CALORIC REQUIREMENTS IN THE HEMODIALYSIS SUBJECT

by

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(ABSTRACT)

The nutritional needs of the renal patient vary as the renal function decreases. Little information exists concerning energy requirements for patients on hemodialysis. Renal failure has been called a wasting disease as evidenced by decreased body weight, body fat, arm circumference and serum proteins. This research was designed to help precisely define energy requirements for the hemodialysis subject. Resting energy expenditure (REE) was measured by indirect calorimetry in 17 male hemodialysis subjects whose mean age was 55 years at the Veterans Administration Medical Center in Hampton, Va. The Beckman MMC Horizon System, a portable device which permits the determination of heat production from gas exchange, oxygen consumption and carbon dioxide production was used.

By regression analysis, the measured REE was compared to the basal energy expenditure (BEE): the ideal weight based on the Metropolitan Life Insurance tables, the current weight taken on day of indirect calorimetry, a non-dialysis day, and the post dialysis weight taken immediately after dialysis. A correlation analysis of the dependent variable, REE, with the current, ideal and post dialysis BEE variables resulted in correlation coefficients of .3783, .0003, and

.3946 respectively. None of these correlation coefficients were significantly correlated with the REE. The post dialysis variable had the highest correlation coefficient, and thus the strongest relationship to the REE. While any of the weights studied could be used to determine energy needs for the hemodialysis subject, post dialysis weight may be the most desirable choice.

ACKNOWLEDGEMENTS

Many thanks go to Dr. Terry Tierney and Dr. Tim Morck for their help with this research at the VAMC. Special thanks go to Dr. Korslund and Dr. Novascone for their assistance and consideration. Thanks also to Dr. Webb for acting as a committee member on such short notice.

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INTRODUCTION

Human hemodialysis, the procedure by which water and diffusible solutes are removed from the blood of renal patients, was developed in the 1960's. Today approximately 55,000 patients are treated by dialysis in the United States. The disease processes for which hemodialysis is the treatment of choice eventuate from renal insufficiency and end stage renal disease (ESRD). When the patient is started on dialysis, the need to replete protein in the body is emphasized. In addition, the maintenance of basic caloric needs are concurrently treated and closely monitored during the rehabilitation process. There has been a great deal of data obtained on the protein needs of the renal patients. During the process of renal insufficiency until end stage renal disease when dialysis is initiated, nutritional status decreases. If caloric needs could be established more precisely, this would assist in improving the nutritional status of these patients. Overestimating their needs could possibly mean more dialysis time, because some of these calories may be from protein. Underestimating their needs may cause further depletion in their nutritional status. Through this research the relationship of alternative methods of computing caloric requirements in hemodialysis patients (ideal weight vs. post dialysis vs. current weight) with the caloric requirement determined through indirect calorimetry can be studied. Currently the calculation of caloric requirement is based on current weight, which given the patients compromised physical status is seldom close to ideal.

REVIEW OF LITERATURE

In 1903, Atwater and Benedict completed the original energy balance studies by direct calorimetry for 150 full days (1). This method measures the subject's heat production as the temperature change in water circulates through the chamber's walls.

Indirect calorimetry permits the determination of heat production from the measurement of nitrogen excretion and gas exchange, oxygen consumption and carbon dioxide production from the equilibrated data points are used with the Weir formula to derive Resting Energy Expenditure (REE) in kilocalories per day (2).

$$[3.9(VO\ ) + 1.1\ (VCO\ )]\ 1440\ \text{min/day} = REE$$

This method is equivalent to that used by Atwater and Benedict. Investigators in the past have used this technique to study the metabolic processes of various diseases and to formulate standards for REE in the normal populations. The most cited of these are the multiple linear regression equations of Harris and Benedict (3).

The Harris and Benedict equation is based on normal healthy individuals. Energy requirements in hospitalized patients cannot be adequately predicted from equations based on healthy individuals. By using the Weir formula, a more accurate determination of the metabolic needs can be made in the renal patients (4).

In 1978, Long et al. used a technique developed by Kinney et al. in 1964 which allowed for continuous monitoring of expired gases in acutely ill patients (5). Gas exchange measurements (usually 3-5 in number) were made during the day, averaged, and then extrapolated to a

24-hour urinary nitrogen excretion values. From this a daily resting caloric expenditure could be calculated. This information was then used as a guide to establish the proper amounts and composition of oral and IV nutrition in the convalescing patient.

In 1981, Elwyn et al. used indirect calorimetry to study the energy needs of surgical patients (6). Total energy expenditure can be divided into relatively constant resting energy expenditure (REE) and the activity energy expenditure. The latter is the most variable and can range up to 6 to 8 times the resting energy expenditure in a well trained individual. Resting energy expenditure is then further divided into basal metabolic rate (BMR) and the expenditure from food intake. Elwyn found it was not uncommon in a hospitalized patient to find the resting energy expenditure to be underestimated or overestimated by 30 percent. This becomes even more significant when it is confounded by corrections for stress, disease and food utilization in estimating caloric needs. By indirect calorimetry, Elwyn demonstrated a significant increase in energy expenditure in the burn and septic patient.

