



## Research

## Pregnant women maintain body temperatures within safe limits during moderate-intensity aqua-aerobic classes conducted in pools heated up to 33 degrees Celsius: an observational study

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## KEY WORDS

Pregnancy  
Exercise  
Temperature  
Aqua-aerobics  
Water temperature



## ABSTRACT

**Question:** What is the body temperature response of healthy pregnant women exercising at moderate intensity in an aqua-aerobics class where the water temperature is in the range of 28 to 33 degrees Celsius, as typically found in community swimming pools? **Design:** An observational study. **Participants:** One hundred and nine women in the second and third trimester of pregnancy who were enrolled in a standardised aqua-aerobics class. **Outcome measures:** Tympanic temperature was measured at rest pre-immersion (T1), after 35 minutes of moderate-intensity aqua-aerobic exercise (T2), after a further 10 minutes of light exercise while still in the water (T3) and finally on departure from the facility (T4). The range of water temperatures in seven indoor community pools was 28.8 to 33.4 degrees Celsius. **Results:** Body temperature increased by a mean of 0.16 degrees Celsius (SD 0.35,  $p < 0.001$ ) at T2, was maintained at this level at T3 and had returned to pre-immersion resting values at T4. Regression analysis demonstrated that the temperature response was not related to the water temperature (T2  $r = -0.01$ ,  $p = 0.9$ ; T3  $r = -0.02$ ,  $p = 0.9$ ; T4  $r = 0.03$ ,  $p = 0.8$ ). Analysis of variance demonstrated no difference in body temperature response between participants when grouped in the cooler, medium and warmer water temperatures (T2  $F = 0.94$ ,  $p = 0.40$ ; T3  $F = 0.93$ ,  $p = 0.40$ ; T4  $F = 0.70$ ,  $p = 0.50$ ). **Conclusions:** Healthy pregnant women maintain body temperatures within safe limits during moderate-intensity aqua-aerobic exercise conducted in pools heated up to 33 degrees Celsius. The study provides evidence to inform guidelines for safe water temperatures for aqua-aerobic exercise during pregnancy. [Brearley AL, Sherburn M, Galea MP, Clarke SJ, (2015) Pregnant women maintain body temperatures within safe limits during moderate-intensity aqua-aerobic classes conducted in pools heated up to 33 degrees Celsius: an observational study. *Journal of Physiotherapy* 61: 199–203]

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## Introduction

Obstetric guidelines for exercise during pregnancy recommend that pregnant women participate in regular moderate-intensity physical exercise.<sup>1–3</sup> They consistently advise not to overheat during exercise due to the potential for foetal harm.<sup>2–4</sup>

Many pregnant women choose to exercise in water, either swimming or participating in aqua-aerobics classes. There are a number of benefits of doing so, including the low-impact effects of buoyancy and the significant beneficial effects on the cardiovascular system due to hydrostatic pressure.<sup>5</sup> Another benefit is that water is an excellent conductor of heat, having 25 times the conductivity rate of air, and is thus an excellent dissipater of exercise-induced body heat if the heat gradient is adequate.<sup>6</sup> Pool water temperature could therefore have a direct effect on whether overheating will occur during an aqua-aerobics session.

Water temperatures between 33 and 37 °C have been termed thermoneutral in a non-exercising healthy person.<sup>7,8</sup> The value may be toward the lower end of these temperatures in a pregnant

woman because of the insulating effect of increased fat storage during pregnancy.<sup>5</sup> During exercise, the thermoneutral value of water may alter due to endogenous heat production and vary with the intensity and duration of the exercise. The thermoneutral temperature for moderate-intensity swimming or aerobic exercise in water is reported to be 30 °C.<sup>9</sup> This temperature is considered to be an appropriate temperature for pregnant women doing aerobic exercise in the pool.<sup>5</sup>

When medical bodies have written guidelines for exercise in pregnancy, they consistently warn against overheating; however, only two give a value for the upper limit of water temperature and these have been inconsistent. The 2003 guidelines of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists<sup>10</sup> stated that pregnant women must not exercise in water above 28 °C, but the current guidelines have no recommended value for water temperature.<sup>3</sup> The current British guidelines from the Royal College of Obstetricians and Gynaecologists state that water temperature for aqua classes in pregnancy should not exceed 32 °C.<sup>2</sup> The American College of Obstetricians

and Gynecologists has not provided a recommended value for water temperature for exercise during pregnancy.<sup>1</sup>

To date, there is little evidence in the literature for the safe upper limit of pool water temperature for pre-natal exercise. The aim of this study was to examine body temperature response of pregnant women engaged in an aqua-aerobics program in community swimming pools, which are normally heated between 28 and 33 °C. Such information would provide empirical evidence that may help to support or inform guidelines for water temperature in aerobic exercise during pregnancy.

Therefore, the research question for this observational study was:

What is the body temperature response of healthy pregnant women exercising at moderate intensity in an aqua-aerobics class where the water temperature is 28 to 33 °C?

## Method

### Design

This observational study measured the body temperature changes in pregnant women before, during and after an aqua-aerobics class. The classes involved moderate-intensity exercise in water at the temperatures currently maintained in community pools.

