Journal of Electrical Engineering and Computer Sciences
Vol. 3 No.2, December 2018
ISSN: 2528-0260
P.513-530

STUDY OF FOOD RECOMMENDATIONS TO MEET NUTRITIONAL NEEDS BASED ON DIVERSITY OF IDEAL WEIGHT CALCULATION METHODS

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ABSTRACT

At present, Indonesia faces multiple nutritional problems, namely the problem of malnutrition and over nutrition problems. Diet is the most influential thing in the state of individual nutrition. Nutrition that is not optimal will be related to poor health. Nutritional problems in essence are public health problems, but the response cannot be done with medical approaches and health services alone. The purpose of this study is to conduct an in-depth analysis to determine the nutritional needs of each individual. The level of nutritional adequacy and ideal body weight will be analyzed using the formula of Ideal Body Weight (BBI), Broca's formula, and the formula for Body Mass Index (BMI). Daily calorie requirements will be analyzed using the Energy Basal Metabolism (EMB) formula based on BMI, Harris Bennedict formula, and Perkeni formula. Recommendations for nutritional intake will be calculated using a formulation determined by the Ministry of Health of the Republic of Indonesia. The results of the analysis obtained from this study are the calculation of nutritional status, ideal body weight, daily caloric needs, and recommendations for nutritional intake which refers to the nutritional adequacy standards of the Indonesian Ministry of Health and also recommends the amount of food to be consumed by individuals daily calories adjusted to the criteria of each individual, namely Normal (not sick), coronary heart sufferers, and people with Diabetes Mellitus.

Keywords: Nutrition, Ideal Body Weight, Conventional BBI, Body Mass Index (BMI), Broca, Calories, BMI based on BMI, Harris Bennedict, Perkeni, Recommendation, Coronary Heart, Diabetes.

I. INTRODUCTION

One characteristic of an advanced nation is a nation that has a high level of health, intelligence and work productivity. These three things are influenced by nutritional conditions (Ministry of Health of the Republic of Indonesia, 2014). Nutrition is a chemical bond that the body needs to carry out its functions, namely to produce energy, build and maintain tissues and regulate life processes (Almatsier, 2005). Diet is the most influential thing in the state of individual nutrition. Nutrition that is not optimal will be related to poor health. Nutritional problems in essence are public health problems, but the response cannot be done with medical approaches and health services alone.

At present, Indonesia faces multiple nutritional problems, namely the problem of malnutrition and over nutrition problems. To improve the level of community nutrition, the Minister of Health has implemented the Nutrition Awareness Program (KADARZI). From this program, it is expected that each individual has a personal awareness of needed nutrition (Ministry of Health, 2007).

With the advancement of technology, people should be able to use it to support the level of nutrition awareness. This study was made to conduct an in-depth analysis of the level of nutritional needs based on the conditions of each individual ranging from body weight, height, age, individual activity factors, stress factors, and individual health conditions.

ISSN: 2528-0260
P.513-530

II. BASIC THEORY

2.1 Conventional BBI

The conventional BBI calculation method is relatively easy and is mostly done by the public in general. The formula for calculating ideal body weight in adults is as follows:

$$BBI = (TB - 100) - (TB - 100)\ x\ 10\%$$

Or

$$BBI = (TB - 100)\ x\ 90\%$$

Information :

TB = Height (cm)

2.2 Broca

This formula was discovered by Dr. Pierre Paul Broca in 1871, but then who popularized it was Dr. BJ Devine around 1970, so sometimes people know this formula with the name Devine formula.

Broca's formula for women's ideal body weight:

$$= (TB - 100) - (15\%\ x\ TB\ - 100)$$

Broca's formula for male ideal body weight:

$$= (TB - 100) - (10\%\ x\ TB\ - 100)$$

Information :

TB: Height (cm)

2.3 IMT

The Body Mass Index (BMI) is a simple tool or way to monitor the nutritional status of adults, especially those related to lack and excess weight. The IMT formula can only be used for adults over the age of 18 and cannot be applied to infants, children, adolescents, pregnant women and sportsmen (MOH, 2003). To find out the value of this IMT, it can be calculated by the following formula:

$$\text{IMT} = \frac{Berat\ Badan}{Tinggi\ Badan^2}$$

ISSN: 2528-0260
P.513-530

Table 1 BMI Threshold Limits in Indonesia according to the Indonesian Ministry of Health

	Kategori	IMT
Kurus	Kekurangan berat badan tingkat berat	< 17.0
	Kekurangan berat badan tingkat ringan	17.0 – 18.4
Normal		18.5 – 25.0
Gemuk	Kelebihan berat badan tingkat ringan	25.1 – 27.0
	Kelebihan berat badan tingkat berat	> 27.0

In addition to determining the nutritional status of individuals, BMI is also often used to calculate an individual's ideal body weight. The following is the formula used to calculate the ideal body weight of an individual based on the BMI category:

$$21 = \frac{Berat\ Badan}{Tinggi\ Badan^2}$$

• Ideal female body weight

$$22.5 = \frac{Berat\ Badan}{Tinggi\ Badan^2}$$

• Ideal male body weight.