In 1985, Kopple et al. measured resting energy expenditure by indirect calorimetry in nondialized chronic renal patients (7). Each patient received .55-.60g protein/kg and randomly 45, 35, 25, 15 kcal/kg/day. The indirect calorimetry was performed at the end of the study. The energy expenditure of these patients was compared to normal men and women eating a libitum diets. Their values of the CRF patients did not differ significantly from the normal values. Dr. Kopple et al. were puzzled as to why the REE in the renal patient did not decrease when fed lower energy intakes. The chronic renal failure patient may not be able to conserve energy expenditure normally when energy intake is restricted. This may be another cause of malnutrition in renal failure.

Renal disease is often called a wasting disease. This can be shown by decreased body weight, body fat, arm circumference and serum proteins. Such factors as diet restrictions, anorexia, super imposed illness, repeated hospital admissions and tests all contribute to this wasting syndrome. Nutritional intervention plays an important role in attaining and maintaining the sense of well-being and improving the quality of life for the renal patient.

Many nutrients are lost during hemodialysis. These include free amino acids, peptides, water soluble vitamins and possibly glucose. Suggested guidelines of total calories for the dialysis patient:

35 kcal/kg/day - weight maintenance

25-30 kcal/kg/day - weight loss

40-50 kcal/kg/day - weight gain (8, 9)

Unless sufficient calories are given from cabohydrates and fats, the protein will be forced into energy production which could mean longer dialysis time (10). These guidelines still leave an unanswered question. Should we use current or ideal body weight? Through this research energy needs could be prescribed in more precise terms.

MATERIALS AND METHODS

The first objective of this research was to demonstrate that the predicted Basal Energy Expenditure (BEE) is correlated to measured Resting Energy Expenditure (REE) in the hemodialysis patient.

The second objective was to show that the ideal weight parameter best describes the population variance when age and height are blocked independent variables as compared to current or post dialysis weight.

Seventeen male hemodialysis subjects with chronic renal failure were evaluated at the Veterans Administration Medical Center (VAMC) dialysis unit in Hampton, Virginia during the calendar year January 1985 - January 1986. The subjects ranged in age from 38-67 years. The subjects were medically stable or had no recent hospital admissions within 2-3 months. Their duration of dialysis treatment ranged from nine months to fourteen years.

Resting energy expenditure was measured by the Beckman MMC Horizon System. This portable device measures the partial pressure of oxygen and carbon dioxide in mixed expired air in addition to volume temperature, time and barometric pressure. The raw data were processed by a programmable calculator which determines and prints at one-minute intervals the final metabolic variables: oxygen consumption, carbon dioxide production, minute ventilation and respiratory quotient. The Beckman MMC also signals steady states. Steady state means clearly stable values of minute ventilation, oxygen consumption, carbon dioxide production and respiratory quotient. The gas analyzers are calibrated prior to use to precisely analyze mixtures which approximate the composition of mixed expired air (16% O_2, 4% CO_2, balance N_2).

Subjects fasted after midnight before beginning the test. When he arrived in the morning, his height, weight, and wrist circumference were measured. Weight was taken on an electronic scale. A hospital scale and a tape measure were used respectively to obtain height and wrist circumference. Consent forms were signed and subjects were asked to lie quietly for approximately 30 minutes before the test was initiated. The subject had to breathe into a mouthpiece for 30-40 minutes after a steady state was obtained. A steady state was reached after the subject had adjusted to the mouthpiece and was breathing in a normal manner.

The Harris Benedict Equation was used to determine the predicted BEE of the current, ideal and post dialysis weight. The current and ideal weights were calculated on the same day as the indirect calorimetry was done. The ideal body weight (IBW) was determined by using the Metropolitan Life Insurance tables (11) (Appendix I). The frame size was determined by wrist circumference measurement as shown in Appendix II (12). The subjects are usually dialyzed three times a week. Dry weight is defined as the weight immediately following dialysis treatment. The BEE based on the post dialysis weight was calculated based on the dry weight on the day before the REE was determined.

The data given in kilocalories were analyzed by a regression analysis. The measured REE was the dependent variable. The independent variables of height and age were entered. Then the independent variables of BEE in kilocalories, based on current, ideal, and post dialysis weights were analyzed. The statistical analyses were done using the SPSS (Statistical Procedure for Social Sciences). The strength of the overall obtained prediction equation was evaluated utilizing an F-test. The interrelationships among the dependent and independent variables were examined by the Pearson Product Moment Correlational Analysis.

RESULTS

Table I gives a descriptive analysis of the variables studied. A regression analysis was performed on each of the three predictor variables. The dependent variable was correlated to the calculated current, ideal and post dialysis energy variable. As indicated in Table I, the range of the three predictors was generally the same. Furthermore, their variance was very similar as would be required for a valid regression analysis.

The objective of this regression analysis was to predict the value of the dependent measured REE variable given the values of the associated variables of normal, post dialysis and ideal independent variables. The dependent variable or measured REE was obtained from the author's sampling and the independent variables were calculated from the Harris Benedict Equation. From the analysis, an equation was derived which could be used to estimate the value of the dependent variable given the value of the independent variables. This equation provides an estimate and not a prediction interval.

This regression equation was derived from the algebraic formula:

$Yx = a + b X$

Yx = estimated value of dependent variable given a specific value of the independent variable, X.

a = point of intersection of linear regression line.

b = slope of regression line.

x = specific value of independent variable.

