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DECISION SUPPORT SYSTEMS FOR SELECTING THE NUTRITIOUS FOOD FOR OBESITY PATIENTS WITH THE MOORA METHOD

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ABSTRACT

Besides doing activities and diligent exercise, maintaining diet and health is very important for everyone. Maintain health and body shape, especially in people with obesity. Lack of attention and knowledge of the nutritional content of food consumed causes many people with irregular eating patterns and without choosing what foods should be consumed become one of the causes of obesity. Obesity is overweight with excessive fat filling. But obesity can certainly be prevented and repaired with proper food selection knowledge and good to eat. The decision support system can be a solution for obese people to know the food that should be suitable for consumption. By implementing the MOORA method on the decision support system that calculates values automatically by the system and produces the best alternative. So the research results in the form of the best alternative value food that should be consumed are presented in the form of manual calculations that are likened to the calculations on the system with ranking so that the result is a benchmark for obese people to choose suitable food for consumption.

INTRODUCTION

In addition to maintaining diet, nutritional content and diligent exercise are forms of activities in maintaining healthy living and healthy and normal body shape. Lack of knowledge of the nutritional value of food to be consumed causes someone to indifferent in choosing good food to consume. So that it impacts on body health and is one of the causes of obesity.

Obesity is the presence of high levels of fat that accumulate in a person's body which causes body weight to be outside the ideal limit, where the fat cells in a person's body will continue to increase which is affected by weight gain until the disruption of health [1].

At this time the selection of food menus would certainly be difficult for the community, especially in adolescents, because of the many types of food and knowledge of nutritional value is very low and indifferent. As an example of fast food in accordance with modern lifestyles that can also affect ideal body shape, weight, and health conditions. There is also food with archipelago cuisine with appetizing flavors

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that make everyone hungrily eat without thinking about the risk of gaining weight and even reaching the obesity category. Foods that are consumed with diverse nutritional content and in varying amounts as well, cause many people with obesity. But with the decision support system that is applied to the selection of food for obese people can be a solution in helping sufferers in choosing foods that are suitable for consumption.

The decision support system by the MOORA method has also been previously carried out by Aldi Muhasyah, Soraya Rahma Hayati, M. Ikhsan Setiawan, Heri Nurdiyanto, Yuhandri with the results of research that helped in the selection of new journaTables [2]. In addition, research on food selection support systems for obesity sufferers has also been carried out with other methods such as AHP [3], Fuzzy Resistant [4]. Research on other decision support systems using the ELECTRE method [5], WASPAS [6], SAW [7], TOPSIS [8], PROMETHEE [9], VIKOR [10].

In this study, taking the MOORA method on the decision support system in the selection of nutritious foods for obese people is expected to be a solution to facilitate obesity sufferers in choosing foods that are suitable for consumption and continue to prioritize the nutritional value contained in food.

METHOD

To facilitate researchers in completing this research a systematic research framework is needed in the following sequence of steps:

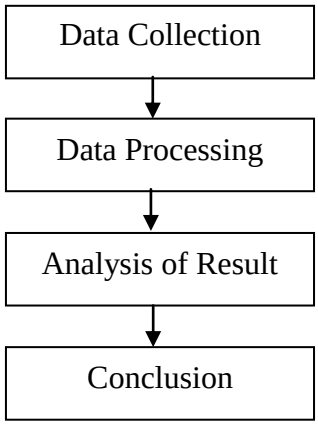

Image 1. Research Stage

Data Collection

To obtain data in accordance with the discussion understudy, direct observation was carried out by conducting research at the UPTD Puskesmas Datuk Bandar Tanjungbalai. Data collected on the nutritional value of obesity sufferers' needs are used as criteria later.

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Data Processing
The data that has been obtained will be processed according to system requirements. At this stage, the MOORA method is applied to the decision support system in accordance with the calculation method.

Analysis of Result
After applying the MOORA method to the decision support system, an analysis of the results of the suitability of the manual calculation is carried out with the counts produced by the system created.

Conclusion
After all the steps have been carried out then a conclusion is determined.

Decision Support System
A decision support system is a system that helps in making decisions effectively, both in complex, structured, and unstructured conditions [9][11][12].

Multi-Objective Optimization on the basis of Ratio Analysis (MOORA)
In decision making, the MOORA Method is very easy to understand, especially in separating the subjective parts of an evaluation process into decision weight criteria. And also is a method that has a good level of selectivity that can determine goals and criteria by optimizing one or more conflicting attributes together [2][1][11][13][14].