### Participants, therapists and centres

Healthy, pregnant women in their second and third trimester of pregnancy who were already enrolled in a pre-natal aqua-aerobics program were invited to participate in the study. The women had already received signed medical clearance from their obstetrician or midwife and had no medical condition or pregnancy complications that would deem them unfit to undertake aerobic exercise. Each participant was measured on one occasion only.

Women who were limited in their capacity to exercise because of musculoskeletal conditions or multiple pregnancies were excluded. Other exclusion criteria were: fever, high blood pressure and potential pre-eclampsia, an open wound, local infection, an allergy to chlorine, feeling unwell on the day, and ruptured membranes (due to risk of bacterial infection). Women in their first trimester of pregnancy were not admitted to the aqua-aerobics program due to class size limitations and the benefits of buoyancy being greater once body shape changes.

For standardisation, one therapist researcher led all aqua-aerobics classes and undertook all measurements. The researcher and participants were blinded as to pool water temperature, which was measured at the end of the exercise session.

Measurements took place at seven indoor community pools over a period of 18 weeks. The pools were chlorinated according to the regulations set by the Victorian Health Department. Pool depths ranged from 0.7 to 2.2 metres.

### Intervention

The aqua-aerobics program consisted of a standardised exercise routine and choreography, which was led by the physiotherapist. The 45-minute class included a 35-minute moderate-intensity aerobic workout, which was choreographed to motivating contemporary music of 130 beats per minute, and consisted of warm-up, cardio-fitness exercises, resisted exercises, mobilisation exercises and deep-water exercise without rest periods. The participants were asked to exercise at mid-sternum depth. Standard aquatic equipment, such as foam water dumbbells and foam noodles, were used for added resistance and flotation. The last 10 minutes of the class consisted of pelvic floor muscle exercises, and an active cool-down with floating and gentle stretching. All participants in the class were asked to work at moderate intensity, that is, 13 on the Borg Rating of Perceived Exertion (RPE) scale,<sup>11</sup> or a metabolic equivalent (MET) of

4. Women who were taking part in the study were asked to keep their head well out of the water and not to get their ears wet. Participants consumed water ad libitum, but were encouraged to do so while still moving.

### Outcome measures

Body temperature was measured with an infrared, tympanic, electronic thermometer<sup>a</sup>. Water temperature and air temperature were measured with a handheld resistance thermometer<sup>b</sup>. Humidity was measured with a hygrometer<sup>c</sup>.

Upon arrival at the pool, each participant was asked to sit quietly to read and sign an informed consent form and then to read the Borg RPE Scale. The Borg RPE Scale has been found to be useful for physical exercise prescription for pregnant women in their last gestational trimester, both in water and on land, especially when exercise is performed at moderate intensity.<sup>11</sup> It is recommended for monitoring exercise intensity in pregnancy in preference to heart rate, which is considered unreliable.<sup>12</sup> Having attended previous aqua-aerobics classes, participants were already familiar with the concept of moderate-intensity exercise.

Tympanic temperature was measured from the right ear with the tympanic thermometer<sup>a</sup> set on 'ear' mode. It was measured four times: Time 1 (T1) – prior to entering the pool after sitting quietly for 15 minutes; Time 2 (T2) – after exercising in the pool for 35 minutes; Time 3 (T3) – at the end of the 45-minute class before exiting from the water; and Time 4 (T4) – prior to leaving the facility after showering and dressing.

Perceived exertion was recorded at T2. If the tympanic temperature was found to be > 1.5 °C above the resting temperature (the safe upper limit for maternal core temperature rise reported in the pregnancy literature<sup>13–15</sup>), or if the participant looked flushed or felt uncomfortably warm or hot, she was asked to cease exercising.

### Data analysis

The sample size required to detect a 0.5 °C change in body temperature after exercise was based on a pilot study (unpublished) where tympanic temperature change was measured in 20 students before and after cycling. From this study and consideration of the clinical group of interest, a standard deviation of the change in temperature in the order of 1.5 °C was assumed (repeated measures design, mean difference in pre-exercise and post-exercise temperature). Using an alpha of 0.05 and a power of 0.8, the sample size was calculated to be 73. The actual sample size was increased to at least 100 in order to ensure a minimum number of participants in the sub-sets of pool temperatures that were to be compared.

Regression analysis was used to examine patterns in the data, with water temperature being the independent variable and the change in tympanic temperature being the dependent variable. The covariates, air temperature and humidity were adjusted for by multiple regression analysis. The participants were also grouped according to water temperature categories: Group 1 – participants exercising in water temperature between 28.8 and 30.0 °C; Group 2 – participants exercising in water temperature between 30.1 and 32.0 °C; Group 3 – participants exercising in water temperature between 32.1 and 33.4 °C. Analysis of variance was used to compare the groups in terms of body temperature. A result was considered statistically significant if the *p*-value was < 0.05.

### Results

Three hundred and thirteen women in the second or third trimester of pregnancy attended the aqua-aerobics classes over the study period. One hundred and fourteen women volunteered to participate in the study and two of these did not meet the inclusion criteria. Three participants were excluded from the analysis as water was splashed into their ears. Therefore, the data from

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