TABLE I

Means, standard deviations, and ranges of variables

VARIABLE	MEAN	SD	RANGE
Age (years)	55	8.5	38 - 67
HT (height cm)	176	4.7	168 - 183
WT CURKGS[a]	78	19.4	49 - 124
WT IDKGS[b]	73	4.2	66 - 80
WT POKGS[c]	76	19.1	49 - 123
MEASREE KCAL[d]	1575	245	976 - 1944
CURBEE KCAL[e]	1639	289	1139 - 2165
IDBEE KCAL[f]	1556	136	1385 - 1716
POSTBEE KCAL[g]	1615	276	1133 - 2152

[a]Current weight in kilograms.

[b]Ideal weight in kilograms.

[c]Post dialysis weight in kilograms.

[d]Measured resting energy expenditure in kilocalories.

[e]Basal energy expenditure in kilocalories based on current weight.

[f]Basal energy expenditure in kilocalories based on ideal weight.

[g]Basal energy expenditure in kilocalories based on post dialysis weight.

The intercorrelation of the predictor variables with the dependent measured REE are presented in Table II. This correlation used the following Pearson product moment correlation coefficient:

$$r = \frac{(2x\ 2y)}{N}$$

2x = 2 scores from variable x

2y = corresponding 2 scores for variable y.

N = number of pairs of x and y values.

Figure 1 is a scatter diagram in which each plotted point represents an observed pair of values for the independent post dialysis BEE and the dependent variable measured REE. This scatterplot has the strongest relationship of the three variables. The r value (correlation coefficient) was .3946, and the F value was .1178, which was not statistically significant.

Figure 2 is a scatterplot of the independent variable current BEE and the dependent variable REE. The r value was .3783 and the value was .1343, and was not statistically significant. Visual examination of the raw data also reveals that this variable was similar numerically to the post dialysis variable.

Figure 3 is a scatterplot of the independent variable ideal BEE and the dependent variable REE. The correlation coefficient of .0003 and the F value of .9973 indicated that these parameters were not significantly related. Thus, this variable was the one least likely to predict the measured REE. The ideal weight parameter did not best describe the population variance.

TABLE II

Intercorrelation of the Variables

Variables:	AGE	HTCM[a]	MEASREE[b]	CURBEE[c]	POSTBEE[d]
HTCM	-.2927 (17) P= .254				
MEASREE	.1192 (17) P= .649	-.2302 (17) P= .374			
CURBEE	-.4963 (17) P= .043*	.0816 (17) P= .756	.3783 (17) P= .134		
POSTBEE	-.4595 (17) P= .064	.0741 (17) P= .777	.3938 (17) P= .118	.9970 (17) P= .000*	
IDBEE	-.6045 (17) P= .010*	.6577 (17) P= .004*	.0009 (17) P= .997	.5281 (17) P= .029*	.5207 (17) P= .032*

*$P \leq 0.05$

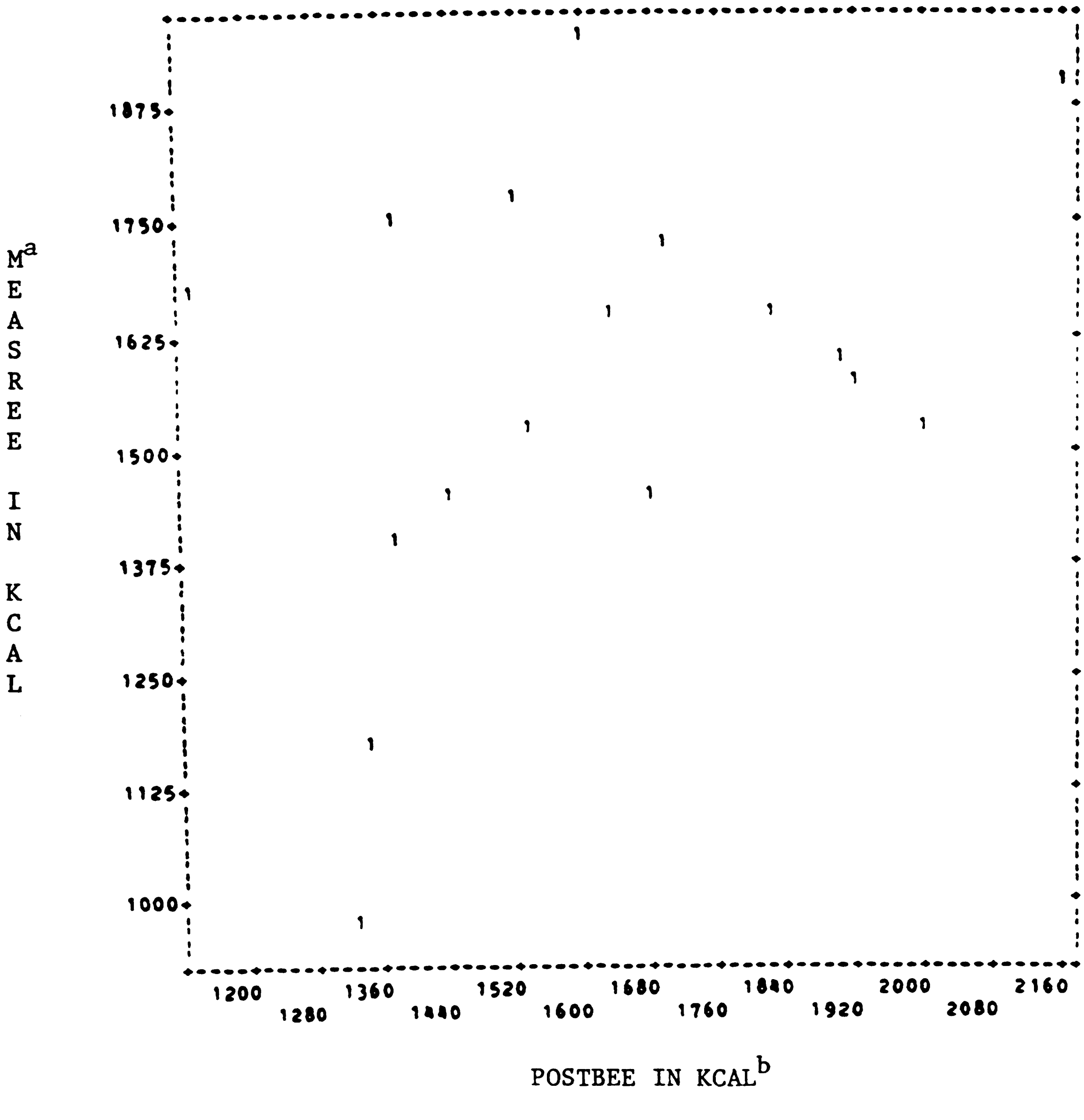
[a]Height in centimeters.

