American Journal of Emergency Medicine xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Perceived exertion using two different EMS stretcher systems, report from a Swedish study

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ARTICLE INFO

Article history:
Received 1 December 2017
Received in revised form 9 February 2018
Accepted 24 February 2018
Available online xxxx

Keywords:
EMS
Stretcher
Workload
Borg-scale

ABSTRACT

Background: Emergency medical services (EMS) facilitate out of hospital care in a wide variety of settings on a daily basis. Stretcher-related adverse events and long term musculoskeletal injuries are commonly reported. Novel stretcher mechanisms may facilitate enhanced movement of patients and reduce workload for EMS personnel.
Aim: To describe EMS personnel's perceived exertion using two different stretcher systems.
Methods: The methodology of this explorative simulation study included enrolling twenty ($n = 20$) registered nurses and paramedics who worked in ten pairs ($n = 10$) to transport a conscious, 165 lb. (75 kg) patient using two different EMS stretcher systems: the Pensi stretcher labeled A and the ALLFA stretcher labeled B. The ten pairs ($n = 10$) were randomized to use either an A stretcher or a B stretcher with subsequent crossover. The pairs performed six identical tasks with each stretcher, including conveying stretchers from an ambulance up to the first floor of a building via a staircase, loading a patient on to the stretcher, and using the stretcher to transport the patient back to the ambulance. The subjective Rating of Perceived Exertion (RPE) survey (Borg scale) was used to measure perceived exertion at predefined intervals during transport.
Results: No significant differences in workload were seen between stretcher groups A and B regarding unloading the stretcher (7.4 vs 8.2 $p = 0.3$), transporting up a stairway (13.7 vs 12.5 $p = 0.06$), lateral lift (12.1 vs 11.2 $p = 0.5$), or flat ground transportation (10.4 vs 11.1 $p = 0.13$). Pairs using stretcher A showed significantly less workload with regards to transporting down a stairway (11.0 vs 14.5 $p < 0.001$) and loading into ambulance (11.1 vs 13.0 $p < 0.001$).
Conclusion: A structured methodology may be used for testing the exertion levels experienced while using different stretcher systems. The use of supporting stretcher system mechanisms may reduce perceived exertion in EMS personnel mainly during transports down stairs and during loading into ambulance vehicles.

1. Introduction

On a daily basis, Emergency Medical Services (EMS) provide care within communities for patients suffering from a wide variety of conditions. In 2016, 877,670 calls for medical assistance were made throughout Sweden to national dispatch centers, of all priorities [1].

Provision of prehospital emergency care can be psychologically and physically demanding for EMS personnel as patients are found in varying conditions and sometimes in difficult environments [2,3].

With a general increase in mean body mass index in high income countries (HIC) [4] and an increase in the number of calls annually, prehospital care personnel are increasingly likely to retire early, often because of musculoskeletal injuries [5].

The wheeled stretcher makes it possible to provide a range of alterable positions for patients and EMS personnel both in and out of the ambulance compartment, making it an important tool in prehospital work. There are many different types of stretcher systems in use in different ambulance organizations [6-8]; however, transporting patients on stretchers increases workload significantly, especially when transporting patients down stairwells and when loading patients in and out of the ambulance compartment. According to Aasa et al., another potential problem with some of the equipment in the prehospital setting is that its size and dimensions are developed primarily for use by men. As a result female ambulance personnel are potentially more vulnerable to developing musculoskeletal dysfunction, particularly in the neck and shoulder area [9].

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https://doi.org/10.1016/j.ajem.2018.02.023
0735-6757/

In Sweden as well as in the U.S., both the Reeves stretcher (http://www.reevesems.com) and the Stryker stair-stretcher are used (https://ems.stryker.com/en) Although multiple different stretcher systems are available worldwide, we believe that a structured methodology for testing EMS personnel perceived exertion during common stretcher-handling is warranted. The aim of this explorative study was to describe a methodology and EMS personnel's perceived exertion using two different EMS stretcher systems.

2. Methods

2.1. Design

This explorative simulation study employs a methodology for testing exertion using different stretcher systems with a cross-over design in which twenty ($n = 20$) study participants paired up into ten EMS teams ($n = 10$) to use a stretcher to convey a patient from the first floor of a building to an ambulance. The teams were randomized to start with either one of two EMS stretcher systems. All ten teams ($n = 10$) carried both stretchers (Fig. 3).

