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ORIGINAL RESEARCH

The Epidemiology and Medical Morbidity of Long-Distance Backpackers on the John Muir Trail in the Sierra Nevada

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Introduction—The baseline characteristics and medical morbidity of hikers on the 354 km (220 mi) John Muir Trail (JMT) have not been previously reported.

Methods—Using online and on-site recruitment, hikers completing the JMT in 2014 were directed to an online 83-question survey. Pearson correlations, regression models, and descriptive statistics were applied to data, reported as mean±SD (range). Statistical significance was set at $P<0.05$.

Results—Of 771 respondents, 57% were men aged 43±14 (13–76) y; they hiked 15.2±7.6 (5–34) days and traveled 272±129 (45–1207) km (169±80 [28–750] mi). Backpackers lost 3.5±2.6 (+3.6 to −18.2) kg (7.7±5.8 [+8 to −40] lbs). Over half (57%) of respondents reported illness or injury, with blisters (57%), sleep problems (57%), and pack strap pain (46%) most prevalent. Altitude illness affected 37%. Thirty hikers left the trail; of these, 4 required emergency medical services evacuations (3 by helicopter). Increasing age, base pack weight, and body mass index (BMI) were all associated with a decrease in the distance hiked per day. Higher base pack weight was associated with illness or injury, whereas older age was slightly protective. Increasing BMI was associated with a slight increase in medical illness or injury and a strong association with evacuation from the trail.

Conclusions—JMT hikers experienced medical issues seen on other national trails. Weight loss was prevalent. Most hikers had medical complaints, with few seeking medical attention. Heavy packs and higher BMIs were associated with undesirable outcomes, while older hikers fared better.

Keywords: backpacker injuries, wilderness recreation, lightweight backpacking, altitude illness, base pack weight, backcountry evacuation

Introduction

The John Muir Trail (JMT) is a wilderness hiking trail in the southern Sierra Nevada range in Central California that stretches from a northern terminus, Happy Isles Trailhead in Yosemite National Park, to a southern terminus on the summit of Mount Whitney in Sequoia National Park. The trail, over 321 km (200 mi) and uninterrupted by roads, runs mostly at elevations at or above 2400 m (8000 ft), with 35% of the trail traversing elevations above 3000 m (10,000 ft).

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Cross-sectional surveys have been done to identify illness and injury among long-distance backpackers of the 3540 km (2200 mi) Appalachian Trail (AT)[1,2] coursing along the eastern United States from Maine to Georgia and the 435 km (270 mi) Long Trail in Vermont.[3] There are no similar data available for the 354 km (220 mi) JMT in Central California.

Backpacking has changed in the last decade with the availability of lighter materials. Backpackers debate whether lightweight or traditional backpackers are more exposed to illness and injury. There is little data to support either argument. Pack weights are compared by generally accepted base pack weight (BPW) categories of heavy, traditional, lightweight, ultralight, or super-ultralight. These refer to the total weight of the entire gear kit, excluding consumables (food and water). Consumables are not included because the amount varies by trip length and conditions. The authors are aware of only 1 small study addressing the impact of pack weight

on illness and injury; that study concluded that increasing pack weight was correlated with increased incidence of paresthesias.[4]

During the trip, medical conditions were experienced by 50 to 80% of long-distance hikers, depending on the source citation.[1–3] Medical assistance was sought up to 25% of the time; however, activation of emergency medical services (EMS) was uncommon.[2] Only 8.4% of long-distance hikers reported feeling unprepared to deal with illness and frequently self-managed problems on the trail.[3] A review of the United States National Park System from 2007 to 2011 reported that the national incidence of EMS events was 45.9 events per 1 million visitors.[5] A backcountry survey of trail users is well suited to investigate events that affect hikers but do not rise to the level of EMS activation.

In this study we profile the epidemiology, conditioning level, pack weights, speed of travel, and prevalence of illness or injury or evacuation during hiking experiences. We propose that conditioning, lightweight BPW, and faster rates of travel correlate with an increased likelihood of trip completion without evacuation and decreased prevalence of illness and injury.

Methods

A retired San Francisco lawyer who is a JMT enthusiast wrote the survey using Survey Monkey. Two of the authors of this study (SS, AH) became aware of the survey when recruited to participate in 2014. Survey questions were designed to address concerns often posed by new hikers of the JMT in online communities. Colloquial language is used throughout and is quoted where applicable. The 2014 posthike survey was 60 pages long with 83 questions. Not all questions would be seen by an individual participant, due to the branching response options available regarding the route used by the respondent. Consent for participation in the survey, and the intended distribution of deidentified results, was given on the first page of the survey. A sample of the survey can be seen in Figure 1.

The survey appeared in 2013, with a limited response rate. Recruitment for the survey was performed through online message boards via Yahoo and Facebook groups for prospective JMT hikers. In 2014 on-site solicitation of hikers completing the JMT, with manual distribution of the online address for the survey, was performed by volunteers affiliated with the online hiking communities.

This study is a cross-sectional sample of hikers who completed part or all of the JMT during 2014. The study period was May 7, 2014 through October 19, 2014. The exclusion criteria were hikers who 1) reported a planned trip length of 5 days or less; 2) planned a trip that did not include the JMT; and 3) indicated that they would not answer the questions from a personal, as opposed to a group, point of view. Participation in the survey was voluntary; respondents were not required to answer all 83 questions.

Information extracted from the survey included overall travel time, total distance completed, pretrip estimation of distance per day, actual distance per day, BPW, backpacking experience in the preceding 10 years, prehike physical conditioning, body weight change, difficulty of hike, and prevalence of illness or injury and/or evacuation. A nonvalidated (0–5) scale for severity was used for medical illness and injury questions (Figure 1): 0 denoted "not at all," 1 was "minimal," 3 was "significant," 5 was "severe," and "not applicable or prefer not to answer" was the final answer option. Data are reported in both metric and imperial units. However, the reader should be aware BPW categorizations are colloquially defined by imperial unit cutoffs; thus, the metric conversions create awkward thresholds.

Some survey responses were changed to binary variables for regression analysis. Illness and injury were either present or absent. Prehike physical fitness was either conditioned or not. Conditioning was defined to ascertain prehike preparation for the physical demands of an extended hike at elevation carrying a full pack. The survey categories were <1, 1–2, 2–4, 4–8, 8–16, and >16 hours of exercise per week in the month preceding the hike. We used the survey categories of 4 or more hours to denote prehike conditioning. These categories exceed the minimum recommendation of 2.5 hours of weekly exercise to maintain health.[6]

SPSS Statistics was used to calculate descriptive statistics. Pearson's correlations and logistic regression models were used to compare baseline characteristics with evacuation and reported morbidity. Statistical significance was accepted at $P<0.05$. Data are presented as mean±SD (range) or (P value, 95% CI range) as appropriate. Percentages were calculated from the number of valid responses entered for each query, not for the entire cohort taking the survey. The absence of a response was not considered as a valid entry. In each case in which a percentage is given, the number of persons giving each response will be listed in parentheses. This study received Institutional Review Board review and approval from the University of California San Francisco Fresno Medical Education Program.

Results

DEMOGRAPHICS

Of a total of 771 respondents, the vast majority (93%) completed ≥90% of survey questions (reached or