[b]Measured resting energy expenditure in kilocalories.

[c]Basal energy expenditure in kilocalories based on current weight.

[d]Basal energy expenditure in kilocalories based on post dialysis weight.

[e]Basal energy expenditure in kilocalories based on ideal weight.

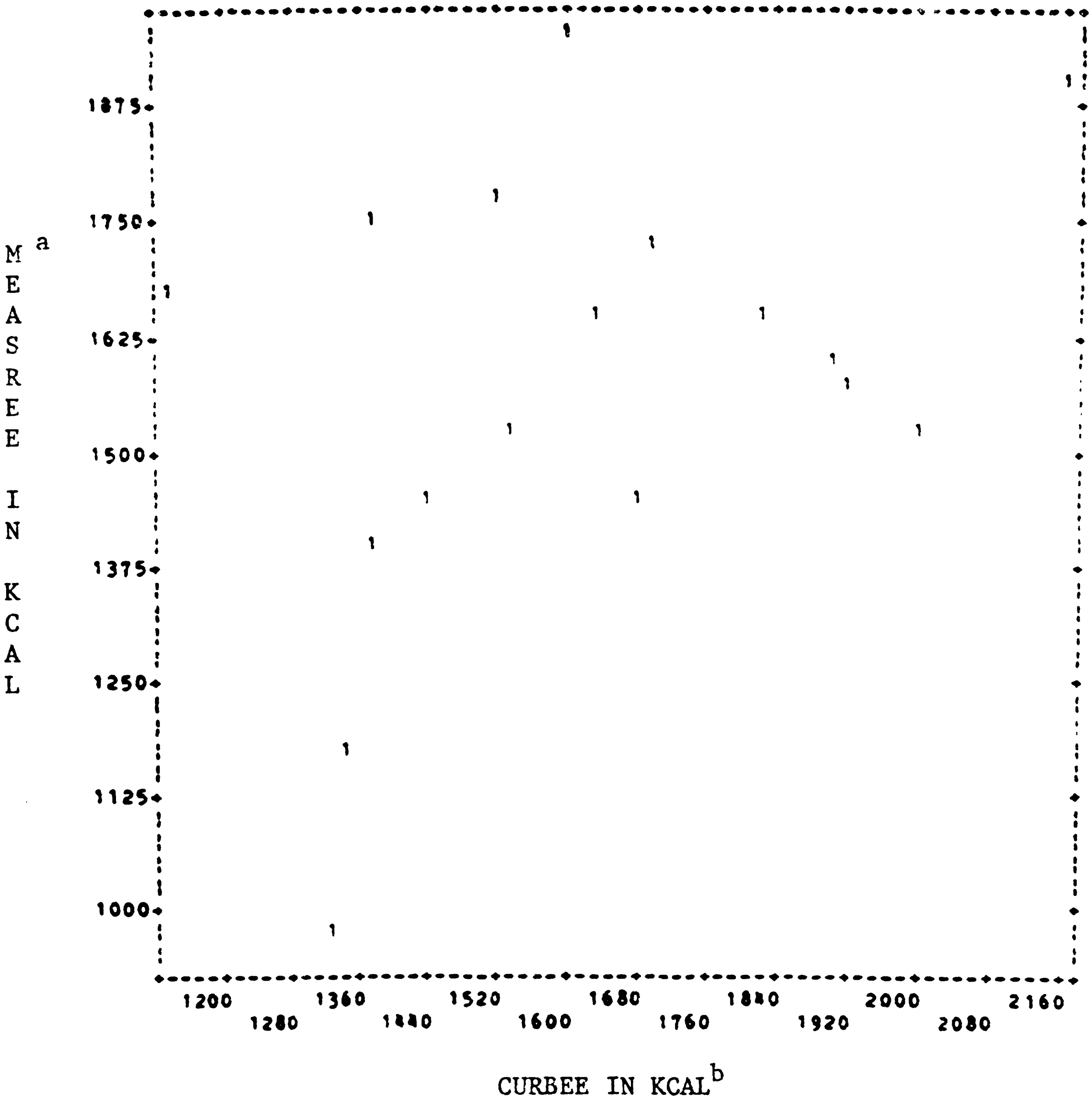


Measured resting energy expenditure

Basal energy expenditure based on post dialysis weight

FIGURE 1

PLOT OF MEASREE WITH POSTBEE

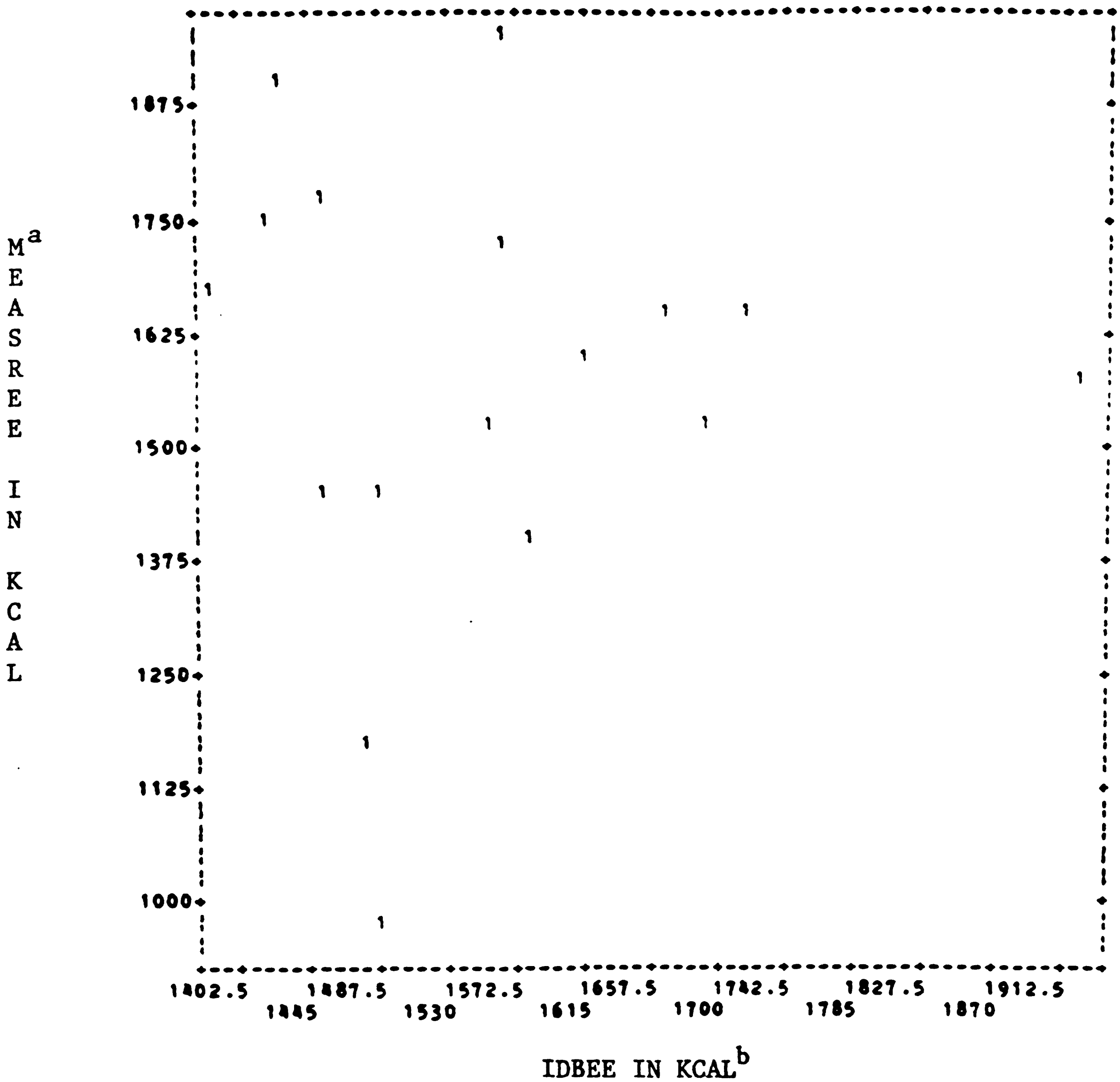


[a] Measured resting expenditure

[b] Basal energy expenditure based on current weight

FIGURE 2

PLOT OF MEASREE WITH CURBEE



[a]Measured resting expenditure

[b]Basal energy expenditure based on ideal body weight

FIGURE 3

PLOT OF MEASREE WITH IDBEE

Figure 4 illustrates the kilocalories (kcal) per kilogram (kg) of body weight of each subject for the three variables based on his own REE. These values were obtained by adding 30% to the measured REE, and dividing this number by ideal, current and post dialysis weights, respectively. As may be recalled from the literature review, the current recommendations are 45 kcal/kg for the underweight, 30-35 kcal/kg for maintenance and 25-30 kcal/kg for weight loss. The kilocalories needed for the sample subjects ranged from 18-45 kcal/kg. The mean for each weight was 28.2, 27.5, 27.9 for ideal, current and post dialysis respectively.

