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Original Article

Assessing the effect of the cost-of-living crisis on hot water bottle-related burns in the United Kingdom, a single-centre retrospective observational study

Mahaveer S. Sangha[1,*], Michelle Baker, Alexander J. Baldwin, Alexandra Murray

Department of Plastic & Reconstructive Surgery, Stoke Mandeville Hospital, Aylesbury, UK

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ABSTRACT

Background: The cost-of-living crisis (CoLC) is an economic climate that the United Kingdom (UK) has been experiencing since late 2021, characterized by an increase in the price of essential goods faster than real-term incomes. Food and fuel poverty has ensued. This study aimed to assess whether the CoLC is associated with an increase in hot water bottle (HWB)-related burns as patients seek alternative heating sources to keep warm.

Methods: Records of patients treated for HWB burns between December 2019 and March 2023 were reviewed for patient demographics, burn depth and surface area, patient comorbidities, and patient index of multiple deprivation (IMD). The incidence of admissions, IMD, and severity of injury were compared prior to and during the CoLC using either independent *t*-test or Kruskal–Wallis H test.

Results: Between December 2019 and March 2023, 177 patients were treated for HWB burns, 79 prior to the CoLC, and 98 during. Of the patients, 55 patients were male and 122 females. An independent *t*-test comparing average monthly admissions prior and during the CoLC identified a significant difference ($p = 0.042$), with a mean increase of 1.85 cases (95% CI: 0.71–3.63). Additionally, a

* Corresponding author at: Foundation Year 2 Doctor, John Radcliffe Hospital, Headley Way, Headington, Oxford OX3 9DU, UK.
E-mail address: mahaveer.sangha.16@ucl.ac.uk (M.S. Sangha).
[1] Present address: John Radcliffe Hospital, Headley Way, Headington, Oxford, OX3 9DU, UK

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Kruskal–Wallis H test showed statistically significant difference in the number of patients treated for HWB burns between the seasons ($p = 0.001$). An independent *t*-test comparing average patient IMD prior and during the CoLC identified no difference ($p = 0.33$). *Conclusion:* The increase in HWB burns coincides with the increase in energy costs and general cost of living that has occurred in the UK since October 2021.

Introduction

The cost-of-living crisis (CoLC) is an economic climate that the United Kingdom (UK) has been experiencing since late 2021, characterized by an increase in the price of essential goods faster than real-term incomes. It has been fueled by events such as the COVID-19 pandemic, the UK's exit from the European Union, and Russia's invasion of Ukraine.[1] The CoLC is expected to have a widespread impact on health care in the UK, from changes to policy and health-seeking behaviors to ill-health from malnutrition and mental health decline. Moreover, analyses indicate the CoLC will disproportionately impact the less financially fortunate and exacerbate pre-existing health care inequalities.[2]

One area affected is the cost of energy. The inability to heat homes due to financial hardship can lead to the use of alternative heat sources.[3] An example is the hot water bottle (HWB), a rubber container that holds and maintains warm water and is used to provide warmth in cold weather and possibly pain relief.[4] HWBs can lead to thermal injuries in one of 4 ways: (1) spills from filling, (2) rupture, (3) leakage/failure of seal, and (4) direct thermal injury.

Previous studies have shown HWB-related burns lead to both partial- and full-thickness burns, with total body surface area (TBSA) approximately 1%–3%[5] and women being disproportionately affected.[6] Lower limbs and the abdomen are the most commonly affected regions.[7] Although most injuries are not severe, deaths secondary to HWB burns have been reported, and previous audits have influenced legislation and prohibition of HWBs.[8]

The aims of this study were as follows: (1) to assess whether the CoLC is associated with an increase in HWB-related burns, (2) to assess the influence of seasons on the incidence of HWBs, (3) to investigate variables and their association with changes in incidence before and after the CoLC, and (4) to investigate if the CoLC has altered the management and/or financial cost of supplying care for patients with HWB burns.

Methods

A retrospective interrupted time series service evaluation was designed in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) checklist.[9] In keeping with UK National Health Service (NHS) Research Authority guidance, ethical approval is not required for such studies.[10] The project was formally and prospectively registered.

Two cohorts of consecutive patients were compared: those attending our regional burns unit with HWB-related burns from December 2019 until the beginning of the CoLC and those attending during the CoLC until March 2023. December 2019 marked the first date patients' burns records were transcribed electronically and available for analysis.

