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CONTRIBUTION TO INVESTIGATIONS ON WORKERS' BASAL METABOLISM*

The results of the authors' investigations permit of the following conclusions:

1. Basal metabolism of workers doing heavy physical work was higher than of those doing lighter physical work;

2. Basal metabolism of ore loaders, carpenters and stokers in the agglomeration exceeded Harris-Benedict rates for about 19%;

3. Harris-Benedict tables of basal metabolism apply only to workers doing lighter physical work.

The investigations of F. G. Benedict have pointed out the constancy of man's basal metabolism and his insensitiveness to certain environmental factors. On the basis of observations which were responsible for this claim, Harris and Benedict were able to draw up their well-known tables showing that weight, height, age and sex determine the metabolic rates. Discrepancies from these standard values would imply pathological changes of the organism examined. However, tests carried out by Palmer, Means and Gamble on the one hand and by Gessler on the other have shown that different seasons exerce an influence on man's basal metabolism. Ozorio de Almeida has proved that climate has an analogous influence. In experiments with animals one of us (5) has studied the influence of temperature, to which animals had been exposed for some time, on basal metabolism. Thus a grown-up rat living for weeks in a temperature of between 0 and + 2° C produces at that temperature about 2440 cal per m^2 of his body surface in 24 hours and its basal metabolism is about 900 cal per m^2 in 24 hours. Living in a temperature of 16—20° C it produces about 1140 calories per m^2 in 24 hours, and its basal metabolism amounts to altogether 640 cal per m^2 in 24 hours. Thus the dependance of basal metabolims on the total energetic metabolism, carried out for some time under the influence of external temperature, has been proved.

Starting from this fact that the intensity of supplementary processes of oxidation, increasing in order to maintain the constancy of body temperature in the zone of chemical thermoregulation, influences the intensity of basal oxidation processes, we were interested in our work to find out what are the rates of basal metabolism of certain workmen producing daily constant, though mutually different, amounts of warmth during the process of industrial production?

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In other words: have all clinically healthy workers, irrespective of the work they perform, a basal metabolism of roughly the same rate per unit of body surface, or, in still other words, do the rates of basal metabolism of physical workmen during heavy work correspond to Harris-Benedict tables?

We carried out investigations on clinically healthy workers of the Bor mines following the method Douglas-Haldane. The temperature in the laboratory where energetic metabolism was measured was kept around 19° C. Lying on a bed at least half-an-hour before the beginning of measurements of gas changes the workmen would be covered with a light blanket.

The persons on whom basal metabolism investigations were carried out were trained beforehand in the respiratory technique; 10—20 hours were allowed to lapse from the end of their work to the measurement of basal metabolism. During that time the workmen would sleep and relax completely. All measurements were carried out in the morning. On the previous night they would have a little bread with tea for supper, and in the morning they would take no food before the experiments.

For our investigations we used mostly workmen doing physically heavy and physically light work to find our first bearings in the problem before us. Conditions under which those workmen worked were hygienic except those in the furnace and in the agglomeration. Their nutrition was on the whole equal. The results obtained are reproduced in table 1.

This table shows that the values discovered for most workmen do not correspond to those noted by Harris and Benedict. Some workmen showed no divergence from rates put forward by these American authors or they showed only a slight increase, whereas others, those doing heavy work, showed substantial increase amounting to + 18%.

If we compare the approximate daily consumption of the workers examined on the basis of the papers by Rubner and Molčanova with the rates obtained in basal metabolism, we shall notice close interdependence between daily output of work and basal metabolic rates (table 2).

We do not know the daily energetic requirements of assistant borers (on rock face) and of slag removers. Their work is no doubt lighter than that of carpenters and stokers, and heavier than that of workers in the machine workshop. Therefore in our table they were placed between those two groups.

TABLE 1

Basal metabolism of some workers

Workers	Occupation	Age Years	Weight kg	Height cm	Basal metabolism cal. per 24 hours		Basal metabolism increase beyond Benedict rates in %
					found	according to Benedict	
A.S.	mine exploder	24	65.6	173	1679	1672	0
B.D.	engine builder	21	77.1	183	2026	1901	6.4
M.P.	» »	19.5	93.6	186	2162	2153	0
N.Ž.	metal turner	20	59	173	1687	1609	4.9
St.Lj.	locksmith	29	53.45	164	1401	1412	0
H.G.	accountant	20	59.47	165	1698	1625	4
I.D.	assistant chief of furnace	45	59.6	157	1394	1364	2.2
K.N.	assist. borer	21	61	164	1688	1584	6.6
B.J.	slag remover	30	61.7	167	1727	1548	11.5
K.H.	» »	27	64.1	169	1709	1607	6.3
S.V.	stoker in agglomeration	30	63.9	175	1927	1584	19.4
Lj.J.	»	27	62.5	165	1900	1569	21.1
Lj.S.	»	19	66.8	168	1963	1630	20.4
M.M.	assistant carpenter	25	54.4	162	1625	1450	9.5
S.P.	»	44	73.9	174	1990	1656	20.1
D.V.	loader	26	69 37	171	2152	1694	27
J.A.	»	28	65.6	172	1977	1634	21
I.St.	»	19	58.3	174	1949	1628	19 7
T.M.	»	21	63.6	173	1867	1671	11.7
S.P.	»	45	61.0	164	1682	1428	17.8
B.J.	carpenter	36	68.4	178	1817	1657	9.6

TABLE 2

Consumption of energy in everyday life and basal metabolic rate

Worker	Average daily consumption cals.	Increase of basal metabolism beyond Benedict rates
Mine exploder, locksmith, engine builder, metal turner, assistant chief of furnace, clerk	3000	± 0%
Assistant borer (on rock face), slag remover		+ 8%
Ore loader, carpenter, assistant carpenter, stoker in agglomeration	5000	+ 17.9%

This evident interdependance between the entire daily output of energy and the basal metabolic rate is shown by the comparison between the amount of work in the course of the last month and the basal metabolic rates registered among those workers who had their daily output of work thoroughly examined (table 3).

TABLE 3

Daily output of work and basal metabolic rates

Workers	Number of tip-trucks with about 900 kg of ore loaded daily	Increase of basal metabolism beyond Benedict rates
B.J.	15	9.6%
T.M.	15	11.7%
M.M.	15	9.5%
D.V.	25	27.0%
J.A.	25	21.0%
Lj.J.*	25	21.1%

* Stoker in agglomeration who threw daily 25 trucks of ore into the foundry.

Thus we see that there exists a close interdependence between the daily consumption of energy and the basal metabolic rate. Not only does man's basal metabolism change under the influence of supplemental heat as shown by Palmer, Means and Gamble — basal metabolism being higher in winter than in summer — but it changes also under the influence of physical work. This is borne out also by investigations of Farkas, Geldrich and Szakall on corn-cutters.

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3. Harris-Benedict tables of basal metabolism apply only to workers doing lighter physical work.

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SADRŽAJ

PRILOG POZNAVANJU OSNOVNOG PROMETA U RADNIKA*

Autori iznose svoja opažanja o bazalnom metabolizmu kod radnika.

Na osnovu izvršenih ispitivanja mogu se izvesti ovi zaključci:

1. Bazalni metabolizam radnika na teškom fizičkom radu veći je nego u radnika na lakšem fizičkom radu.

2. Bazalni metabolizam utovarivača rude, tesara i ložača na aglomeraciji veći je od Harris-Benedictovih vrijednosti oko 19%.

3. Harris-Benedictove tablice bazalnog metabolizma vrijede samo za radnike, koji rade lakše fizičke poslove.

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