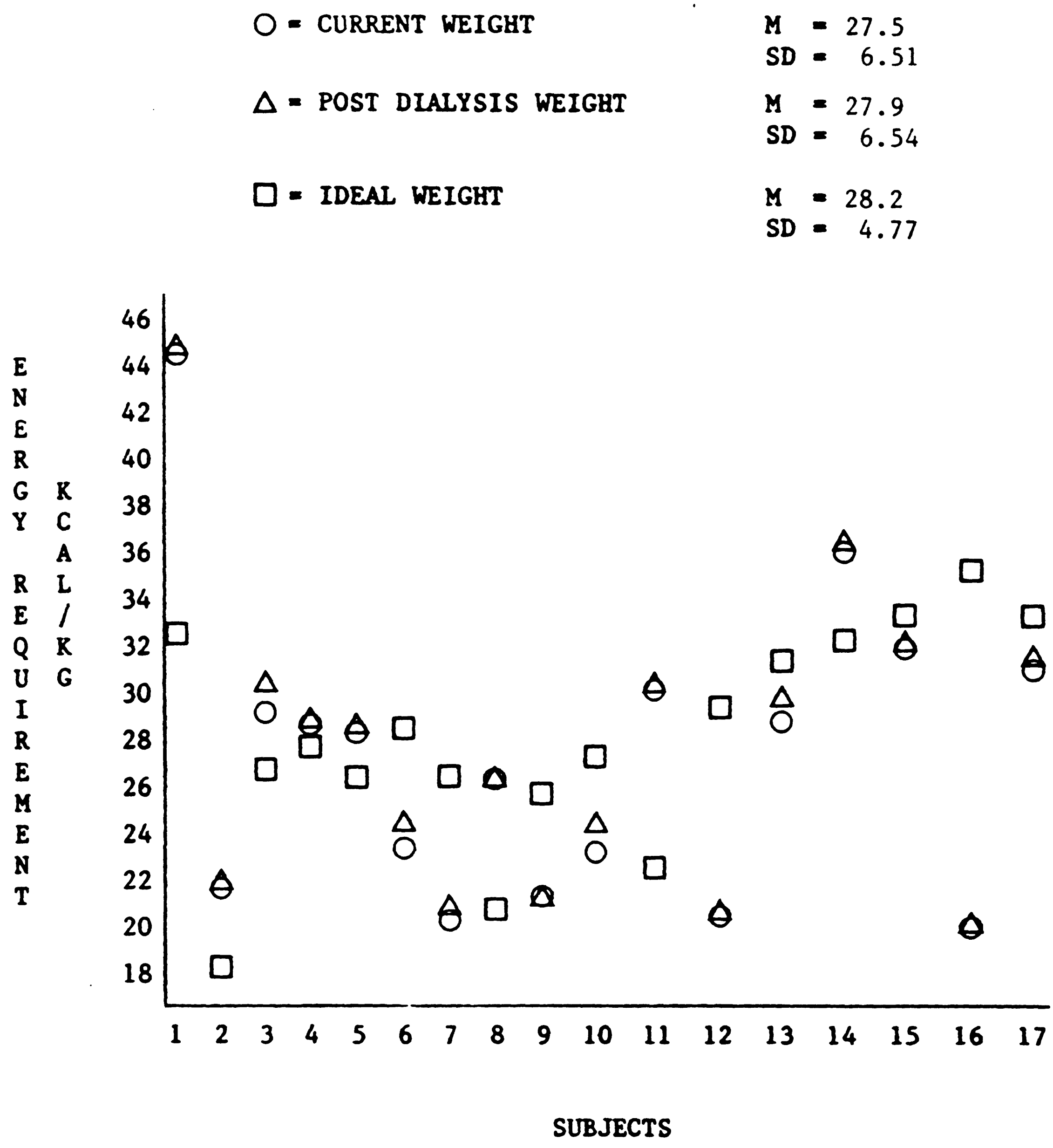


FIGURE 4

ENERGY REQUIREMENT OF SUBJECTS CALCULATED FROM REE AND EACH OF THE THREE WEIGHT MEASUREMENTS

DISCUSSION

The ideal BEE correlated significantly to the height as expected. The ideal BEE also correlated significantly with the age which is a variable already computed by Harris and Benedict. The post dialysis BEE correlated significantly with the current BEE because these weights were taken within 24 hours of each other and were in close proximity. The ideal BEE correlated siginificantly with the current BEE. The post dialysis BEE correlated significantly with the current BEE. The post dialysis BEE correlated with the ideal BEE because these are weights on the same subjects. The raw data on each subject is shown in Appendix VI.

Thunberg et al. reported no improvement in nutritional status in a group of long term maintenance hemodialysis patients who were followed for a mean of 31 months (13). Kopple et al. followed 30 men undergoing hemodialysis from 0 to 156 months. His results indicated that most of the patients had abnormal nutritional parameters and appeared wasted (14).