Description:

Weight (kg)

Height (cm)

2.4 EMB based on BMI

EMB is a minimum energy requirement that is needed by the body to maintain the function of respiratory devices, blood circulation, body temperature, gland activities, and other vegetative functions (Arisman, 2004: 162).

Table 2 Table of EMB Physical Activity According to the Indonesian Ministry of Health

Activity	Man	Woman	Jenis Kegiatan
Very Light	1,30	1,30	1-3x Sports in a week

ISSN: 2528-0260
P.513-530

Light	1,65	1,55	3-5x Sports in a week
Average	1,76	1,70	5-6x Sports in a week
Heavy	2,10	2,00	2x Sports in a week

Calculation formula for EMB requirements Normal :

$$EMB = 1\ Kal\ x\ BB\ (kg) x\ 24\ jam\ x\ Aktivitas\ Fisik$$

Calculation formula for EMB requirements for weight gain:

$$EMB = 1\ Kal\ x\ BB\ (kg) x\ 24\ jam\ x\ Aktivitas\ Fisik + 500$$

Calculation formula for EMB requirements for weight loss:

$$EMB = 1\ Kal\ x\ BB\ (kg)\ x\ 24\ jam\ x\ Aktivitas\ Fisik - 500$$

2.5 Harris Benedict

This formula was created by Harris and Benedict in 1909, which until now is still widely used and is considered as one of the best estimates. The calculation of Harris Bennedict Formula is done in 4 steps (Nutrition Care Team RSSA Malang, 2014), namely:

1. Calculate the Basal Energy Expenditure (BEE) Calories.

a. Harris Bennedict BEE formula for men:

$$BEE = 66 + (13.7\ x\ BB) + (5\ x\ TB) - (6.8\ x\ U)$$

b. Harris Bennedict BEE Formula for Women:

$$BEE = 66.5 + (9.6\ x\ BB) + (1.8\ x\ TB) - (4.7\ x\ U)$$

ISSN: 2528-0260
P.513-530

2. Determining the activity factor (FA)

Table 3 Physical Activity Tables used in RSSA Malang.

	Type of activity
1.05	Total bed rest, CVA-ICH
1.1	Mobilization in bed
1.2	Walk around the room Light activities such as employees
1.3	office, housewife, shop clerk, etc.
1.4	Moderate activities like students, factory employees, etc.
1.5	Heavy activity like a driver, porters, pedicab drivers, carpenters buildings, etc.

3. Determine the stress factor (FS).

Table 4 Table of Stress Factors used in RSSA Malang.

	Type of activity	normalization
1	Normal (No. Sick)	1
1.1 – 1.2	Heart failure, minor surgery	1.15
1.13	Body temperature rise 1 ° C	1.13
1.15 – 1.35	Skeletal trauma, curratage, PEB, post partum	1.25
1.3 – 1.5	Major operation abdomen / thorax, SCTP	1.4
1.35-1.55	Multiple trauma	1.45
1.5	Heart failure cancer	1.5
1.5– 1.8	Sepsis	1.65
1.1 – 1.5	Post selective surgery (there is a tool installed)	1.3
1.2– 1.4	Infection	1.3
1.1– 1.25	10% burns	1.175
1.25 – 1.5	25% burns	1.375
1.5– 2	50% burns	1.75

ISSN: 2528-0260
P.513-530

4. Calculate the Total Energy Expenditure (TEE)

$$TEE = BEE\ x\ FA\ x\ FS$$

2.6 Perkeni

Perkeni's formula is a formula for calculating nutritional requirements specifically for people with Diabetes Mellitus to know the amount of daily caloric needs. The Perkeni formula is done in several steps (Nutrition Care Team RSSA Malang, 2014):

1. Perform Basal Energy calculations

a. For woman

$$Energi\ Basal = Berat\ Badan\ (kg) x\ 25\ Kalori$$

b. For men

$$Energi\ Basal = Berat\ Badan\ (kg) x\ 30\ Kalori$$

2. Determining Physical Activity Factors (FA)

Table 5 Table of Activity Factors in RSSA Malang

	Jenis Kegiatan
5%	Total bed rest, CVA-ICH
10%	Mobilization in bed
20%	Take a walk
30%	Mild activities (office employees, housewives, shop clerks, etc.)
40%	Moderate activities (Students, factory employees, etc.)
50%	Heavy activity (driver, driver, pedicab driver, builder, etc.)

