

EFFECT OF BREATHING GAS PRESSURE ON RESPIRATORY STATICS AND DYNAMICS OF
IMMERSED MAN.

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The deficiency of physiological evidence concerning levels of pulmonary work divers can tolerate, has resulted in the ventilatory requirements of underwater breathing apparatus being largely based upon mechanical testing. This study investigated elastic and flow-resistive pulmonary work during immersion. It was hypothesised that immersion would elevate pulmonary work, and that the use of positive static breathing pressures would return pulmonary work to levels which exist in air.

Ten subjects performed trials in air (control) and during upright immersion. Subjects wore a diving hood which provided facial counter-pressure, and were supplied air at four hydrostatic pressures: mouth pressure, lung centroid pressure (P_{LC} : +1.33kPa relative to sternal notch pressure), P_{LC} -0.98kPa, P_{LC} +0.98kPa. Transrespiratory, transpulmonary and transthoracic pressures, and inspiratory airflows were recorded (50Hz) during static pressure-volume relaxation manoeuvres, and spontaneous respiration. Elastic work, pulmonary resistance (at mean flow rate of $0.51.s^{-1}$) and dynamic pulmonary work were computed.

Uncompensated immersion resulted in a two to three-fold elevation in static inspiratory muscle work ($p < 0.05$), dynamic pulmonary work ($p < 0.05$), and pulmonary resistance averaged over inspiration and expiration ($p < 0.05$). Breathing pressure compensation produced a progressive return of each variable towards control status. Values for static and dynamic pulmonary work were not significantly different from control levels when air was supplied at P_{LC} ($p > 0.05$).

It was suggested the mechanism responsible for improved pulmonary mechanical status, with breathing pressure modification, was an elevation in expiratory reserve volume and pulmonary vascular disgorgement. It was concluded that underwater breathing apparatus be modified to supply air at +1.33kPa relative to the pressure at the sternal notch, when divers adopt an upright posture. This value for P_{LC} is approximately 0.5kPa less than that usually found within the literature.