], [9][10], [11] and others [12]. Based on these problems, researchers used the PROMETHEE II algorithm which is part of a decision support system. Related research is carried out by [13] where the results of this study are able to recommend one social media to the formation of brand attachments using the PROMETHEE II method. It is expected that the results of the study can provide recommendations on the selection of calcium milk products that are appropriate for old age.

2. Methodology

The research data was obtained by conducting observations and interviews with consumers (elderly) by taking 150 samples randomly in Simalungun district. The following assessment criteria obtained from interviews and observations in determining the best calcium milk products based on consumer choice as shown in table 1 and alternative calcium milk products used as shown in table 2 below:

| Criteria | Information | Initials |
|----------|-------------|---------|
| Criteria 1 | Price | C1 |
| Criteria 2 | Content | C2 |
| Criteria 3 | Side effects | C3 |
| Criteria 4 | Taste Variant | C4 |

| Product | Information |
|---------|-------------|
| Anlene | A1 |
| Entrasol | A2 |
| Prolansia | A3 |
| Appeton 60+ | A4 |

The following is the suitability rating data from each alternative that has been processed based on the results of the questionnaire on 150 consumers, where the mentat data processing is assisted by using Microsoft Excel software as shown in table 3 below:

| Table 3. Compatibility Rating of Each Alternative at Each Criteria |
Criteria | Min/Maks | Dairy products | A1 | A2 | A3 | A4
---|---|---|---|---|---|---
C1 | Maks | 0.72 | 0.7 | 0.7 | 0.6 |
C2 | Maks | 0.7 | 0.6 | 0.63 | 0.7 |
C3 | Maks | 0.72 | 0.73 | 0.7 | 0.6 |
C4 | Maks | 0.78 | 0.8 | 0.63 | 0.2 |

3. Results and Discussion

Based on the explanation in tables 1, 2, 3, the following is how to complete the PROMETHEE II method in the case of selecting calcium milk products that are good for the elderly.

**STEP I. Calculate Preference Value:**
The existing criteria will then be calculated for the value and index of preference as follows:

1. **Price Criteria Value (C1)**
   - C1(A1,A2) : \( d = C1(A1) - C1(A2) \)
     - \( d = 0.72 - 0.7 = 0.02 \)
     - \( d > 0 \) then \( H|d| = 1 \)
   - C1(A2,A1) : \( d = C1(A2) - C1(A1) \)
     - \( d = -0.02 \)
     - \( d < 0 \) then \( H|d| = 0 \)
   - C1(A1,A3) : \( d = C1(A1) - C1(A3) \)
     - \( d = 0.72 - 0.7 = 0.02 \)
     - \( d > 0 \) then \( H|d| = 1 \)
   - C1(A3,A1) : \( d = C1(A3) - C1(A1) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
   - C1(A1,A4) : \( d = C1(A1) - C1(A4) \)
     - \( d = 0.72 - 0.6 = 0.12 \)
     - \( d > 0 \) then \( H|d| = 1 \)
   - C1(A4,A1) : \( d = C1(A4) - C1(A1) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
   - C1(A2,A1) : \( d = C1(A2) - C1(A1) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
   - C1(A3,A2) : \( d = C1(A3) - C1(A2) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
   - C1(A2,A4) : \( d = C1(A2) - C1(A4) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)

2. **Content Criteria Value (C2)**
   - C2(A1,A2) : \( d = C2(A1) - C2(A2) \)
     - \( d = 0.7 - 0.6 = 0.1 \)
     - \( d > 0 \) then \( H|d| = 1 \)
   - C2(A2,A1) : \( d = C2(A2) - C2(A1) \)
     - \( d = 0.6 - 0.7 = -0.1 \)
     - \( d < 0 \) then \( H|d| = 0 \)
   - C2(A1,A3) : \( d = C2(A1) - C2(A3) \)
     - \( d = 0.7 - 0.63 = 0.07 \)
     - \( d > 0 \) then \( H|d| = 1 \)
   - C2(A3,A1) : \( d = C2(A3) - C2(A1) \)
     - \( d = 0.63 - 0.7 = -0.07 \)
     - \( d < 0 \) then \( H|d| = 0 \)
   - C2(A1,A4) : \( d = C2(A1) - C2(A4) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
   - C2(A4,A1) : \( d = C2(A4) - C2(A1) \)
     - \( d = 0.7 - 0.7 = 0 \)
     - \( d = 0 \) then \( H|d| = 0 \)
\[ d = 0 \text{ then } H|d| = 0 \]