3. Determining the Stress Factor (FS)

Table 6 Table of Stress Factors in RSSA.

	Type of activity	normalization
10%	Pure DM	10%
10 – 20%	CHF, minor surgery, CVA (neuro case)	15%
13%	Febris, Increase in body temperature 1 ° C	13%
20 – 40%	Infection	30%
50%	CH, Ca	50%

ISSN: 2528-0260
P.513-530

50% – 80%	Sepsis	65%
10 – 50%	Post elective surgery	30%
10 – 25%	10% burns	17.5%
25 – 50%	25% burns	37.5%
50 – 100%	50% burns	75%

4. Determine my age correction

Table 7 Age Correction Tables in RSSA.

Age	
5%	40 – 49 years
10%	50 – 59 years
15%	– 69 years
20%	> 70 years

5. Calculate the Total Energy Expenditure (TEE)

$$TEE = Energi\ Basal + Energi\ Basal(FA + FS + KU)$$

2.7 Calories in Food

Calculating the number of calories contained in food is needed to meet daily calorie needs. The proportion of food needed in one day can be calculated based on DKBM (Dinkes, 2007). The number of calories in food ingredients can be calculated using the formula:

$$X = \frac{a}{BDD}\ x\ C$$

Information :

X = Amount of nutrients contained in food ingredients

a = Amount of food (gram) BDD = Edible portion of food material

C = Amount of nutrients contained in 100 grams of food ingredients

If, the total calories of food ingredients are known then to calculate the amount of food ingredients from the total calories can use the following formula:

$$a = \frac{Kal}{C}\ x\ 100(gram) x\ \frac{BDD}{100}$$

ISSN: 2528-0260
P.513-530

Information:

a = Amount of food (gram) Kal = Number of calories desired. BDD = Edible parts of food ingredients

C = Amount of nutrients contained in 100 grams of food ingredients

To meet the maximum nutritional needs, it is necessary to consume food served in 3 times a meal and 3 times a snack with a percentage of 65% carbohydrate needs, 15% protein, and 20% fat every meal (Nutrition Installation RSSA Malang, 2014). The following is a standard time and food distribution in a day:

Table 8 Food Distribution Standards

Time	Type of food	Calories / day	DKBM Group
Morning (6:00 - 8:00)	Carbohydrate	25%	A
	Protein		B, C, D, E, F, H
	Fat		I, J
Morning Snacks (10.00)	Fruit	10%	G
Afternoon (12.00 - 13.00)	Carbohydrate	25%	A
	Protein		B, C, D, E, F, H
	Fat		I, J
Finger Food Afternoon (16.00)	Fruit	10%	G
Night (18:00 - 19:00)	Carbohydrate	20%	A
	Protein		B, C, D, E, F, H
	Fat		I, J
Evening Snack (21.00)	Fruit	10%	G

III. CALCULATION ANALYSIS

3.1 Calculation of Ideal Body Weight Analysis

To calculate the ideal body weight, there are 3 formulas provided in this research is the formula BBI Conventional, BMI formula, and also Broca's formula.

The conventional BBI formula is no longer used in Indonesia as a benchmark for calculating the ideal body weight, because the results of the calculation of this formula are relative numbers. Thus, calculations using the conventional BBI formula do not provide accurate results. In addition, when compared with the IMT formula, the formula of BBI Conventional only uses the Body Height indicator without taking into account the actual Body Weight that individuals currently have.

ISSN: 2528-0260
P.513-530

In Broca's formula, if viewed from its initial function, this formula is made for use in the medical world, namely to calculate the dosage of certain drugs such as digoxin, theophylline, or gentamicin. In addition, this formula was developed in France and uses the average body size of French people where the population in France belongs to the Caucasian race group. with the average height of the population is 175.6 cm for men and 162.5 cm for women. While Indonesia is included in the Mongoloid Race group with an average height of 158 cm for men and 147 cm for women (Ian Langtree, 2018). From this description, it can be concluded that the use of Broca's formula which refers to the standards of French height will not be suitable if applied to the population of Indonesia who have an average height lower than the population of France.