In applying the MOORA method to the decision support system steps are taken in the use of the MOORA method [12] [15][16] itself, including:

Step 1, Make a Matrix of Decisions

$$x = \begin{bmatrix} x_{11} & x_{12} & . & x_{1n} \\ x_{21} & x_{22} & . & x_{2n} \\ . & . & . & . \\ x_{m1} & x_{m2} & . & x_{mn} \end{bmatrix} \quad (1)$$

Step 2, Determine the Normalization Matrix

$$x^*_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (2)$$

Where x_{ij} is alternative matrix *j* in criteria *i;* i = 1, 2, 3…, n is the order number of the attribute or criterion; *j* = 1, 2, 3 …, m is the number of the alternative; x^*_{ij} is a

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alternative normalization matrix *j* on criteria *i*.

Step 3, Calculate the Optimization Value

If the attribute or criteria for each alternative is not given a weight value.

Normalized measurements are added in the case of maximization (for beneficial attributes) and reduced in minimization (for unprofitable attributes) or other words reduce the maximum and minimum values in each row to get rankings in each row if formulated then: the attribute or criterion

$$y_j^* = \sum_{j=1}^{g} x_{ij} - \sum_{j=g+1}^{n} x_{ij} \qquad (3)$$

Where i : 1, 2, 3, …, g are attributes or criteria with maximized status; j : g+1, g+2, g+3, …, n are attributes or criteria with minimized status; y^*_i : alternative max-min normalization matrices j.

If the attribute or criteria for each alternative is given a weighting value of importance.

Giving a weighting value to the criteria, provided that the maximum criteria specific gravity value is greater than the minimum criteria specific gravity value.

The following formula calculates the MOORA multiobjective optimization value, the multiplication of the criteria weight to the maximum attribute value minus the multiplication of the criteria weight to the minimum attribute value, if formulated then:

$$y_j^* = \sum_{j=1}^{g} W_j X_{ij}^* - \sum_{j=g+1}^{n} W_j X_{ij}^* \qquad (4)$$

Where W_j = weight against alternative j; y_i = normalized preference value of alternative j for all attributes.

RESULT AND DISCUSSION

To produce alternative choices in a decision support system with the MOORA method, several criteria are needed to be used as calculation material in the assessment process. In the decision support system for selecting nutritious foods for obese people has the following criteria:

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Table 1. Criteria

Criteria	Information	Weight	Type
C1	Total Energi	0,2	Benefit
C2	Total Lemak	0,1	Cost
C3	Total Protein	0,2	Benefit
C4	Total Karbohidrat	0,2	Cost
C5	Total Kolesterol	0,1	Benefit
C6	Total Kalori	0,1	Benefit

The weight value for each criterion is determined based on the results of the nutritional value needed by each user who uses this application, the weight value will be filled automatically on the system by adjusting the nutritional adequacy rate of each person. Adequacy of nutrition is also influenced by one's sex and ideal body weight. And for protein requirements taken from the formula as follows:

PN = Age Category * IBW (5)

Where PR = Protein Needs, IBW = Ideal Body Weight (kg).
While the fat requirements are calculated using the following formula:

$$FN = \frac{20-30\%*TEE}{9} \quad (6)$$

Where FR = Fat Needs, and TEE= Total Energy Expenditure, while the energy needs are taken from the following formula:

TEE = BMR * PA (7)

Where BMR = Basal Metabolic Rate, and PA = Physical Activity, other than that for carbohydrate needs taken from the formula as follows:

$$CN = \frac{TEE-(TEDP+TEDL)}{4} \quad (8)$$

Where CN = Carbohydrate Needs, TEDP = Energy Total from Protein, dan TEDL = Energy Total from Fat.

Alternatives taken as examples of food choices in this decision support system are as follows:

Table 2. Alternative

Alternative	Keterangan
A1	Buger
A2	Kentang Goreng
A3	Mie Instan
A4	Nasi Goreng

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Table 2. Alternative

Alternative	Keterangan
A5	Sate Daging
A6	Pecel Ayam
A7	Lontong Pecal
A8	Bubur Ayam
A9	Martabak Telor
A10	Martabak Manis

Furthermore, providing alternative values for each criterion as shown in the following table:

