

## PEER REVIEW HISTORY

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### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Short- and long-term survival in critical patients treated by helicopter emergency medical services in Finland – a registry study of 36,715 patients
<b>AUTHORS</b>	Björkman, Johannes; Laukkanen-Nevala, Päivi; Olkinuora, Anna; Pulkkinen, Ilkka; Nurmi, Jouni

### VERSION 1 – REVIEW

<b>REVIEWER</b>	David Lockey University of Bristol, UK
<b>REVIEW RETURNED</b>	23-Nov-2020

<b>GENERAL COMMENTS</b>	<p>The author present a large study which examines the short and long term mortality of patients attended by a national HEMS service which delivers an enhanced level of pre-hospital critical care to patients with injury and medical emergencies. The aims of the study are interesting – by comparing the population attended by HEMs to the age matched general population and examining SMR of each. The authors suggest that longer term excess mortality may contribute to more accurate assessment of the benefits or otherwise of costly HEMs services. A limitation of the study is that only mortality rather than any assessment of functional outcome in survivors is presented.</p> <p>The authors present an excess mortality over a prolonged period after attendance by HEMS. They comment that some excess mortality is to be expected from an increase in co-morbidity, continued expression of the same disease process or activities or lifestyle factors which predispose to trauma. It is unclear whether they believe that these factors might fully explain their results. The authors state that the reasons for the long term mortality cannot be established by this study.</p> <p>The methodology is well described and the STROBE checklist presented. The limitations of the data and interpretation are well documented. The statistical techniques used appear to be appropriate and straightforward.</p> <p>The age ranges include only one for those aged 18-64 years. Do the authors think that young adults and older adults might have significantly different medical emergencies and mechanisms of injury?</p> <p>In terms of generalisability of the results of this study to other EMS systems I note that the RSI rate is 29% - suggesting a relatively high acuity patient population. This may indicate an effective</p>
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	<p>dispatch system but may not reflect the patient population in other countries. The manuscript is well written and easy to follow but there are some English language improvements required.</p> <p>Overall this manuscript presents new data on an interesting subject. It does generate more questions than answers and I am not entirely clear whether the excess mortality described is actually surprising or just previously undescribed.</p>
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<b>REVIEWER</b>	Asuka Tsuchiya Department of Emergency and Critical Care Medicine, National Hospital Organization Mito Medical Center, Japan
<b>REVIEW RETURNED</b>	11-Dec-2020

<b>GENERAL COMMENTS</b>	<p>Dear authors Thank you for giving me the opportunity to review this interesting manuscript. This study is descriptive, and this theme is very important for the HEMS population.</p> <p><b>Major Points</b> In this study, the authors compared the long-term outcomes of patients transported by helicopter with those of the general population. It is not surprising that the prognosis of patients with the disease and the general population is worse in the former. Without comparing the three groups of patients, those transported by ambulance, those transported by helicopter, and the general population, it cannot be concluded that the long-term prognosis of patients transported by helicopter is poor.</p> <p><b>Minor Points</b> <b>Methods</b> 1. What does it mean? "Patients deceased in a previous timespan were disregarded, allowing to focus on only those who died during each individual timespan in question." Describe it more clearly. 2. Describe all confounders you adjusted for logistic regression analysis in the Methods section. 3. Did tests of significance are two-tailed ?</p> <p><b>Results</b> 4. Table 1; Describe all missing data in Table1. 5. Table 1; Describe the detail of "Other medical problem" because about 20% of the population is in this category.</p>
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### VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name: David Lockey

Institution and Country: University of Bristol, UK

Please state any competing interests or state 'None declared': None declared

The author present a large study which examines the short and long term mortality of patients attended by a national HEMS service which delivers an enhanced level of pre-hospital critical care to patients with injury and medical emergencies. The aims of the study are interesting – by comparing the population attended by HEMs to the age matched general population and examining SMR of each. The authors suggest that longer term excess mortality may contribute to more accurate

assessment of the benefits or otherwise of costly HEMs services. A limitation of the study is that only mortality rather than any assessment of functional outcome in survivors is presented

Our response:

We profoundly thank the professor for his insight into our manuscript. We agree that quality of life is an important factor. We have discussed this in the manuscript and see that a future study involving the life quality and changes thereof of survivors after HEMS care is warranted. As a matter of fact, we are currently conducting a prospective study including the analyse of quality of life and neurological performance 1 and 12 months after prehospital RSI (<https://www.boprastudy.fi/>).

The authors present an excess mortality over a prolonged period after attendance by HEMS. They comment that some excess mortality is to be expected from an increase in co-morbidity, continued expression of the same disease process or activities or lifestyle factors which predispose to trauma. It is unclear whether they believe that these factors might fully explain their results. The authors state that the reasons for the long term mortality cannot be established by this study.

Our response:

Indeed, the data does not allow analysing the reason for the elevated mortality. It can however be hypothesised that the excess mortality in most groups can be attributed to a manifestation of an underlying cause, e.g., coronary heart disease in OHCA or depression and substance abuse in intoxication. We have subsequently elaborated this in the discussion.

Added to the discussion: These factors might partially explain the increased mortality, although not entirely. Some factors, such as organisation of rehabilitation, commitment to care and sheer chance in accidents cannot be overlooked.

The methodology is well described and the STROBE checklist presented. The limitations of the data and interpretation are well documented. The statistical techniques used appear to be appropriate and straightforward.

The age ranges include only one for those aged 18-64 years. Do the authors think that young adults and older adults might have significantly different medical emergencies and mechanisms of injury?

