

Energy Expenditure in Free-Living (DLW)

Measurement of total energy expenditure in free-living humans using reference standard doubly labeled water (DLW) technique

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The use of the doubly labeled water (DLW) technique offers the best estimate of total energy expenditure (TEE) in free-living humans under routine conditions, therefore making it the reference standard of energy expenditure in validation studies. The technique involves the ingestion of water labeled with two stable isotopes of a single hydrogen ($^2\text{H}_2\text{O}$) and oxygen (H_2^{18}O). The method is based on the principle that after a loading dose of $^2\text{H}_2^{18}\text{O}$, ^{18}O is eliminated as CO_2 and water, while deuterium is eliminated from the body as water. The rate of CO_2 production, and, thus, energy expenditure, is calculated from the difference of the two elimination rates. DLW is an ideal method for use in free living subjects because it is noninvasive and nonrestrictive. The only requirement of subjects is to give urine and saliva specimens before and after drinking an initial dose of $^2\text{H}_2^{18}\text{O}$, and then return in one to two weeks to give a final urine specimen. During the period between the initial and final urine and saliva samplings, subjects are free to carry out their normal activities and are not required to maintain diaries or wear any devices. This is a safe procedure as the isotopes are stable and emit no radiation. Limitations of the DLW method include high cost (about \$1100/person), the need for specialized equipment and expertise to implement the techniques, and the fact that the method can only be used to measure expenditure over a long period of time (e.g. 10–14 days). Doubly labeled water has an error rate of about 5% over a 2-week period due to starting and ending conditions.

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