Reviewer's report

Title: A counterbalanced cross-over study of the effects of visual, auditory and no feedback on performance measures in a simulated cardiopulmonary resuscitation

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Reviewer: Jo Kramer-Johansen

Reviewer's report:

Written by:
Jo Kramer-Johansen, MD, PhD
Andres Neset, medical student, student fellow

This study of volunteers’ performance of CPR on training manikins aims to study the impact of different modes of feedback on overall CPR-quality in a 10 minute test and the temporal evolution of CPR quality during the 10 minutes. The discussion on fatigue and feedback are often over-simplified and this paper provides important results that demonstrates that fatigue in CPR is not yet a fully understood phenomenon and not as simple as “getting tired”.

Many studies of manikin CPR have been using tests of three or five minutes, and we are happy to see more studies with longer duration.

Major Compulsory Revisions

The background section is too long and much of its content would be more appropriate in the discussions section. Please rewrite to lead the reader to the main aims of the study.

The description of the design currently does not aid the reader to clearly identify the aims of the study. A simple flow-chart could be included.

15 subjects performed CPR without feedback in phase 1 and 10 subjects completed a phase 2. Please clarify how many tests were performed in phase 2 and how subjects were randomized (or not!) to the sequence of tests. If a concern about carry-over effects of feedback to the non-feedback tests was the reason for the two-phase design, please state so and discuss in the limitations section.

Limitations of the study must be discussed in the discussions section. The use of a manikin designed for training purposes rather than research must be included.

If participants were not randomly assigned to the order of the tests, this must also be stated as a limitation.

Conclusions: Needs to be rewritten. The conclusion section should be focused on your findings, not on what is known from previous research. The conclusion from the abstract could be used.
Minor Essential Revisions

We feel that the manuscript could be shorter.

Please clarify the difference between “time” as the timing of each of the tests and “time” as the duration of performance within each test.

Abstract, results section: you state that recommended compression rate is 80 – 100, but this is not in accordance to Guidelines 2005 (or 2010), and in the results section of the article you use 90 – 120.

Design section: it must be clearly stated whether or not participants were randomized to the order of which they received visual and auditory feedback.

Methods section: Was a power analysis performed to determine the number of participants?

Measures section, paragraph 2: the Borg Rating of Perceived Exertion scale: A reference is needed. The range and meaning of the scale must be stated.

Measures section: Why is force used to measure fatigue? As the spring used in the manikin is of linear stiffness, the force and the compression depth should correspond closely and using only one of these variables should be sufficient.

Measures, paragraph 2: There is no reference to the results of these force measurements later in the manuscript, if these measurements did not result in any valuable data and did not change the mechanics of the performance, please take out.

You write a health questionnaire to confirm continuing eligibility for the study. What was the exclusion criteria?

Procedures, paragraph 2: Why was a special outfit needed for this performance? From the picture (Figure 2) it is clear that markers for motion patterns is placed on the subjects, but such measures are not reported. Please state whether such data from the same experiments have been published previously or if they are planned for publication elsewhere.

Results:

Please state in the first paragraph the number of test subjects that completed each test of the study. (I.e. if all performed CPR for the full 10 minutes).

We would strongly recommend you to report exact p-values (as opposed to > or <0.05), as this is more informative.

It is unclear why you choose to do an analysis of the first two minutes of the tests. If this is to enable comparison with other studies on fatigue (e.g. Hightower); or because of the two minutes chest compressions sequences in the current guidelines, this should be stated. Otherwise this analysis adds little, and the text and corresponding two figures could be taken out.

Discussion: you write visual feedback also reduced performance variability and thereby increasing variability in compressions, but you have not performed statistical tests to confirm this. You must either moderate your statements or
remove this from the article.

Table 1: number of participants in each group should be included in the header. From what you write in the manuscript 15 persons participated in phase one (no feedback) and only 10 in phase 2 (auditory and visual feedback).

Table 1: A column with p-values, or footnotes on statistically significant differences, should be included.

Number of participants completing ten minutes in each of the three tests should be reported.

Figures:

All lines in the figures seem to be “smoothed” between your 15s data sampling points, please avoid such electronic post-processing in the figures.

Please use the full range of mm (0-50) in y-axis (figure 5), you could add horizontal lines to mark the borders for feedback in the figure. (This also applies to figure 4, compression rates)

Avoid decimals in the x-axis (minutes) – place the markers at each full minute.

The linear trendlines (figs 3, 4, 5, 6, and 7) does not aid our understanding of the data and clutters the figures, please remove.

Figures 6 and 7: Remove this figures, as the number of figures are already high and the information given in this figures are already presented in figures 4 and 5.

Figure 8: What does Scale 6 – 19 mean? According to American College of Sports Medicine (http://www.acsm.org/AM/Template.cfm?Section=Search&TEMPLATE=/CM/ContentDisplay.cfm&SECTION=Updated_single_page&CONTENTID=8648) the range of the Borg scale is 6 – 20.

The range of the y-axis should be similar to that of the scale used.

Discretionary Revisions
We would recommend you to avoid using the abbreviation RPE.

An interesting point regarding fatigue is that not all studies find a decay in CPR-quality, we think a couple of sentences discussing this could benefit the discussion.

Minor issues not for publication
Discussion, paragraph 4: Aufderheide misspelled (the second time it is written in this paragraph).

Background, specific question 1: correction should be replaced with correct.
Discussion, paragraph 4: Here you write Kg, but earlier you have consistently written kilograms.
Figure 8: We would recommend to write minutes instead of mins.

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

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