

## Sensitivity And Specificity Of Crandal And Ilayperuma's Formula To Predict Adult Weight And Height

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### Abstract

Many medical conditions do not allow direct weighing or measurement of body height. The circumference of the upper arm (CUA) is an alternative in determining body weight, while the ulna length can be used as an alternative for height. The aim of this study was to identify the sensitivity and specificity of Crandal and Ilayperuma's Formula to predict adult weight and height in Indonesia, especially in Pekanbaru. This study conducted using a quantitative approach with cross sectional design and involving 116 respondents who recruited using accidental sampling. The instrument used is a questionnaire, manual weight scales, metlin, and heel microtoise. Data were analyzed using spearman to and logistic regression test. The results showed that the sensitivity value of the Crandal and Ilayperuma's formula were 78,2% and 63,4%. Meanwhile, the specificity value of Crandal and Ilayperuma's formula were 75,4% and 80%. The Area Under the Curve (AUC) values in the Crandal and Ilayperuma formulas were 76,7% and 70,7%. Based on these findings, it can be concluded that the Crandal and Ilayperuma's formula can be used as an alternative in determining the estimation of weight and height of adults in Indonesia, even with moderate diagnostic power.

Keywords: circumference of the upper arm, crandal, estimation, ilayperuma, ulna length

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### INTRODUCTION

Nutritional screening is an important part of a person's nutritional identity. The accuracy and reliability of the instruments used in screening must ensure the suitability of the data obtained. The faster and easier to use the screening instrument which minimizes the time needed for the screening process (1). The nutritional screening process should be carried out as simply and efficiently as possible by nurses and other medical staff. Nutritional screening aims to identify the risk of nutritional problems and predict the possible improvement or worsening of outcomes and the effects of nutritional (2,3). The instruments used in nutritional screening need to be developed and

validated in various populations (4,5). The ideal instrument of high sensitivity and specificity and crucially in patients with special conditions. There are many instruments used in nutritional screening which consist of the main principles of assessing the actual condition (including body weight, height, and body mass index), 5% weight loss within 3 months, decreased food intake, and changes. and decreased appetite (6).

Body weight and height are included in the anthropometric measurement parameters which are very important in determining nutritional status (7). Determination of body weight in a way that is easy, fast and accurate is needed, especially in the clinical setting in terms of determining

drug doses or weight-based procedures for the safety and effectiveness of the intervention given (8). In certain medical conditions such as decreased consciousness, stroke, lower limb fracture, and the patient is unable to stand, upper arm circumference (UAC) can be used as an alternative to weight (6,9). As for the alternative measurement of height, the ulna length can be used (7,10,11). Many formulations used in predicting weight and height were adopted from America and Europe and very few were specific to Indonesians (12). Even though Indonesians have different body proportions, mistakes can occur in their calculations. Therefore, research problem was formulated to see how accurate the Crandal and Ilayperuma's formulas in predicting height and weight of adults in Pekanbaru.

This research scheme is based on the results of observations and interviews of researchers in the inpatient room for neurology, internal medicine and intensive care at several hospitals in Riau province, which found that nurses rarely weigh weight regularly due to the difficulty of weighing due to the patient's disease condition so that errors can occur in calculations. the patient's nutritional and therapeutic needs. Based on this phenomenon, this research aims to analyzing how sensitive and specific the Crandal and Ilayperuma formulas were for Indonesia, especially in Pekanbaru.

## **METHODOLOGY**

This study conducted using a quantitative approach with cross sectional design and involving 116 respondents who recruited using accidental sampling based on the inclusion criteria. The inclusion criteria in this study were adult men and women who lived in Pekanbaru, willing to be respondents, able to communicate, able to stand upright and have no defects in the spine, arms and legs. Data were collected included age, sex, height, weight, ulna length, upper arm circumference (UAC), and ethnic. The instrument used are a

questionnaire for demographic data, a manual weight scales, a metlin, and a heel microtoise. Body height is measured by standing upright using a microtoise heel with a maximum size of 200 cm with an accuracy of 0,1 cm. The length of the ulna was measured between the olecranon and the styloid process of the left arm with the hand crossed over the chest pointing at the shoulder with the palm open using a metline. Weight data is obtained by weighing the respondents using aneroid scales. Each data is observed and notes by the enumerator on the research observation sheet.

