# Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials

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## Abstract

**Objectives** To determine whether parachutes are effective in preventing major trauma related to gravitational challenge.
**Design** Systematic review of randomised controlled trials.
**Data sources:** Medline, Web of Science, Embase, and the Cochrane Library databases; appropriate internet sites and citation lists.
**Study selection:** Studies showing the effects of using a parachute during free fall.
**Main outcome measure** Death or major trauma, defined as an injury severity score $>15$.
**Results** We were unable to identify any randomised controlled trials of parachute intervention.
**Conclusions** As with many interventions intended to prevent ill health, the effectiveness of parachutes has not been subjected to rigorous evaluation by using randomised controlled trials. Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organised and participated in a double blind, randomised, placebo controlled, crossover trial of the parachute.

## Introduction

The parachute is used in recreational, voluntary sector, and military settings to reduce the risk of orthopaedic, head, and soft tissue injury after gravitational challenge, typically in the context of jumping from an aircraft. The perception that parachutes are a successful intervention is based largely on anecdotal evidence. Observational data have shown that their use is associated with morbidity and mortality, due to both failure of the intervention[1 2] and iatrogenic complications.[3] In addition, "natural history" studies of free fall indicate that failure to take or deploy a parachute does not inevitably result in an adverse outcome.[4] We therefore undertook a systematic review of randomised controlled trials of parachutes.

## Methods

### Literature search

We conducted the review in accordance with the QUOROM (quality of reporting of meta-analyses) guidelines.[5] We searched for randomised controlled trials of parachute use on Medline, Web of Science, Embase, the Cochrane Library, appropriate internet sites, and citation lists. Search words employed were "parachute" and "trial." We imposed no language restriction and included any studies that entailed jumping from a height greater than 100 metres. The accepted intervention was a fabric device, secured by strings to a harness worn by the participant and released (either automatically or manually) during free fall with the purpose of limiting the rate of descent. We excluded studies that had no control group.

### Definition of outcomes

The major outcomes studied were death or major trauma, defined as an injury severity score greater than 15.[6]

### Meta-analysis

Our statistical apprach was to assess outcomes in parachute and control groups by odds ratios and quantified the precision of estimates by 95% confidence intervals. We chose the Mantel-Haenszel test to assess heterogeneity, and sensitivity and subgroup analyses and fixed effects weighted regression techniques to explore causes of heterogeneity. We selected a funnel plot to assess publication bias visually and Egger's and Begg's tests to test it quantitatively. Stata software, version 7.0, was the tool for all statistical analyses.

## Results

Our search strategy did not find any randomised controlled trials of the parachute.

## Discussion

### Evidence based pride and observational prejudice

It is a truth universally acknowledged that a medical intervention justified by observational data must be in want of verification through a randomised controlled


Parachutes reduce the risk of injury after gravitational challenge, but their effectiveness has not been proved with randomised controlled trials trial. Observational studies have been tainted by accusations of data dredging, confounding, and bias.[7] For example, observational studies showed lower rates of ischaemic heart disease among women using hormone replacement therapy, and these data were interpreted as advocating hormone replacement for healthy women, women with established ischaemic heart disease, and women with risk factors for ischaemic heart disease.[8] However, randomised controlled trials showed that hormone replacement therapy actually increased the risk of ischaemic heart disease,[9] indicating that the apparent protective effects seen in observational studies were due to bias. Cases such as this one show that medical interventions based solely on observational data should be carefully scrutinised, and the parachute is no exception.

### Natural history of gravitational challenge

The effectiveness of an intervention has to be judged relative to non-intervention. Understanding the natural history of free fall is therefore imperative. If failure to use a parachute were associated with 100% mortality then any survival associated with its use might be considered evidence of effectiveness. However, an adverse outcome after free fall is by no means inevitable. Survival has been reported after gravitation challenges of more than 10 000 metres (33 000 feet).[4] In addition, the use of parachutes is itself associated with morbidity and mortality.[1–3 10] This is in part due to failure of the intervention. However, as with all interventions, parachutes are also associated with iatrogenic complications.[3] Therefore, studies are required to calculate the balance of risks and benefits of parachute use.

### The parachute and the healthy cohort effect

One of the major weaknesses of observational data is the possibility of bias, including selection bias and reporting bias, which can be obviated largely by using randomised controlled trials. The relevance to parachute use is that individuals jumping from aircraft without the help of a parachute are likely to have a high prevalence of pre-existing psychiatric morbidity. Individuals who use parachutes are likely to have less psychiatric morbidity and may also differ in key demographic factors, such as income and cigarette use. It follows, therefore, that the apparent protective effect of parachutes may be merely an example of the "healthy cohort" effect. Observational studies typically use multivariate analytical approaches, using maximum likelihood based modelling methods to try to adjust estimates of relative risk for these biases. Distasteful as these statistical adjustments are for the cognoscenti of evidence based medicine, no such analyses exist for assessing the presumed effects of the parachute.

### The medicalisation of free fall

It is often said that doctors are interfering monsters obsessed with disease and power, who will not be satisfied until they control every aspect of our lives (*Journal of Social Science*, pick a volume). It might be argued that the pressure exerted on individuals to use parachutes is yet another example of a natural, life enhancing experience being turned into a situation of fear and dependency. The widespread use of the parachute may just be another example of doctors' obsession with disease prevention and their misplaced belief in unproved technology to provide effective protection against occasional adverse events.