The CoLC was defined to have started in October 2021 by the UK Office of National Statistics, an independent subsidiary of the UK Statistic Office that produces statistical analyses for the UK Parliament. This date coincided with the first month of rising energy costs.

Only patients sustaining an injury from either (1) spills from filling, (2) rupture, (3) leakage/failure of seal, or (4) direct thermal injury from a HWB were included. No restrictions were placed on sex, age, severity of injury, or comorbidities.

The following pre-specified variables were extracted from electronic patient records where available: patient demographics, burn depth (areas of affected deep dermis/full thickness and superficial dermis recorded separately) and TBSA, patient comorbidities, patient index of multiple deprivation (IMD) rank, number of admissions (defined by at least one overnight stay in the burns unit), total length of admission, number of operations and intraoperative details, and the number of clinic appointments with a medical member of the Burns multidisciplinary team (either physician/surgeon or specialist nurse). The IMD is a measure of relative deprivation that includes the following weighted variables: income (22.5%), employment (22.5%), education (13.5%), health (13.5%), crime (9.3%), barriers to housing and services (9.3%), and living environment (9.3%).[11] It is used to measure poverty in small, defined regions within the UK. The greater the rank, the lower the relative deprivation of the individual. The IMD rank for each patient was obtained using their postcode and the 2019 Indices of Deprivation Mapper, a publicly available online tool produced by the UK Government to assess the relative deprivation of small regions.

Data collection and statistical analysis

Eligible patients were identified, anonymised, and collated by the Burns Department data coordinator, and variables were extracted by one author (M.S.) from electronic records. Descriptive analyses were used as a cursory assessment of variables, and Kruskal–Wallis and Student's *t*-tests were used in the comparison of non-parametric and parametric variables between the 2 cohorts, respectively. Additionally, comparisons between seasons and months were assessed. Winter months were classified as December, January, and February; Spring as March, April, and May; Summer as June, July, and August; and Autumn as September, October, and November. All statistical analyses were conducted using IBM SPSS version 27.0.1.[12]

Results

Demographic comparison

In total, 177 patients were included in this study, 79 from the pre-CoLC and 98 during CoLC (Table 1). Fifty-five males (23 pre-CoLC and 32 during) and 122 females (56 pre-CoLC and 66 during) were recruited. The average age of patients was 44.0 pre-CoLC and 45.4 during ($p = 0.727$, standard error [SE]: ±5.29), the average age of males was 46.0 pre-CoLC and 44.3 during, and the average age of females was 43.2 pre-CoLC and 46.1 during. Nineteen patients were <18 years of age (9 pre-CoLC and 10 during), and 158 were ≥18 years (70 pre-CoLC and 88 during). Comorbidities were recorded in 51 patients (22 pre-CoLC and 29 during).

Table 1
Summary of demographic findings between cohorts.

	Pre-CoLC: December 2019 to September 2021	During CoLC: October 2021 to March 2023
Total patients	79	98
Male	23	32
Female	56	66
Average age, y	44.0	45.4
Average TBSA	1.48	1.48
Average SA with FTB	0.2	0.1
Average IMD rank	21,041	18,102
Managed surgically	9	17
≥1 medical comorbidity	22	29

Abbreviations: CoLC: cost of living crisis, TBSA: total body surface area (%), SA: surface area, FTB: full-thickness burn, IMD: index of multiple deprivation.

Comparison of IMD rank

The average IMD rank was 21,401 pre-CoLC and 18,102 during ($p = 0.33$, SE: ±3239.6). The average IMD rank for males was 23,198, and for females was 20,176 ($p = 0.025$, SE: ±1337.4). When separating these by pre-CoLC and during, the average IMD rank was 25,780 and 21,219 for males, respectively, and 19,378 and 20,844 for females, respectively. For those <18 years, the average IMD rank was 21,176, and for those ≥18 years, it was 21,075. The average patient IMD rank for Winter was 20,583, for Spring it was 21,355, for Summer it was 21,957, and for Autumn it was 21,452.

Comparison of severity

The average surface area for superficial/partial-thickness burns was 1.48 pre-CoLC and 1.48 during ($p = 0.99$, 95% SE: ±0.336). The average area for males was 1.54, and for females was 1.45 ($p = 0.790$, SE: ±0.364). The average surface area for deep/full-thickness burns was 0.229 pre-CoLC and 0.118 during ($p = 0.147$, 95% SE: ±0.763). The average area for males was 0.114, and for females was 0.194 ($p = 0.333$, SE: ±0.083). The average TBSA affected was 1.71 pre-CoLC and 1.59 during ($p = 0.720$, SE: ±0.335). The TBSA for males was 1.66, and for females was 1.64 ($p = 0.959$, SE: ±0.363).