The current IMT formula is a formula that is used as a standard to determine the level of nutritional adequacy and also the calculation of ideal body weight in Indonesia which has been determined by the Indonesian Ministry of Health since 2003. The IMT formula has 2 functions, namely to determine the level of individual nutrition and also to calculate individual ideal body weight.

3.2 Analysis of Calculation of Daily Calorie Needs

In this study, 3 formulas will be provided to be used to calculate daily caloric requirements, namely the EMB formula based on BMI, Harris Bannedict formula, and also the Perkeni formula.

EMB based on IMT is currently no longer applied in Indonesia to calculate daily calorie needs because this formula uses only two indicators, namely Weight and Physical Activity. Whereas in its development in other equations, currently it has used 5 indicators to calculate daily calorie needs. At present, the Ministry of Health of the Republic of Indonesia has set a standard that is used to calculate daily caloric requirements, namely using the Harris Bennedict formula and also the Perkeni formula.

3.3 Analysis of Calculation of Nutrition Intake Recommendations

To meet the maximum nutritional needs, consumption of food served in 3 meals is divided into breakfast 25%, lunch 25% and dinner 20% of total daily calorie needs, and 3x snacks as much as 10% of total daily calorie needs. In each presentation, it consists of 65% Carbohydrates, 15% Protein, and 20% Fat from the total calorie needs in each presentation. While for snacks will be in the form of fruit in each presentation.

Based on data on food ingredients contained in DKBM, carbohydrates are obtained from food ingredients with class A, protein is obtained from food ingredients with groups B, C, D, E, F, H, fat is obtained from food ingredients with groups I and J, while for fruit will be obtained from food with class G.

After knowing the number of calories needed for each item, it will calculate the amount of food needed. To see the consistency of calculations calorie needs after it is known the amount of food that must be consumed in units of grams. Then, calculations can be made with the inverse formula.

IV. IMPLEMENTATION AND TESTING

4.1 Calculation Implementation

Trial this calculation will be done as much as 6x with the limitations of individual conditions as follows:

1. Women with normal conditions (not sick).

2. Men with normal conditions (not sick).

ISSN: 2528-0260
P.513-530

3. Women with coronary heart disease.

4. Men with coronary heart disease.

5. Women with diabetes mellitus.

6. Men with diabetes mellitus.

Case 2:

If Juki is a 46-year-old construction worker with a height of 175 cm and weighs 55 kg. How many daily calories does Juki need to achieve ideal body weight?

$$\text{IMT} = \frac{Berat\ Badan}{Tinggi\ Badan^2}$$
$$= \frac{55}{1.75^2} = \frac{55}{3.0625} = 17.959$$

Juki's nutritional status is a shortage of light weight body weight, to determine the ideal body weight number Juki, then do the calculation:

$$22.5 = \frac{Berat\ Badan}{Tinggi\ Badan^2}$$
$$22.5 = \frac{Berat\ Badan}{1.75^2}$$
$$Berat\ Badan = 22.5\ x\ 1.75^2$$
$$= 68.906\ kg$$

So Juki was advised to increase the weight at the number 68,906 kg to reach the ideal body weight.

Calculate Juki's Daily Calorie Needs:

$$BEE = 66 + (13.7\ x\ BB) + (5\ x\ TB) - (6.8\ x\ U)$$
$$= 66 + (13.7\ x\ 66.564) + (5\ x\ 172) - (6.8\ x\ 46)$$
$$= 1572.212\ Kalori$$

$$TEE = 1572.212\ x\ 1.5\ x\ 1 = 2358.318\ Kalori$$

After it is known that the total daily calorie needs, in fulfilling their needs can be mapped into the presentation time as follows:

Table 9 Individual Calorie Distribution of Men with Normal Conditions

Waktu	Makan	Camilan
Pagi	$= 25\%\ x\ total\ kalori$ $= 25\%\ x\ 2358.318$ $= 589.58\ Kalori$	$= 10\%\ x\ total\ kalori$ $= 10\%\ x\ 2358.318$ $= 235.832\ Kalori$

ISSN: 2528-0260
P.513-530

Siang	$= 25\%\ x\ total\ kalori$ $= 25\%\ x\ 2358.318$ $= 589.58\ Kalori$	$= 10\%\ x\ total\ kalori$ $= 10\%\ x\ 2358.318$ $= 235.832\ Kalori$
Malam	$= 20\%\ x\ total\ kalori$ $= 20\%\ x\ 2358.318$ $= 471.664\ Kalori$	$= 10\%\ x\ total\ kalori$ $= 10\%\ x\ 2358.318$ $= 235.832\ Kalori$