The maintenance hemodialysis subject has been described as above and by many researchers as wasted. This research was limited because a lean body mass determination was omitted. If it had been obtained, possibly more definite terms could be given to the post dialysis weight parameter. The nutritional parameters used for the assessment of the chronic renal failure patient need different definitions for the stable homodialysis subject. The sensitive aspects of these measurements are their changes over time for the hemodialysis population (15).

The sample size of this research was smaller than anticipated. Forty six subjects were identified as potential candidates. Some of the reasons for the limited size were several subjects went on peritoneal dialysis and others obtained a transplant.

The analysis for the REE went smoothly. The Beckman machine never had any difficulties during each measurement. There was one period during the study year when the machine required a part and was unavailable for about three weeks.

Through a personal contact, Dr. Kopple referred the author to a symposium of his entitled "Causes of catabolism and wasting in acute and chronic renal failure" (16). This article gives reference to separate energy expenditure studies done by Kopple, Gotch, and Feinstein in acute renal failure. Energy expenditure was increased 37% above normal in patients with acute renal failure. The Harris Benedict Equation was used for some of these studies but the results could not establish any firm relationship between energy intake and decreasing renal function.

After studying the literature on indirect calorimetry, it is evident that hormones do affect metabolic rates. Insulin promotes protein synthesis. However, in chronic renal failure insulin resistence is common (17). Three out of the 17 subjects were diabetic, and this is another factor in the study which may have confounded the results.

The National Dialysis Study evaluated the caloric intake of 165 randomized dialysis subjects (18). The mean caloric intake for all groups was 24 kcal/day. This value was obtained from kilocalories/day from diet histories divided by post dialysis weight. Many of the food records indicated underestimation as evaluated by protein catabolic rate and dietary protein intake.

Clinical application of this research indicates that current caloric guidelines are higher than could be justified by REE measurements from this study. The activity factor was computed so this was total energy expenditure. When energy requirements were calculated based on measured REE from this study, only one subject required approximately 45 kcal/kg. These figures were based on his current and post dialysis weights. When calculated on ideal weight this subject would only require 33 kcal/kg. Elevated caloric needs may mean higher protein intake unless care is taken in choosing foods. This extra protein in the diet could result in a need for more dialysis time. Caloric requirements in the stable hemodialysis population need to be better defined.

This research was restricted by sample size. To validate this study, a larger sample would be required. This may be possible by obtaining data for several years at the dialysis unit in Hampton, VA or perhaps working cooperatively with another VA dialysis unit.

This research suggests that the chronic hemodialysis subject's caloric needs could be estimated by any of the calculated weights. The post dialysis weight may be best because it resulted in the highest correlation coefficient with the REE, but the relationship was not statistically significant. A larger population sample might validate the relationship. After a subject is stable on hemodialysis, the body adapts its energy needs to its current muscle mass even if it is below ideal parameters. Long term changes in energy balance and measurements of lean body mass provide an important reference for comparison of rates of energy expenditure among groups of dialysis subjects (19). A measurement of lean body mass was not obtained, but would have added credence.

A larger sample of the stable hemodialysis population needs to be examined. This research project provided a window for an area which needs a door. A duplication of this study with more definitive criteria and a larger population should produce a significant guideline for determining the energy needs of the stable hemodialysis subject. Lean body mass needs to be determined and correlated to the REE. Also, another study should not include diabetics as another disease is another variable added to the equation.

CONCLUSIONS

This research identified a need for further research. There were no significant differences in using ideal, current or post dialysis weight for determining caloric needs. The post dialysis parameter was found to be the variable most strongly related to the REE. The ideal body weight parameter was found to be the variable with the least relationship to the REE. Clinical application of these findings is that the calorie needs of a subject seemed to be lower than those recommended. Current recommendations stem from the pre-dialysis stages. Recommendations for caloric intake of the stable hemodialysis patient need to be more clearly defined.

SUMMARY

As End Stage Renal Disease evenuates into a dialysis treatment, nutritional status in most patients decreases to a severe depletion. A number of factors contribute to this wasting, such as diet restrictions superimposed illnesses and anorexia. The dietitian and physician are faced with the dilemma of determining caloric needs for these subjects as well as monitoring their monthly nutritional blood values. In an attempt to define caloric needs in more detail, indirect calorimetry or resting energy expenditure (REE) was completed on 17 stable male hemodialysis subjects. Their mean age was 55 years, and their dialysis duration ranged from nine months to 14 years. In a regression analysis, the REE measurement was compared to the Harris Benedict equation using ideal, current and post dialysis weight variables to determine which was the best predictor of the REE. Correlation analyses were completed for all three of the weight variables - ideal, current and post dialysis with REE. After statistical analysis using the F test, none of the variables were found to be significantly related to the REE. The post dialysis variable had the strongest comparison to the REE. Sample size was the largest limitation in this study. A larger sample would mean less chance and possibly more significance.