\[ C2(A2,A3) : \quad d = C2(A2) - C2(A3) \]
\[ d = 0.6 - 0.63 \]
\[ d = -0.03 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C2(A3,A2) : \quad d = C2(A3) - C2(A2) \]
\[ d = 0.63 - 0.6 \]
\[ d = 0.03 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C2(A2,A4) : \quad d = C2(A2) - C2(A4) \]
\[ d = 0.6 - 0.7 \]
\[ d = -0.1 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C2(A4,A2) : \quad d = C2(A4) - C2(A2) \]
\[ d = 0.7 - 0.6 \]
\[ d = 0.1 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C2(A3,A4) : \quad d = C2(A3) - C2(A4) \]
\[ d = 0.63 - 0.7 \]
\[ d = -0.07 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C2(A4,A3) : \quad d = C2(A4) - C2(A3) \]
\[ d = 0.7 - 0.63 \]
\[ d = 0.07 \]
\[ d > 0 \text{ then } H|d| = 1 \]

3. Side effects Criteria Value (C3)

\[ C3(A1,A2) : \quad d = C3(A1) - C3(A2) \]
\[ d = 0.72 - 0.73 \]
\[ d = -0.01 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C3(A2,A1) : \quad d = C3(A2) - C3(A1) \]
\[ d = 0.73 - 0.72 \]
\[ d = 0.01 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C3(A1,A3) : \quad d = C3(A1) - C3(A3) \]
\[ d = 0.72 - 0.7 \]
\[ d = 0.02 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C3(A2,A3) : \quad d = C3(A2) - C3(A3) \]
\[ d = 0.73 - 0.7 \]
\[ d = 0.03 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C3(A3,A2) : \quad d = C3(A3) - C3(A2) \]
\[ d = 0.7 - 0.73 \]
\[ d = -0.03 \]
\[ d < 0 \text{ then } H|d| = 1 \]

\[ C3(A2,A4) : \quad d = C3(A2) - C3(A4) \]
\[ d = 0.6 - 0.63 \]
\[ d = 0.03 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C3(A4,A2) : \quad d = C3(A4) - C3(A2) \]
\[ d = 0.6 - 0.63 \]
\[ d = 0.13 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C3(A2,A4) : \quad d = C3(A2) - C3(A4) \]
\[ d = 0.6 - 0.7 \]
\[ d = 0.13 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C3(A3,A4) : \quad d = C3(A3) - C3(A4) \]
\[ d = 0.7 - 0.6 \]
\[ d = 0.1 \]
\[ d > 0 \text{ then } H|d| = 1 \]

4. Taste Variant Criteria Value (C4)

\[ C4(A1,A2) : \quad d = C4(A1) - C4(A2) \]
\[ d = 0.78 - 0.8 \]
\[ d = -0.02 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C4(A2,A1) : \quad d = C4(A2) - C4(A1) \]
\[ d = 0.8 - 0.78 \]
\[ d = 0.02 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C4(A1,A3) : \quad d = C4(A1) - C4(A3) \]
\[ d = 0.78 - 0.63 \]
\[ d = 0.15 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C4(A3,A1) : \quad d = C4(A3) - C4(A1) \]
\[ d = 0.63 - 0.78 \]
\[ d = -0.15 \]
\[ d < 0 \text{ then } H|d| = 0 \]

\[ C4(A1,A4) : \quad d = C4(A1) - C4(A4) \]
\[ d = 0.78 - 0.2 \]
\[ d = 0.58 \]
\[ d > 0 \text{ then } H|d| = 1 \]

\[ C4(A4,A1) : \quad d = C4(A4) - C4(A1) \]
\[ d = 0.2 - 0.78 \]
\[ d = -0.58 \]
\[ d < 0 \text{ then } H|d| = 1 \]

\[ C4(A2,A3) : \quad d = C4(A2) - C4(A3) \]
\[ d = 0.8 - 0.63 \quad \text{then} \quad H|d| = 1 \]
\[ d = 0.17 \]
\[ d > 0 \text{ then } H|d| = 1 \]
\[ d = C_4(A_3) - C_4(A_2) \]
\[ d = 0.63 - 0.8 \]
\[ d = -0.17 \]
\[ d < 0 \text{ then } H|d| = 0 \]
\[ d = C_4(A_2) - C_4(A_4) \]
\[ d = 0.8 - 0.2 \]
\[ d = 0.6 \]
\[ d > 0 \text{ then } H|d| = 1 \]
\[ d = C_4(A_4) - C_4(A_3) \]
\[ d = 0.2 - 0.63 \]
\[ d = -0.43 \]
\[ d < 0 \text{ then } H|d| = 0 \]
\[ d = C_4(A_3) - C_4(A_4) \]
\[ d = 0.63 - 0.2 \]
\[ d = 0.43 \]