Based on the results of the above calculations, to meet the calorie needs in each serving of food can be obtained from several types of food ingredients as follows:

Table 10 Distribution of Individual Foods for Men with Normal Conditions

Presentation	Calories	Fulfillment	Food
Makan Pagi	589.5	Karbohidrat $= 65\%\ x\ Kal.\ Pagi$ $= 65\%\ x\ 589.58$ $= 383.227\ Kalori$	Roti Putih $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{383.227}{248} x\ 100\ x\ \frac{100}{100}$ $= 154.527\ gram$
		Protein $= 15\%\ x\ Kal.\ Pagi$ $= 15\%\ x\ 589.58$ $= 88.437\ Kalori$	Keju $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{88.437}{326} x\ 100\ x\ \frac{100}{100}$ $= 27.128\ gram$
		Lemak $= 20\%\ x\ Kal.\ Pagi$ $= 20\%\ x\ 589.58$ $= 117.916\ Kalori$	Margarin $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{117.916}{720} x\ 100\ x\ \frac{100}{100}$ $= 16.377\ gram$
Camilan Pagi	235.832	Buah	Jambu Biji $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{235.832}{49} x\ 100\ x\ \frac{82}{100}$ $= 394.658\ gram$
Makan Siang	589.5	Karbohidrat $= 65\%\ x\ Kal.\ Siang$ $= 65\%\ x\ 589.58$ $= 383.227\ Kalori$	Beras Setengah Giling $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{383.227}{363} x\ 100\ x\ \frac{100}{100}$ $= 105.572\ gram$
		Protein $= 15\%\ x\ Kal.\ Siang$ $= 15\%\ x\ 589.58$ $= 88.437\ Kalori$	Angsa $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{88.437}{354} x\ 100\ x\ \frac{60}{100}$ $= 14.989\ gram$
		Lemak $= 20\%\ x\ Kal.\ Siang$ $= 20\%\ x\ 589.58$ $= 117.916\ Kalori$	Minyak Kacang Tanah $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{117.916}{902} x\ 100\ x\ \frac{100}{100}$ $= 13.073\ gram$
Camilan Siang	235.832	Buah	Alpokat $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{235.832}{85} x\ 100\ x\ \frac{61}{100}$ $= 169.244\ gram$
Makan Malam	471.636	Karbohidrat $= 65\%\ x\ Kal.\ Malam$ $= 65\%\ x\ 471.636$ $= 306.563\ Kalori$	Kentang $= \frac{Kal}{C} x\ 100\ x\ \frac{BDD}{100}$ $= \frac{151.022}{83} x\ 100\ x\ \frac{85}{100}$ $= 118.97\ gram$

ISSN: 2528-0260
P.513-530

		Protein $= 15\% \; x \; Kal. \; Malam$ $= 15\% \; x \; 471.636$ $= 70.745 \; Kalori$	Ayam $= \frac{Kal}{C} \; x \; 100 \; x \; \frac{BDD}{100}$ $= \frac{34.851}{302} \; x \; 100 \; x \; \frac{58}{100}$ $= 6.693 \; gram$
		Lemak $= 20\% \; x \; Kal. \; Malam$ $= 20\% \; x \; 471.636$ $= 94.327 \; Kalori$	Margarin $= \frac{Kal}{C} \; x \; 100 \; x \; \frac{BDD}{100}$ $= \frac{46.468}{720} \; x \; 100 \; x \; \frac{100}{100}$ $= 6.454 \; gram$
Camilan Malam	235.832	Buah	Semangka $= \frac{Kal}{C} \; x \; 100 \; x \; \frac{BDD}{100}$ $= \frac{80.135}{28} \; x \; 100 \; x \; \frac{46}{100}$ $= 190.852 \; gram$

4.2 System Implementation

The system starts with a loading screen and then displays the home page which is the main display of the Nutrition Intake Recommendation application. There are several menus in it, the Body Mass Index menu functions to calculate the nutritional status and ideal body weight. The daily Calorie menu serves to calculate daily calorie needs. Menu Nutrition recommendations function to calculate the amount of food recommended to meet calorie needs.