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APPENDICIES

APPENDIX I

1983 METROPOLITAN HEIGHT AND WEIGHT TABLES

MEN

HEIGHT		SMALL	MEDIUM	LARGE
FEET	INCHES	FRAME	FRAME	FRAME
5	2	131	136	144
5	3	133	138	147
5	4	135	139	149
5	5	137	142	152
5	6	139	145	155
5	7	142	148	159
5	8	144	151	162
5	9	147	154	166
5	10	149	157	169
5	11	151	160	173
6	0	155	164	176

Metropolitan Life Insurance Tables 1983 with shoes in pounds (11)

APPENDIX II

Wrist Measurement*

$$r = \frac{\text{height (in centimeters)}}{\text{wrist circumference (in centimeters)}}$$

	r value	frame size
males	10.4 or greater	small
	9.6 to 10.4	medium
	9.6 or less	large
	11.0 or greater	small
	10.1 to 11.0	medium
	10.1 or less	large

This method of estimating body frame size correlates well with results obtained with the body frame size chart.

*Grant, J. P, 1980 (12)

APPENDIX III

Abbreviations

HD - Hemodialysis, artificial kidney or dialysis by means of a blood access.

VAMC - Veterans Administration Medical Center

BEE - Basal energy expenditure.

BUN - Blood urea nitrogen.

ECF - Extracellular fluid volume.

EDRD - End stage renal disease.

RDA - Recommended dietary allowance.

REE - Resting energy expenditure.

KG - Kilogram.

Post dialysis - Weight recorded immediately after dialysis.

Current Weight - Weight recorded on day of BEE.

Ideal Weight (desirable) - Weight based on Metropolitian Life Insurance tables.

CRD - Chronic renal dialysis.

KCAL - Kilocalories

SPSS - Statistical procedure for social sciences.

F-test - Developed by RA Fisher, the analysis of variance concept.

VO_2 - Oxygen consumption.

VCO_2 - Carbon dioxide production.

APPENDIX IV

PATIENT CONSENT FORM

VETERANS ADMINISTRATION MEDICAL CENTER
HAMPTON, VIRGINIA 23667
Information About:

"Caloric Measurement of hemodialysis Patients"

I understand that the purpose of this project is to determine the number of calories I need for good health. I understand that I will have to fast or go without food from midnight until completion of the measurement, and that I will have to breathe into a mouthpiece for almost 30–45 minutes. I understand that I may have to do this more than once.

I understand that I may or may not benefit from this study, but that my participation will help my doctors and dietitian better understand my health. If the results of this measurement are made public, I will not be identified by name without my written permission. Also, I understand that the Food and Drug Administration may inspect these records.

I understand that my participation is voluntary and if I elect not to participate there will be no penalty or loss of benefits to which I am otherwise entitled. Also, I understand that I may withdraw from the study at any time without penalty or loss of benefits to which I am otherwise entitled.

In the event I sustain physical injury as a result of participation in this investigation, if I am eligible for medical care as a veteran, all the necessary and appropriate care will be provided. If I am not eligible for medical care as a veteran, humanitarian emergency care will nevertheless be provided.

If I have any questions about this project, I may call Ms. Vicki Rondinelli, phone #722-9961, beeper 572 or Dr. Timothy Morck, ext 655. Both of the Hampton VAMC.

If I have any medical questions about this project I may call Dr. Tom MacKenzie, beeper 27.

______________________________ ______________________________

Patient's Signature Date **Witness' Signature Date**

I have explained the above to the subject on the date stated on this Consent Form.

____

Physician's Signature Date

APPENDIX V

RAW DATA ON EACH SUBJECT

SUBJECT NUMBER	AGE	HEIGHT	WRIST	WEIGHT CURRENT	WEIGHT IDEAL	WEIGHT POST DIALYSIS	MEAS REE	PREDICTED BEE CURRENT	PREDICTED BEE IDEAL	PREDICTED BEE POST DIALYSIS
	YEARS	CM	CM	KG	KG	KG	KCAL	KCAL	KCAL	KCAL
1	67	170.0	10.0	49.0	67	48.6	1680	1139	1385	1133
2	61	175.0	10.0	58.6	70	57.7	976	1337	1490	1323
3	52	175.0	10.0	64.5	70	61.8	1451	1479	1486	1441
4	51	177.8	9.0	74.5	77	74.0	1655	1636	1667	1630
5	56	180.0	11.0	69.5	75	69.0	1522	1546	1552	1540
6	43	167.6	10.0	80.9	66	78.0	1458	1726	1452	1686
7	38	182.8	10.0	98.6	75	95.0	1535	2080	1689	2004
8	63	181.6	10.0	57.5	73	57.5	1170	1339	1478	1339
9	51	177.8	8.0	95.0	79	95.5	1574	1917	1686	1924
10	54	182.8	9.6	91.0	78	87.7	1647	1872	1716	1822
11	54	172.7	9.6	60.0	80	59.5	1393	1393	1578	1383
12	49	172.7	8.6	100.7	70	100.0	1590	1984	1611	1907
13	45	177.8	9.9	77.9	71	75.0	1733	1723	1562	1689
14	62	175.0	10.0	62.6	70	61.8	1746	1385	1418	1373
15	62	175.0	9.2	79.0	75	78.6	1944	1614	1561	1605
16	66	167.6	8.4	124.0	70	123.0	1912	2165	1427	2152
17	62	172.7	9.7	74.5	69	73.0	1786	1535	1455	1518
MEAN	55	175.5	9.6	77.5	73	76.0	1575	1639	1541	1615
SD	8.5	4.7	.7	19.4	4.2	19.0	245	289	104	276

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