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Improved accuracy of resonant cavity perturbation determination of total body water by using a dual mode measurement

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Total body water (TBW) is an important factor in the diagnosis and treatment of many clinical conditions such as kidney failure, and is also a significant parameter in nutritional studies. The resonant cavity perturbation (RCP) is a rapid, non-invasive and relatively inexpensive method of measuring TBW that has been shown to compare favourably with existing techniques such as deuterium dilution, dual X-ray absorptiometry and bio-impedance analysis. In this method, the patient is placed in a large resonant cavity and the changes to its fundamental resonant frequency and Q-factor are measured. These changes depend on the dielectric properties of the body tissues which in turn are determined mainly by the water content of the body. The sensitivity can be demonstrated by asking a volunteer to drink a small amount of liquid between measurements, and is better than one litre. Although the sensitivity varies from subject to subject, we have shown that by fitting a second-order polynomial to the variation of sensitivity versus the mass-to-height ratio, we are able to apply the RCP method to a wide range of ages and body types. Furthermore, the uncertainties in the measurement owing to our inability to reposition the patient exactly each time can be reduced using a dual-mode method. In this the patient lies horizontally in a room of rectangular cross-section, and two sets of antennas measure the shifts in frequency of two different modes, one with electric field aligned in a dorsal-ventral direction, the other with the field aligned laterally. Combining these reduces the effects of body shape and position.