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ANAIS - PROCEEDINGS

EFFECT OF ANTHOROPOMETRICS PARAMETERS IN A WHOLE BODY COUNTING PROCEDURE TO ABNORMAL LEVELS OF RADIOACTIVITY

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Abstract

Two criteria to evaluate the limit level of abnormal radioactivity measurement on whole-body counter are discussed. The first take in account the sample mean added with three standard deviation. The second suppose that limit would be estabilished to each individual according its own anthoropometrics parameters such weight (W) height (H), total body potassium (TBK) and body fat (F) . The experimental data shown that the criteria using anthropometric parameters improve the evaluation. The multiple linear regression coefficient was $r = 0.92$.

INTRODUCTION

The whole body counting devices are designed to measure radioactivity in the human body with high sensivity and performance. So, they are used in the measurement of the trace levels of gamma emitters. When the WBC are applied in evaluation of low level gamma tracers it is important to know the human background-range-limit (BRL).

As an approximation rule we can estimate the BRL as the sample mean added with three samples standard deviation. However, this criteria does not take in account the variance components which "mask" the basic information, i.e., the abnormal level of radioactive elements.

To establish more accurate BRL value it is important to know the principals variance components in the WBC/measurement.

The total body potassium (TBK) consiste of 0,0118% of K which is the principal radioisotope naturally found in the human body [4]. Based on this information, we can suppose that the results of total count WBC measurement are correlatated directly with the TBK. Burkinshaw et al. (1,3) describe that the TBK can be estimated By:

$$\text{TBK (mmol)} = 814 - 16.27\text{xAge} + 4.3\text{xHeight} + 36.47\text{xWeight} \pm 322 \quad (1)$$

On the other hand, there exist differences of concentration of K in the body tissues [4]. It is know that the muscular tisue is richer in K than the fat tissue. Consequentely, we can suppose that the fat tissue actuate as a shield in the ordinary WBC measurement.

One way to correlate the shielding effect of the fat tissue is by measuring the skinfold thickness using a Harppender caliper, [2].

The height and weight are also WBC-contributory-variables wich have to be account because they are intrinsically correlated with the geometrical counting efficiency.

Based in all these considerations the total count expected from a measurement of an uncontaminated subject is:

$$\text{TCexpec} = a_0 + a_1W + a_2H + a_3\text{TBK} \quad (2)$$

were W is the weight; H is the height; F is the skinfold tickness and TBK is the total body potassium previously estimated by the empirical equation of Burkinshaw et al. (1) and a to a_4 are regression parameters validated to each WBC device.

EXPERIMENTAL

Twenty nine normal man (not suspected of contamination) were measured on

WBC previously calibrated in the 0.1 to 3 MeV energy range.

The WBC device was configured with one 8X4" NaI(Tl) detector assembled in a 10 cm steel room.

RESULTS

After submitting our experimental total count data in multi linear regression we obtained the following equation:

$$TCexpec = -97.9 - 4.9W + 1.5H - 0.88F + 154.8TBK \pm 22 \text{ (cpm)} \quad (3)$$

The statistical regression quality is shown in the table bellow:

REGRESSION TABLE

SOURCE	SQUARE SUM	D.F. (*)	MEAN SQUARE
REGRESSION	56514.58	4	14128.645
DESIDUE	66235.94	22	465.270
TOTAL	66750.52	26	

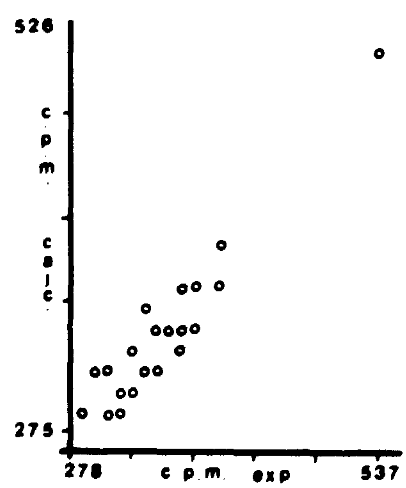
F = 30.37

DETERMINATION COEFFICIENT	=	0.8466
MULTIPLE LINEAR REGRESSION COEFFICIENT	=	0.9201
STANDARD ERROR	=	21.5701

(*) Degrees of freedom

We conclude that TCexpec multi linear model can predict about 85% of the overall experimental variance. The remainder (15%), expressed by the regression standard error is 22 cpm, we can supose that approximately 12cpm is due the statistical flutuation, and so, about 10% is due to others causes not take in account in our experiments.

The following figure show the graphical agreement between the experimental versus claculated values.



The experimental mean value from the 29 measurement was 351 ± 52 cpm, the BRL using the first criteria was 507 cpm. So, each subject will be considered as abnormal if its counts result more than 507 cpm.

On the other hand, if the particular subject has W = 70Kg; H = 170 cm ; AGE = 30 years and a composed skinfold tickness F = 40, then by applying the

$$TC_{expec} = -97.9 - 4.9x70 + 1.5x170 - 0.88x40 + 154.8x4.8 = 410 \pm 22 \text{ cpm}$$

We conclude that the BRL of this measurement is 410 + 66 = 476 cpm, wich represent a better limit. It is easy to imagine that other individuals can show values higher or smaller than the population BRL.

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