### What is already known about this topic

Parachutes are widely used to prevent death and major injury after gravitational challenge

Parachute use is associated with adverse effects due to failure of the intervention and iatrogenic injury

Studies of free fall do not show 100% mortality

### What this study adds

No randomised controlled trials of parachute use have been undertaken

The basis for parachute use is purely observational, and its apparent efficacy could potentially be explained by a "healthy cohort" effect

Individuals who insist that all interventions need to be validated by a randomised controlled trial need to come down to earth with a bump

### Parachutes and the military industrial complex

However sinister doctors may be, there are powers at large that are even more evil. The parachute industry has earned billions of dollars for vast multinational corporations whose profits depend on belief in the efficacy of their product. One would hardly expect these vast commercial concerns to have the bravery to test their product in the setting of a randomised controlled trial. Moreover, industry sponsored trials are more likely to conclude in favour of their commercial product,[11] and it is unclear whether the results of such industry sponsored trials are reliable.

### A call to (broken) arms

Only two options exist. The first is that we accept that, under exceptional circumstances, common sense might be applied when considering the potential risks and benefits of interventions. The second is that we continue our quest for the holy grail of exclusively evidence based interventions and preclude parachute use outside the context of a properly conducted trial. The dependency we have created in our population may make recruitment of the unenlightened masses to such a trial difficult. If so, we feel assured that those who advocate evidence based medicine and criticise use of interventions that lack an evidence base will not hesitate to demonstrate their commitment by volunteering for a double blind, randomised, placebo controlled, crossover trial.

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# Medicine in Egypt at the time of Napoleon Bonaparte

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The scientists and doctors who accompanied Napoleon to Egypt in 1798 undertook a survey that is one of the great intellectual achievements of the 19th century. It left a record of the health and wellbeing of the people, especialy in Cairo

In 1798 Napoleon Bonaparte conquered Egypt with an army of 55 000 men. With his army was a party of 300 men of science and letters whose objective was to record the culture of Egypt. The result was an extensive series of writings and engravings known as the *Description de L'Égypte*.[1] Part of this great work was devoted to recording the health and wellbeing of the people of Egypt, as observed by Bonaparte's surgeons and physicians. In this article we draw attention to some of their achievements.[2]

## French men of medical science

The scientists were selected by Claude Louis Berthollet, who studied medicine and served on scientific committees during the French Revolution (fig 1). He placed in charge of the army's medical core Dr René-Nicolas Desgenettes, who was the expedition's chief medical officer. In Egypt, Desgenettes busied himself with the welfare of the French army and the wellbeing of the Egyptian people. He also read papers to the French Institute at Cairo on the causes of ophthalmia and infant mortality. Remarkably, he inoculated himself with pus from a suppurating bubo to fortify himself against bubonic plague. Desgenettes outlined ideas for a new hospital, a pharmacy, and a school of medicine at Cairo.

The celebrated French naturalist and anatomist Georges Léopold Cuvier was invited to participate. He declined because he was about to start his series of studies of comparative anatomy, published in 1800 as *Leçons d'anatomie comparée.* In his place went one of the most revered men of French medical science, Dr Dominique-Jean Larrey. Bonaparte called him "the most virtuous man I have ever known." One of Larrey's contributions to military medicine was the *ambulance volante* (flying ambulance) that enabled wounded men to be transported from the scene of conflict (fig 2). Larrey published his Egyptian medical researches as *Mémoires et Observations sur plusieurs Maladies*. He was later appointed doctor in surgery and medicine at Paris and was subsequently elevated to a peerage with the titles Monsieur Le Baron and Chevalier de la Légion d'Honneur.

## Tribulations of the military

The French army had to march through the desert to Cairo. The soldiers were maddened by thirst, and their torment was increased by the image of a lake—their first experience of the illusion of a mirage. On reaching the Nile, the troops gorged themselves on watermelons, which carried their own hazards; scores of men became afflicted by waterborne bacteria and

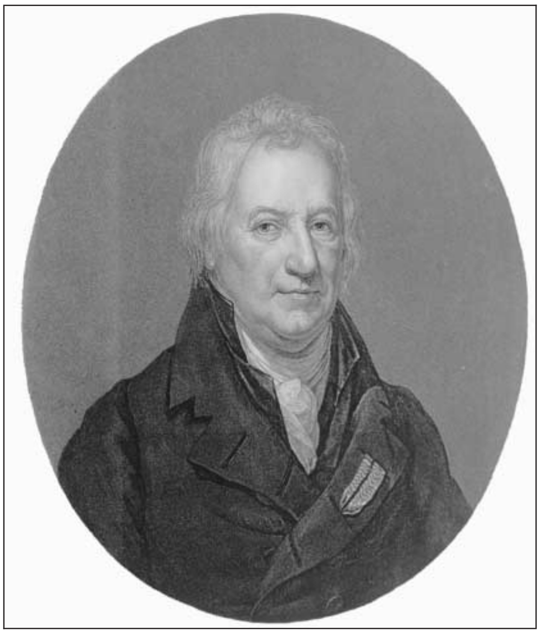

**Fig 1** Claude Louis Berthollet, the distinguished surgeon and chemist who was responsible for recruiting the men of science who accompanied Napoleon Bonaparte on his Egyptian campaign. The decoration in his lapel is that of a Grand Officer of the Order of the Legion d'Honneur

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