Table 3. Alternative values for each criterion

Alternatif	Keterangan	C1	C2	C3	C4	C5	C6
A1	Buger	251	2	4	6	0	60
A2	Kentang Goreng	653	8,01	1,98	20,33	0	156
A3	Mie Instan	1590	14	8	54	0	380
A4	Nasi Goreng	1392	12,34	12,47	41,7	103	333
A5	Sate Daging	673	6,63	18,01	6,79	47	161
A6	Pecel Ayam	188	1,57	5,43	1,94	23	45
A7	Lontong Pecal	553	7,41	7,14	10,9	78	132
A8	Bubur Ayam	1558	12,39	27,56	36,12	72	372
A9	Martabak Telor	850	8,45	10,89	20,38	160	203
A10	Martabak Manis	1131	11,31	7,01	37,37	66	270

The value for each criterion is taken from the nutritional value for each alternative, the unit used for total energy (kj), fat total (g), protein total (g), carbohydrate total (g), cholesterol (mg), and calories total (kkal).

Then apply the calculation steps in the MOORA method, and Make a decision matrix

$$x = \begin{bmatrix} 251 & 2 & 4 & 6 & 0 & 60 \\ 653 & 8{,}01 & 1{,}98 & 20{,}33 & 0 & 156 \\ 1590 & 14 & 8 & 54 & 0 & 380 \\ 1392 & 12{,}34 & 12{,}47 & 41{,}7 & 103 & 333 \\ 673 & 6{,}63 & 18{,}01 & 6{,}79 & 47 & 161 \\ 188 & 1{,}57 & 5{,}43 & 1{,}94 & 23 & 45 \\ 553 & 7{,}41 & 7{,}14 & 10{,}9 & 78 & 132 \\ 1558 & 12{,}39 & 27{,}56 & 36{,}12 & 72 & 372 \\ 850 & 8{,}45 & 10{,}89 & 20{,}38 & 160 & 203 \\ 1131 & 11{,}31 & 7{,}01 & 37{,}37 & 66 & 270 \end{bmatrix}$$

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After making a decision matrix, matrix normalization is carried out using the formula in step 2. In the calculation below, an example of calculating the value of C1 with all alternative values A1 through A10 is taken, and so on until the calculation of C2 criteria with all values of A1 through A10. , etc.

$$C_1 = \sqrt{251^2 + 653^2 + 1590^2 + 1392^2 + 673^2 + 188^2 + 553^2 + 1558^2 + 850^2 + 1131^2}$$
$$= \sqrt{63001 + 426409 + 2528100 + 1937664 + 452929 + 35344 + 305809 + 2427364 + 722500 + 1279161}$$
$$= \sqrt{10178281} = 3190{,}34183$$

$$A_{11} = \frac{251}{3190{,}34183} = 0{,}07867495$$
$$A_{21} = \frac{653}{3190{,}34183} = 0{,}20468026$$
$$A_{31} = \frac{1590}{3190{,}34183} = 0{,}49837919$$
$$A_{41} = \frac{1392}{3190{,}34183} = 0{,}43631688$$
$$A_{51} = \frac{673}{3190{,}34183} = 0{,}21094918$$
$$A_{61} = \frac{188}{3190{,}34183} = 0{,}05892785$$
$$A_{71} = \frac{553}{3190{,}34183} = 0{,}17333563$$
$$A_{81} = \frac{1558}{3190{,}34183} = 0{,}48834894$$
$$A_{91} = \frac{850}{3190{,}34183} = 0{,}26642913$$
$$A_{101} = \frac{1131}{3190{,}34183} = 0{,}35450747$$

Then after completing the calculation on all criteria with each alternative, the calculation results from matrix normalization X^*_{ij} are as follows:

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$$X_{ij}^{*} = \begin{bmatrix} 0{,}078674955 & 0{,}067783125 & 0{,}100901685 & 0{,}065506742 & 0 & 0{,}07871007 \\ 0{,}204680261 & 0{,}271471416 & 0{,}049946334 & 0{,}221958677 & 0 & 0{,}204646181 \\ 0{,}498379197 & 0{,}474481875 & 0{,}20180337 & 0{,}589560675 & 0 & 0{,}498497108 \\ 0{,}436316882 & 0{,}418221881 & 0{,}314561003 & 0{,}455271855 & 0{,}440916416 & 0{,}436840887 \\ 0{,}210949182 & 0{,}224701059 & 0{,}454309836 & 0{,}074131796 & 0{,}201194869 & 0{,}211205354 \\ 0{,}058927855 & 0{,}053209753 & 0{,}136974037 & 0{,}021180513 & 0{,}098457064 & 0{,}059032552 \\ 0{,}173335653 & 0{,}251136478 & 0{,}180109508 & 0{,}119003914 & 0{,}333897868 & 0{,}173162153 \\ 0{,}488348924 & 0{,}419916459 & 0{,}695212609 & 0{,}394350586 & 0{,}308213417 & 0{,}488002432 \\ 0{,}26642913 & 0{,}286383703 & 0{,}274704837 & 0{,}222504566 & 0{,}684918705 & 0{,}266302402 \\ 0{,}354507467 & 0{,}383313572 & 0{,}176830203 & 0{,}407997823 & 0{,}282528966 & 0{,}354195314 \end{bmatrix}$$

