RESPIRATION THROUGH THE SKIN IN PERSONS

OF VARIOUS AGES (from 3-100 years)

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In previous research work carried out on persons 20-30 years of age we showed [1] that cutaneous respiration in
man at rest and under ordinary atmospheric conditions amounted to 1-1.5% of the pulmonary respiration, but that
there was a steep rise (to 8% or more) under unfavorable conditions (high temperature, heavy physical work, asphyxi-
ation, hypoxia) and in a number of pathological states in which a rise compensated to a certain degree for a deficient
pulmonary gas exchange.

In the present work we studied the age peculiarities in respiration through various areas of the human skin.

METHODS

The investigations were carried out on persons aged from 3-100 years by a method which we developed during
earlier work [1]. At the same time as we made measurements on the cutaneous respiration we determined the pul-
monary gas exchange by the Douglas–Haldane method.

Those employed in the tests were healthy persons who had rested for an hour lying on a couch. Ninety-three
persons in all were examined and they belonged to the following age groups: 3-4, 6-7, 9-10, 13-14, 21-30, 31-40,
41-50, 61-80, and 81-100 years. The results of the investigations were statistically examined by an analysis of
variance.

RESULTS

As is seen from Table 1, among children 3-4 years old, there were almost no differences in the respiration
through the various areas of skin, the fluctuations over the different areas being within the limits of 75-78 ml/h/m²
of body surface, both for the absorption of oxygen and for the excretion of carbon dioxide.

Topographical differences in cutaneous respiration were noticed among the age groups. Thus, in children 6-7
years old, the gas exchange through the thorax and abdomen was already rather higher than that through the skin in
the thigh region. In children 9-10 years old, the highest rate of exchange was observed through the skin of the thorax,
a somewhat lower rate through the abdominal skin and a still lower rate over the thigh region.

Besides that, the intensity of gas exchange through the different areas of skin increased with age. Thus, if the
oxygen absorption through the thoracic skin of a 3-4 year old child was, on an average, 78 ml/hour, then the average
absorption increased to 99 ml/hour in a child of 6-7 years, to 106 ml/hour at 13-14 years and at an age of 21-30
years it rose to 108 ml/hour. In persons 31-40 years old, oxygen absorption through the skin rose still further and
amounted to 171 ml/hour. The same high rate of gas exchange through the thoracic skin, as through the skin in other
areas, was observed in persons 41-50 years old.

On the other hand, in individuals over 50 years old the intensity of respiration through the various areas of skin
diminished. A gradual reduction in the amount of oxygen taken up by the skin was observed in persons 80 years old.
Between 80 and 100 years, the intensity of oxygen consumption remained at the previous level or was a little higher.
Similar changes with age occurred in the excretion of carbon dioxide through the skin.

A simultaneous study of the pulmonary gas exchange in these same individuals showed that both the uptake of oxygen and the excretion of carbon dioxide, calculated on 1 m² of body surface, gradually decreased with age.

As is seen from Figs. 1 and 2, the changes in respiration through the skin and through the lungs which take place with aging, are both different (Fig. 1 is drawn from the data in Table 1). Respiration through the skin increases at first but later, beginning at the age of about 50 years, slowly diminishes, whereas respiration through the lungs, calculated on unit surface of the body, gradually diminishes from the age of 3 to 70-80 years. Afterwards, the intensity of pulmonary respiration remains at the previous level or even rises a little.

A comparison which we made between the magnitudes of respiratory exchange through unit surface of skin and the respiration through unit surface of the lungs showed that, in comparison with the lungs, the cutaneous gas exchange increased with age (Table 2). If in the 3-4 year old child the respiration through the various areas of skin which we measured was 0.7-0.73% of the pulmonary gas exchange, then between the ages of 61-80 years it had reached 1.5-1.8%.

As our investigations showed, the changes in the oxygen consumption through the skin and in the amount of carbon dioxide excreted were almost equal and, consequently, the relationship $\frac{CO_2}{O_2}$ in all age groups was, as a rule, close to or equal to unity. At the same time, the respiratory quotient of the pulmonary gas exchange in individuals fluctuated from 0.7 to 1.0. This implies that it is impossible to judge the changes in the metabolism of the organism from a consideration of the respiratory quotient of the cutaneous respiration: the respiratory quotient for pulmonary respiration...