**STEP II:** Calculate the Preference Index Alternative partner (A1,A2)

\[ (A_1,A_2) = (1 + 1 + 0 + 0) = 2/4 = 0.5 \]

Alternative partner (A2,A1)

\[ (A_2,A_1) = (0 + 0 + 1 + 1) = 2/4 = 0.5 \]

Alternative partner (A1,A3)

\[ (A_1,A_3) = (1 + 1 + 1 + 1) = 4/4 = 1 \]

Alternative partner (A3,A1)

\[ (A_3,A_1) = (0 + 0 + 0 + 0) = 0/4 = 0 \]

Alternative partner (A1,A4)

\[ (A_1,A_4) = (1 + 0 + 0 + 1) = 3/4 = 0.75 \]

Alternative partner (A4,A1)

\[ (A_4,A_1) = (0 + 0 + 0 + 1) = 1/4 = 0.25 \]

Alternative partner (A2,A3)

\[ (A_2,A_3) = (0 + 0 + 1 + 1) = 1/4 = 0.25 \]

The following are the complete results of the Preference Index calculation as shown in the following table:

| Alternative partner (A1,A2) | A1 | A2 | A3 | A4 |
|-----------------------------|----|----|----|----|
| (A1,A2) = (1 + 1 + 0 + 0) = 2/4 = 0.5 | 0.5 | 1 | 0.75 |
| (A2,A1) = (0 + 0 + 1 + 1) = 2/4 = 0.5 | 0.5 | - | 0.5 | 0.75 |
| (A1,A3) = (1 + 1 + 1 + 1) = 4/4 = 1 | 1 | 0.5 | - | 0.75 |
| (A3,A1) = (0 + 0 + 0 + 0) = 0/4 = 0 | 0 | 0.25 | - | 0.75 |
| (A1,A4) = (1 + 0 + 0 + 1) = 3/4 = 0.75 | 0.25 | 0.4 | 0.25 | - |
| (A4,A1) = (0 + 0 + 0 + 1) = 1/4 = 0.25 | |
| (A2,A3) = (0 + 0 + 1 + 1) = 1/4 = 0.25 | |

**STEP III:** Calculate PROMETHEE I

1. Calculating Leaving Flow

Then obtained:

\[ A_1 = 1 / (4-1) (0.5 + 1 + 0.75) = 0.749 \]
\[ A_2 = 1 / (4-1) (0.5 + 0.5 + 0.75) = 0.582 \]
\[ A_3 = 1 / (4-1) (0 + 0.25 + 0.75) = 0.333 \]
\[ A_4 = 1 / (4-1) (0.25 + 0.4 + 0.25) = 1.233 \]

2. Calculating Entering Flow

Then obtained:

\[ A_1 = 1 / (4-1) (0.5 + 0 + 0.25) = 0.249 \]
\[ A_2 = 1 / (4-1) (0.5 + 0.25 + 0.4) = 0.382 \]
\[ A_3 = 1 / (4-1) (1 + 0.5 + 0.25) = 0.582 \]
\[ A_4 = 1 / (4-1) (0.75 + 0.75 + 0.75) = 0.749 \]
STEP IV: Calculate PROMETHEE II:

Obtained:

\[ A = 0.749 - 0.249 = 0.5 \]
\[ B = 0.582 - 0.382 = 0.2 \]
\[ C = 0.333 - 0.582 = -0.249 \]
\[ D = 1.233 - 0.749 = 0.484 \]

Based on step 3, the process of step 4 is obtained to calculate PROMETHEE II so that the calculation results in step 4 are shown in the following table:

|                | Net Flow | Ranking |
|----------------|----------|---------|
| Anlene (A1)    | 0.5      | 1       |
| Entrasol (A2)  | 0.3      | 3       |
| Prolansia (A3) | -0.249   | 4       |
| Appeton 60+ (A4) | 0.484   | 2       |

Based on table 5, the process of calculating Net Flow (PROMETHEE II) is obtained from the difference between Leaving Flow and Entering Flow (PROMETHEE I). The biggest results obtained are the best alternatives. In this case, calcium milk products that are recommended for the elderly based on the calculation of PROMETHEE II are Anlene (A1).

4. Conclusion

Based on the results of the study it can be concluded that the PROMETHEE II method can be applied to the selection of calcium milk products for the elderly based on consumer choice. The results of the study mention the 5 alternatives used and 4 assessment criteria obtained by Anlene (A1) as the best recommendation (net Flow: 0.5) and Appeton 60+ (A5) as the second recommendation (Net Flow: 0.484).

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