Next, determine the value Y_i with the formula in step 3 matrix normalization is multiplied by the criteria weights, so as to produce a weight normalized value.

Resulting in weight normalization values as follows:

$$\begin{bmatrix} 0{,}015734991 & 0{,}006778312 & 0{,}020180337 & -0{,}013101348 & 0 & 0{,}007871007 \\ 0{,}040936052 & 0{,}027147142 & 0{,}009989267 & -0{,}044391735 & 0 & 0{,}020464618 \\ 0{,}099675839 & 0{,}047448187 & 0{,}040360674 & -0{,}117912135 & 0 & 0{,}049849711 \\ 0{,}087263376 & 0{,}041822188 & 0{,}062912201 & -0{,}091054371 & -0{,}044091642 & 0{,}043684089 \\ 0{,}042189836 & 0{,}022470106 & 0{,}090861967 & -0{,}014826359 & -0{,}020119487 & 0{,}021120535 \\ 0{,}011785571 & 0{,}005320975 & 0{,}027394807 & -0{,}004236103 & -0{,}009845706 & 0{,}005903255 \\ 0{,}034667132 & 0{,}025113648 & 0{,}036021902 & -0{,}023800783 & -0{,}033389787 & 0{,}017316215 \\ 0{,}097669785 & 0{,}041991646 & 0{,}139042522 & -0{,}078870177 & -0{,}030821342 & 0{,}048800243 \\ 0{,}053285826 & 0{,}02863837 & 0{,}054940967 & -0{,}044500913 & -0{,}06849187 & 0{,}02663024 \\ 0{,}070901493 & 0{,}038331357 & 0{,}035366041 & -0{,}081599565 & -0{,}028252897 & 0{,}035419531 \end{bmatrix}$$

Next, calculate the optimization value of each alternative with the formula in step 4 found in the following table:

Table 4. Value Optimization

Alternative	Information	Maximum (C1+C2+C3+C6)	Minimum (C4+C5)	Yi = Max-Min
A1	Buger	0,050564647	-0,013101348	0,063665996
A2	Kentang Goreng	0,098537079	-0,044391735	0,142928814
A3	Mie Instan	0,237334412	-0,117912135	0,355246547
A4	Nasi Goreng	0,235681854	-0,135146013	0,370827866
A5	Sate Daging	0,176642445	-0,034945846	0,211588291
A6	Pecel Ayam	0,050404609	-0,014081809	0,064486418
A7	Lontong Pecal	0,113118896	-0,05719057	0,170309466
A8	Bubur Ayam	0,327504196	-0,109691459	0,437195655
A9	Martabak Telor	0,163495404	-0,112992784	0,276488188
A10	Martabak Manis	0,180018422	-0,109852461	0,289870884

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Then from the calculation in the table above we get the following ranking results:

Table 5. Ranking

Alternatif	Information	Result	Ranking
A8	Bubur Ayam	0,437195655	1
A4	Nasi Goreng	0,370827866	2
A3	Mie Instan	0,355246547	3
A10	Martabak Manis	0,289870884	4
A9	Martabak Telor	0,276488188	5
A5	Sate Daging	0,211588291	6
A7	Lontong Pecal	0,170309466	7
A2	Kentang Goreng	0,142928814	8
A6	Pecel Ayam	0,064486418	9
A1	Buger	0,063665996	10

From the ranking table above, it can be seen that alternative A8 has the highest-ranking value compared to other values. So a good diet for obese sufferers is Chicken Porridge ranked 1.

CONCLUSION

Based on the results of calculations using the MOORA method, ranking values with calculations that are easy to understand can be applied to decision support systems. So that in the application of nutritional food decision support decision systems for obese people can be used properly with results in accordance with the calculations on the system and manual calculations. Based on fairly simple completion steps, it is expected to be a reference for other researchers.

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