2.2. Setting and study population

The simulations were conducted in Sweden, at the ambulance hub of the Southern Älvsborg's emergency medicine division between November and December 2014. Twenty ($n = 20$) registered nurses who are also licensed paramedics were recruited for this simulation study. The inclusion criteria for participation were two years or more of EMS employment, including experience using both stretcher systems. The study participants were randomized into pairs ($n = 10$) but were considered as individuals during the data collection and analysis. For demographic data see Table 1.

2.3. Conditions

In the Swedish prehospital setting, mainly two stretcher systems are in use: ALLFA® and Pensi®. In addition, for use in stairwells, both the Reeves stretcher (http://www.reevesems.com/Products/StretchersImobilization.aspx) and the Stryker stair-stretcher (https://ems.stryker.com/en/stair-chair) are also available. At the start of each simulation, a stretcher was placed into the ambulance compartment. For each simulation, the stretcher and two rescue bags were carried up to the simulated patient (a tool for descending stairs was added only when the Pensi stretcher was in use). The simulated patient was situated on the first floor in an apartment, one flight up from the ground floor.

The perceived level of exertion was measured during the following predefined tasks:

1. Unloading the stretcher from the ambulance, without patient
2. Transport of equipment and stretcher up one floor stairwell
3. Laterally lifting the stretcher with the patient from a flat position up to a raised, transportation position
4. Moving the stretcher with patient, through a corridor with double doors to a stairwell
5. Carrying the stretcher with the patient down a flight of stairs.
6. Loading the stretcher with the patient into the ambulance

The simulation was ended once the patient was safely loaded onto the ambulance. The participants in each pair were randomized to take either the foot or head end of the stretcher. They maintained these positions in both scenarios.

2.4. Instruments

The perceived physical exertion during these 6 tasks was measured with the subjective Rating of Perceived Exertion (RPE) scale, first introduced in 1982 [13]. Immediately after each task, each participant was asked to respond to the question: “How do you perceive your exerted effort right now?” Participants' responses were then indicated according to a total feeling of exertion using the RPE scale which is graded into 15 levels, starting with level six and ending at level 20. The scale includes expressions which describe the physical workload, for example, “very very light [7], fairly light [11], hard (15)” (see Table 1) [10].

2.5. Stretcher A — Pensi (intervention)

The Pensi stretcher 2000 MA, (Mago Scandinavia AB www.pensi.se) has an undercarriage with high ground clearance that facilitates loading and unloading of the stretcher into the ambulance. The use of large wheels can even provide functionality for the stretcher on uneven surfaces. The frame is collapsible, which allows the stretcher to be laid flat on the ground. The large wheels and the design of the chassis allow the stretcher to be operated without requiring leverage for propulsion. The Pensi stretcher, weighing 84 lbs. (38 kg), can bear a maximum load of 507 lbs. (230 kg). It has is equipped with handles for steering and tools that assist in moving the stretcher down stairs. The stair-climbing device supports slow transportation down steps. The Pensi stretcher can be rolled on flat ground in an upright position. There is an electric support sled (Ergomy) which allows the stretcher to be pulled into the ambulance with a motor. This feature was, however, not used during this study. See Fig. 1.

2.6. Stretcher B — ALLFA (control)

The oldest and still most common system is the ALLFA stretcher (Ferno Norden A/S www.fernonorden.se) see Fig. 2. The system has been in use for several years and is appreciated for its simple and robust construction. At a weight of 81 lbs. (36.9 kg), the ALLFA stretcher bears a maximum load of 661 lbs. (300 kg). The stretcher is designed to be rolled on even surfaces. Rolling the stretcher sideways requires the use of leverage. It is also an opportunity to use the stretcher's extra wheels which can be folded down. The wheels are located on the foot end of the stretcher. Lowering the wheels requires the stretcher to be lifted up 10 cm (approximately 4 in.), at which point the extra wheels can be folded down by a foot. Thereafter Leverage must again be used to move the stretcher sideways when the extra wheels are lowered. These optional wheels must be folded back up before the stretcher can be loaded onto the support sled which then slides it into the ambulance.

The ALLFA stretcher also has an uneven terrain option; extra wheels can be fitted to existing wheels to facilitate transportation on uneven terrain.

Table 1
Rate of perceived exertion, Borg-scale [13].

Level	Description
6	
7	Very very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very very hard
20	

Please cite this article as: Hulldin M, et al, Perceived exertion using two different EMS stretcher systems, report from a Swedish study, American Journal of Emergency Medicine (2018), https://doi.org/10.1016/j.ajem.2018.02.023