Our response

Thank you for your valuable comments. We believe that indeed there are differences in behaviour regarding age. Subsequently the Kaplan-Meier charts have been redrawn to represent the survival in 20-year increments in age groups (except 0-10 yrs. for children, 10-20 yrs. for adolescents) (Fig 2.). For the logistic regressions the groups remain the same as smaller increments would make the subgroups too small, weakening the results.

In terms of generalisability of the results of this study to other EMS systems I note that the RSI rate is 29% - suggesting a relatively high acuity patient population. This may indicate an effective dispatch system but may not reflect the patient population in other countries.

The manuscript is well written and easy to follow but there are some English language improvements required.

Overall this manuscript presents new data on an interesting subject. It does generate more questions than answers and I am not entirely clear whether the excess mortality described is actually surprising or just previously undescribed.

Our response:

HEMS in Finland participates only in the care of the most critically ill and with the highest expected benefit. As such, high acuity is to be expected. In a previous published paper describing HEMS in Finland, the cancellation percentage was surprisingly high, partly due to over-triage.

Added to the discussion: Nevertheless, mortality as the only consideration may lead to suboptimal results and the marked acuity of the patients — 30% required RSI — limit the implementation to the whole EMS community.

The manuscript was proof-read by native speaking language services, however, we have revised it and made slight changes accordingly.

We again wish to thank you for your insight. Indeed, high mortality is to be expected but the fact that it remained elevated during the whole follow-up of three years is a most interesting finding. The questions generated provide good guidelines for future studies.

Reviewer: 2

Reviewer Name: Asuka Tsuchiya

Institution and Country: Department of Emergency and Critical Care Medicine, National Hospital Organization Mito Medical Center, Japan

Please state any competing interests or state 'None declared': None declared

Dear authors

Thank you for giving me the opportunity to review this interesting manuscript. This study is descriptive, and this theme is very important for the HEMS population.

Major Points

In this study, the authors compared the long-term outcomes of patients transported by helicopter with those of the general population. It is not surprising that the prognosis of patients with the disease and the general population is worse in the former. Without comparing the three groups of patients, those transported by ambulance, those transported by helicopter, and the general population, it cannot be concluded that the long-term prognosis of patients transported by helicopter is poor.

Our response:

We wish to thank the reviewer for their input and valuable insight. The main focus of HEMS in Finland is to transport a physician-led team to the patient. The transport to the hospital is mainly done with the responding EMS ambulance with the HEMS physician attending. Our previous study on HEMS operations in Finland reported the number of patients transported by helicopter to be only 2% of encountered patients, while the HEMS physician escorted the patient in the ambulance in ca 50% of encountered patients. (<https://doi.org/10.1186/s13049-020-00739-4>) We have elaborated on the organisation of HEMS in Finland in the Methods section.

The purpose of the comparison to the normal population was to evaluate the possible long-term over-mortality of the short-term surviving patients receiving prehospital critical care. The aim of the study was not to evaluate the effectiveness of the HEMS service on the mortality of the patients.

Added to the introduction: In this study, we describe the short-term and long-term mortality in patients treated by HEMS critical care teams in Finland for different medical reasons. We also identify key factors associated with mortality in different age groups and patient categories in relation to the standardised mortality ratio (SMR).

Added to methods: The HEMS units are usually dispatched by the emergency response centres simultaneously with the responding EMS units, or secondarily by the EMS units attending the call. Patient transport is usually done by the attending EMS unit, with the HEMS physician escorting the patient in the ambulance.

#### Minor Points

##### Methods

1. What does it mean? "Patients deceased in a previous timespan were disregarded, allowing to focus on only those who died during each individual timespan in question." Describe it more clearly.
2. Describe all confounders you adjusted for logistic regression analysis in the Methods section.
3. Did tests of significance are two-tailed?

Our response:

1. We have clarified the methods regarding the analysis. This method is usually used when describing over-mortality, allowing to focus on a specific timespan

Added to methods: Patients deceased at 0-1days, 2-30 days, 1month-1year, 1year-3years were analysed independently. This was achieved by removing the patients deceased in the chronologically earlier timespan from the consecutive groups. This allowed us to focus on one timespan individually to evaluate over-mortality in relation to the normal population.

2. Thank you for your precise remark. In the methods section, the adjusted confounders for the logistic regression analyses are now clearer.

Edited in methods: The planned subgroup analyses and logistic regression confounders included the categorised medical problems, the different age categories, gender and whether airway management or vasopressors were required.

3. Yes, the tests are presented as two-tailed. We now describe it in the Statistical Methods.

Added to the methods: All tests are presented as two-tailed, where applicable.

#### Results

4. Table 1; Describe all missing data in Table1.
5. Table 1; Describe the detail of "Other medical problem" because about 20% of the population is in this category

Our response:

4. During the timeframe, some data was corrupt or missing. We have now included the missing

patients in the respective timeframes in the flowchart (Fig 1)

5. Thank you for your important comment. The definition of Other medical problem has been elaborated in the Methods section. As this group consists of a heterogenous population, care must be used when extrapolating the results. The classification follows the template for HEMS reporting and has been simplified for this study to represent the most common missions of HEMS units in Finland. (doi: 10.1186/1757-7241-19-71 ; 10.1186/s13049-020-00739-4).

Edited in methods: Medical problems were identified from the FHDB and categorised as trauma, OHCA, neurological (including stroke), intoxication and other causes (dyspnoea, chest pain, obstetrical/gynaecological, infection, miscellaneous).

#### VERSION 2 – REVIEW

<b>REVIEWER</b>	David Lockey University of Bristol
<b>REVIEW RETURNED</b>	18-Jan-2021
<b>GENERAL COMMENTS</b>	The authors have addressed most of the issues identified by the reviewers and the manuscript is improved.