Data were analyzed using univariate in descriptive form by looking at the frequency distribution of each respondent's characteristic. In bivariate analysis, the Spearman test was used to assess the relationship between ulna length with height and upper arm circumference (UAC) with weight. The results of the correlation coefficient will show the magnitude or strength of the relationship between the ulna length with height and UAC with body weight. If the p value is  $<0.05$ , it means that there is a significant difference. The final stage of data analysis is to test logistic regression analysis to see the sensitivity and specificity of ulna length and upper arm circumference to predict of height and weight in adult. This can be seen from the Receiver Operating Characteristic (ROC) curve. The ROC curve will depict the area under the curve (AUC) which is an effective method for evaluating the quality of a diagnostic test (13).

## **RESULT AND DISCUSSION**

Based on Table 1 it is found that the majority of respondents were at early adult age (96 peoples or 83,6%). More than half of respondents were woman (69 peoples or 59,5%). The most of respondents's ethnic were Malay (50 peoples or 43,1%). Based on Table 2 it is found that the p value both of ulna length and UAC were same (0,000). It is mean that there were a significant relationship between length of ulna and UAC with height and weight in

Table 1  
Distribution frequency of repondents based on age, sex, and ethnic

Respondents Characteristics	Frequency	Percentage (%)
Age		
Early Adult	96	83.6
Middle age	19	16.4
Sex		
Men	47	40,5
Women	69	59.5
Ethnic		
Malay	50	43.1
Minang	21	18.1
Javanese	17	14.7
Banjar	25	21.6
Bugis	3	2.6

adult. The result also showed a strong correlation with coefficients 0,868 and 0,706. Based on Table 3 and Picture 1 it is found that the sensitivity of crandal and ilayperuma's formula were 78,2% and 63,4%. Meanwhile the specificity of crandal and ilayperuma's formula were 75,4% and 80%.

The result showed that there was a significant relationship between ulna length to height ( $p=0,000$ ) and UAC to weight ( $p=0,000$ ) with correlation coefficient 0,868 and 0,706. This result in line with Mulyasari and Purbowati in their study which showed that ulna length have a strong correlation power with height. On the other hand, they also said that there was a significant relationship between weight estimation by using UAC and actual weight (12). Another study explained that ulna length have better sensitivity rather than knee height to predict body height and already used in some country (14). Borhani-Haghighi, Navid, and Hassanzadeh added that using ulna length

is more precise and reliable method to predict height (10).

Cattermole, Graham, and Reiner in their research found that, there was a strong correlation between UAC and weight body neither in children or adult. They said the mid arm-arm circumference is one of the best parameter for estimated weight. The result from their research concluded that the linear formula of UAC is very appropriate to predict weight in adult and adolescents. By using mid-arm circumference, a accurate estimation of weight in adult could be provided. On the other hand, this simplified formula also cheap and easy to use in clinical setting (9).

Similar result also showed by Bonell, Huyen, Phu, Weirthem, and Nadjm in their research which conducted in Vietnamese population. The result showed there was a good correlation ( $P<0,001$  and  $r= 0,66$ ) between ulna length and height in aged 21-64 years old. The length of ulna could be used as a parameter to predict height when the direct measurement is impossible to do.

Table 2  
The correlation between ulna length and UAC to weight and height

Variable	R	p
Ulna length	0,868	0,000
UAC	0,706	0,000

Table 3  
Sensitivity and Spesifisity of Crandal and Ilayperuma's formula

	Sensitivity	Specificity
Crandal	78,2%	75,4%
Ilayperuma	63,4%	80%

Meanwhile, ulna length also has a good reliability and could be measure quickly and accurately in Vietnamese adult (15).

