BODY SURFACE AREA OF INDIANS

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ABSTRACT

A simple method for measuring body surface area of
man is described. Surface areas of twenty Indian subjects
were measured by this method and compared with the
values calculated by using the height-weight formula of
DuBois. It has been shown that the DuBois formula
can be used for calculating body surface areas of Indians
with the same degree of accuracy as obtained by
DuBois with non-Indian subjects.

Accurate determination of body surface areas has been engaging the atten-
tion of physiologists for over two centuries. They have employed several
methods of measuring it and proposed various formulae by which it may be
calculated from simple measurements (Quiring, 1947). The height-weight
formula proposed by DuBois and others (DuBois & DuBois, 1915; DuBois
et al 1916 ; Sawyer *et al* 1916) is the one most commonly used at present. This
formula relates surface area with height and weight by the expression $A = 71 \cdot 84$
$\times H^{0 \cdot 725} \times W^{0 \cdot 425}$ where A is the surface area in m^2, H the height in cm and
W the weight in kgm. It was based on measurements of surface area on ten
subjects by a method which consisted in preparing a thin mould of the body
surface, cutting up the mould into pieces which could be laid flat, printing the
patterns of the pieces on photographic paper and finding the area of the pieces
by cutting them out and weighing. The subjects chosen by these authors,
though few in number and all of American origin, differed widely from one
another in stature and bodily shape, and owing to this reason, their formula is
being used by workers in other countries as well, notwithstanding possible
differences in body configuration between different peoples. Ramaswamy and
Mookerjee (1953) showed that the formula is also applicable to Indian subjects.
These authors did not actually measure the body surface areas but computed
the same from certain linear measurements using the linear formula method
of DuBois. It was, therefore, considered worthwhile to check the applicability
of the height-weight formula to Indian subjects by carrying out actual
measurements of the body surface areas using a simple and dependable method.

Methods

Methods based on the use of adhesive tapes, paper strips and inking roller
were tried for measuring body surface area, but results were not satisfactory.
The method devised by Paintal (personal communication) for the purpose of
this investigation and found most satisfactory, is as follows:—

Rectangular strips with areas ranging from 1 sq. cm. to 75 sq. cm. were cut
from rubberised cloth, particular care being taken that the edges were straight.
The body surface to be measured was coated with starch emulsion and allowed
to dry. Strips of suitable area were dipped in dilute iodine solution, excess
liquid was pressed out on a flat surface and the strips were laid flat without
creasing or stretching on the starched surface. With slight pressure, a clear blue
impression was left on the body surface when the strips were removed. Another

impression with a suitable strip was then made with its edge exactly coinciding with that of the previous one. In this manner the whole body surface was covered as completely as possible, the area covered being calculated from the number of strips and the corresponding areas. Portions which could not be thus covered were traced out and their areas measured by a planimeter. The scalp could not be measured in this way since no impression could be obtained with the strips owing to the presence of hair. It was measured by stretching on the head a piece of muslin, making the latter tight and free from crease and marking on it the area to be measured. The cloth was then opened out and the area marked out was measured. It is true that due to the presence of hair, the area so obtained was an over-estimation. The penis and scrotum were not measured and this omission (which was less than 50 sq. cm.) was in part made up for by the positive error in the measurements of scalp area. The areas of the strips were checked regularly by taking their impression in the moist state and measuring them by a planimeter. It was found that the areas of the strips were unaffected by continual use.

The reliability of the method was checked by having the surface area of the arm of the same person measured by different individuals. The results agreed within 0·5 per cent. With practice, the measurement of surface area of one subject could be finished in about three hours.

Test Subjects

Measurements were made on twenty Army men varying in age from 24 to 46 years and possessing diverse types of stature and body build.

Experimental Procedure

Measurements were taken during the morning session before the subject had his heavy meal. Nude body weight and height were first recorded. The body surface was demarcated into right and left halves with a wax pencil. Only one half was measured and the result multiplied by two to give the total surface area.

Results

In Table I are given the surface areas of 20 subjects measured according to the method described along with the corresponding figures calculated from the height-weight formula of DuBois and DuBois. Duplicate figures are given for 17 of the subjects on whom the measurements were made twice. The differences between the measured and the calculated areas are expressed as percentage of the measured areas and are given in column 6 of the Table I.

Discussion

As shown in the table, the percentage variation of the calculated from the measured area ranges from +3·7 to —3·4 with an average of +1·3. DuBois and DuBois observed the percentage differences to range from +5·1 to —2·0 with an average of +0·2. By applying the method of least squares to the logarithms of the data on height (H) and weight (W), a formula has been obtained which gives a closer fit to the observed values.

$$\text{Surface area } (A) = 113 \cdot 1 \times H^{0 \cdot 6468} \times W^{0 \cdot 4092}$$

Statistical analysis of the percentage differences show a standard deviation of 2·0 in the present series of observation when DuBois formula is used and 1·7, when the above formula is used for calculating the surface area ; on the other hand, in the series of observation made by DuBois and DuBois, the standard deviation is 2·2.

TABLE I—SURFACE AREA OF INDIAN SUBJECTS
Measured by strip-cover method and calculated by DuBois height-weight formula

Name	Weight Kgm.	Height cm.	Calculated Area m²	Measured Area m²		% variation of calculated from measured area	
				1	2	1	2
MR	68·04	165·1	1·75	1·77	..	—1·1	..
RB	62·60	175·0	1·76	1·73	..	+1·7	..
RP	53·07	162·3	1·56	1·54	..	+1·3	..
ANS	69·85	165·1	1·77	1·71	1·76	+3·5	+0·6
DC	53·53	166·3	1·59	1·60	1·60	—0·6	—0·6
CS	46·27	154·4	1·42	1·47	1·42	—3·4	0
SD	57·15	174·1	1·69	1·68	1·63	+0·6	+3·7
RS	50·80	163·3	1·53	1·48	1·50	+3·4	+2·0
SL	48·08	156·3	1·45	1·41	1·40	+2·8	+3·5
BM	57·15	171·2	1·67	1·64	1·64	+1·8	+1·8
SR	60·33	176·9	1·73	1·73	1·73	0	0
DP	56·70	169·0	1·65	1·60	1·61	+3·1	+2·5
JRS	54·89	160·1	1·56	1·55	1·54	+0·6	+1·3
LS	62·60	166·2	1·70	1·69	1·64	+0·6	+3·7
CB	53·07	167·4	1·59	1·60	1·58	—0·6	+0·6
SKS	61·69	167·4	1·70	1·68	1·67	+1·2	+1·8
JR	60·78	175·0	1·74	1·74	1·73	0	+0·6
JS	59·42	173·8	1·72	1·68	1·67	+2·4	+3·0
SS	55·79	170·6	1·65	1·62	1·63	+1·9	+1·2
SSS	57·15	168·1	1·65	1·63	1·62	+1·2	+1·8

It is, therefore, evident that so far as Army personnel are concerned the DuBois formula is applicable to Indian subjects with the same degree of accuracy as was obtained by DuBois and DuBois in their original series of observation.

Conclusion

The DuBois height-weight formula can be used for calculating the body surface areas of Indian subjects, specially Indian Army personnel. The percentage variation of the calculated values from values obtained by actual measurement is not significantly different from that observed by DuBois and DuBois.

Acknowledgement

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