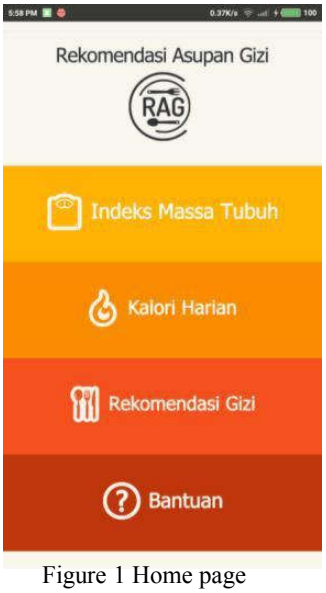

Figure 1 Home page

The following is one example of a system implementation that has been carried out:

ISSN: 2528-0260
P.513-530

Figure 2 Calculations on the Body Mass Index Menu

Figure 3 Calculations on the Calorie Menu

ISSN: 2528-0260
P.513-530

Figure 4 Choosing Foods According to Individual Conditions

ISSN: 2528-0260
P.513-530

Figure 5 Results of Calculation of Nutrition Intake Recommendations

4.3 Analysis of Test Results

Based on the questionnaire distributed to 20 respondents who are directly related to the system. Respondents were asked questions about how they responded to the use of the system. The following are the summary results of the questionnaire calculation:

Table 11 Questionnaire Table

No	INFORMATION	1	2	3	4	5
1.	App menu display	-	-	3	9	8
2.	Easy to understand application	-	-	5	8	7
3.	Easy to use application	-	-	6	7	7
4.	The application has an easy input process	-	-	8	8	4
5.	Application capabilities in the level of accuracy or accuracy of data	-	-	2	15	3
6.	Existing applications rarely occur errors	-	-	8	9	3

ISSN: 2528-0260
P.513-530

7.	Application capability in assisting assignments / jobs	-	-	7	9	4
8.	The application provides information that suits your needs	-	-	2	12	6
9.	Application capabilities can be convincing so you will recommend to your friends / colleagues	-	-	4	7	9
10.	The system provides freedom in choosing information that fits your needs	-	-	5	5	10

The results of the questionnaire answers were carried out using a Likert scale then presented in the form of a diagram with the formula:

((total response x * points Likert scale) /

likert scale total points) * 100%

Where the Likert scale total points

= Σ (total response x * points Likert scale)

= (0 * 1) + (0 * 2) + (50 * 3) + (89 * 4) + (61 * 5)

= 811

Then the result:

Very Dissatisfied = ((0 * 1) / 811) * 100% = 0%

Not Satisfied = ((0 * 2) / 811) * 100% = 0%

Quite Satisfied = ((50 * 3) / 811) * 100% = 18,496%

Agree = ((89 * 4) / 811) * 100% = 43,896%

Enough Agree = ((61 * 5) / 811) * 100% = 37,608%

ISSN: 2528-0260
P.513-530

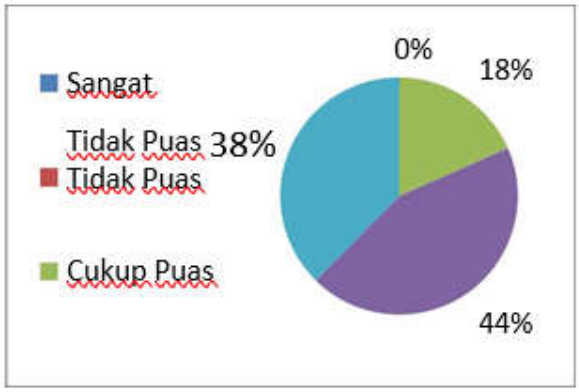

Figure 6 Questionnaire Calculation Result Diagram

Based on Figure 6 Questionnaire Calculation Result Diagram, it is seen that the respondents' high satisfaction with the application of recommendations for nutritional intake with presentations was quite satisfied 18%, satisfied 44%, very satisfied 38%. The description, it can be concluded that the system used is feasible to use.

V. CONCLUSION

From the test results obtained from the analysis of several individual conditions in the previous chapter, the results of the analysis of this study can be summarized as follows:

1. Determine the level of nutrition adequacy and ideal body weight calculated using the BMI formula.

2. For individuals with normal (not sick) criteria and individuals with coronary heart disease, the Harris Bennedict formula will be used to calculate their daily caloric needs.

3. For individuals with criteria for diabetes mellitus patients, the Perkeni formula will be used to calculate their daily caloric needs.

4. The test results show that recommendations for nutritional intake have a caloric value that is in accordance with daily caloric needs per individual.

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ISSN: 2528-0260
P.513-530

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