Based on Picture 1, also showed that the area under the curve (AUC) in Crandal dan Ilayperuma's formula were 76,7% and 70,7%. Its mean the Crandal and Ilayperuma's formula have a moderate diagnostic power to predict weight and height in adult. Sutriani and Isnawati showed that in their study there was no difference between actual height and estimated height by using ilayperuma's formula ( $p > 0,05$ ). They suggest to used ilayperuma's formula in Indonesian people by consider the ethnic and sex of respondents (16).

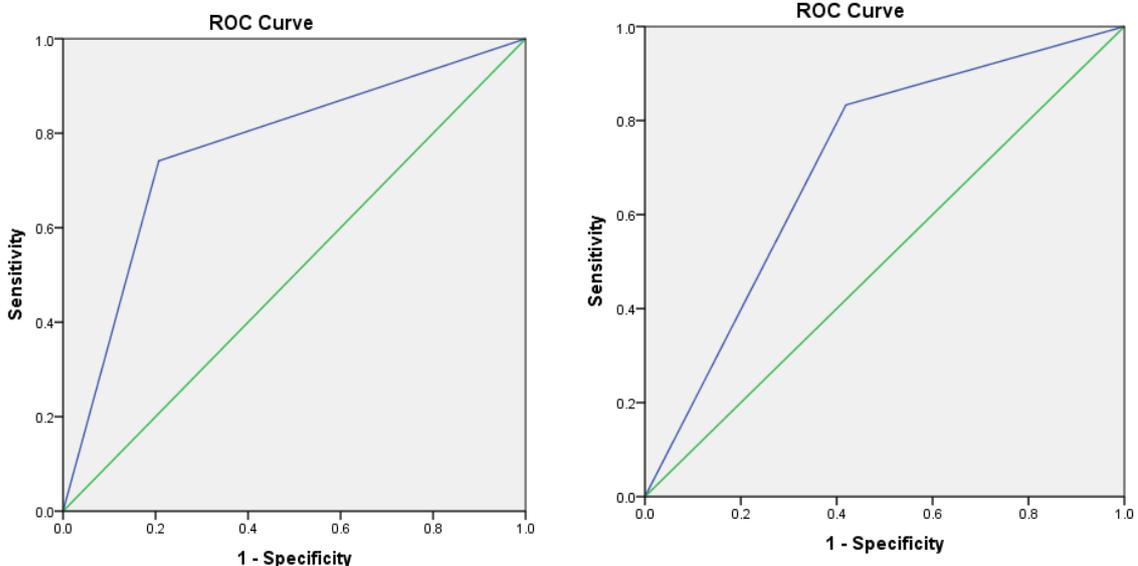
**RESEARCH LIMITATIONS**

This study was conducted during the Covid-19 pandemic so that researchers' access to data collection was limited. A

larger number of samples is likely to provide better research results.

**ETHICAL CLEARANCE**

Ethical in research is an important aspect that must be considered by researchers because it involves respondents who provide personal data. The researchers must be able to conduct research ethically while paying attention to the rights of the respondents. As for the ethical principles applied in this study are autonomy, confidentiality, justice, beneficence and non-maleficence (17). This study has been declared to be ethically appropriate in accordance to 7 (seven) WHO 2011 standards by Ethical Review Board for Medicine and Health Research Fakultas Kedokteran Universitas Riau with No. B/032/Un.19.5.1.1.8/UEPKK/2020.



Picture 1  
Area under the curve (AUC) for Crandal and Ilayperuma

## CONCLUSION

Based on these findings, it can be concluded that the Crandal and Ilayperum's formula can be used as an alternative in determining the estimation of weight and height of adults in Indonesia, although with moderate diagnostic power. It is recommended for nurses or the other health worker to use this formulas as predict for patient height and weight especially the patient who could not be assesst directly. This study was conducted during the Covid-19 pandemic so that researchers' access to data collection was limited. A larger number of samples is likely to provide better research results.

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