The mean depth of superficial/partial-thickness burns varied across seasons: 1.73 in Winter, 1.12 in Spring, 0.992 in Summer, and 1.52 in Autumn. The mean depth of deep/full-thickness burns was 0.111 in Winter, 0.105 in Spring, 0.531 in Summer, and 0.229 in Autumn. The mean TBSA was 1.84 in Winter, 1.23 in Spring, 1.52 in Summer, and 1.76 in Autumn. Analysis of variance (ANOVA) testing for differences between mean superficial/partial-thickness burn depth in each season was not significant ($p = 0.416$), as was ANOVA for deep/full-thickness burns ($p = 0.0.26$) and TBSA ($p = 0.504$).

Comparison of management

Out of the total 177 patients, 26 had operative management and 151 had non-operative management. Among them, 12 patients received debridement only (2 with Versajet), 12 additionally received split skin grafts, and 2 received Biobrane additionally. Ten patients in the pre-CoLC received operative management and 16 during.

In total, 14 patients were admitted pre-CoLC and 20 were admitted during the CoLC, the remaining being managed as outpatients. The average duration of admission was 3.42 days pre-CoLC and 2.80 during CoLC. On average, each patient had 2.64 clinic appointments pre-CoLC and 2.36 during the CoLC.

Comparison of incidence

Pre-CoLC, the average number of cases per month was 3.59; during the CoLC, this increased by 1.89 to 5.44 cases, which was significant ($p = 0.042$, 95% CI: 0.71–3.63) (Figure 1).

Pre-CoLC, the number of Winter cases was 5.17 per month, and during the CoLC, it was 7.67 per month. Pre-CoLC, the number of Spring cases was 3.83 per month, and during the CoLC, it was 4.75 per month. Pre-CoLC, the number of Summer cases was 1.50 per month, and during the CoLC, it was 2.00 per month. Pre-CoLC, the number of Autumn cases was 4.00 per month, and during the CoLC, it was 5.2 per month. Kruskal–Wallis testing showed a significant difference in the number of cases ($H = 16.1$, $p = 0.001$) between seasons (Figure 2).

Discussion

Demographics

Though it has been reported that males and those <18 years of age are most susceptible to burns injuries,[13] our results have indicated that adult females are most frequently injured from HWB. The ratio of male to female patients was 1:2.2. Previous studies have ranged from 1:3.2 to 1:1.2.[5,7] Female predisposition to HWB use can attributed to underlying physiologic and anatomic difference;

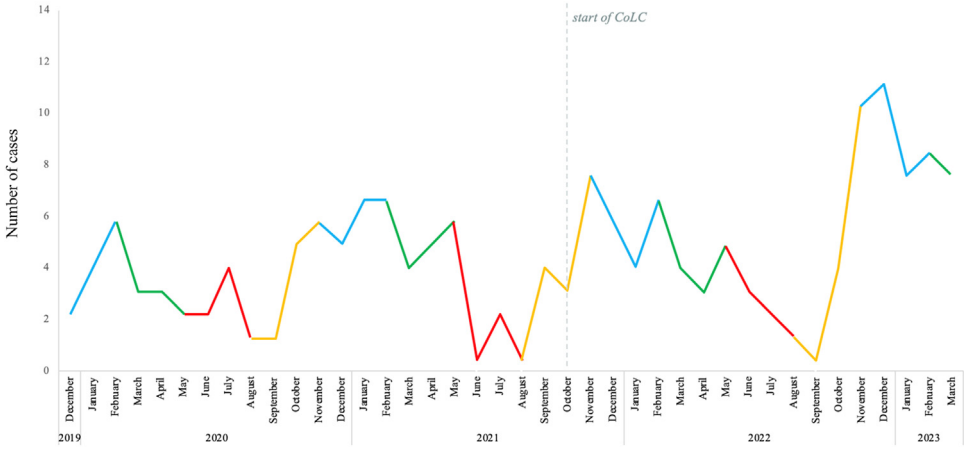

Figure 1. Monthly incidence of HWB-related burns. The start of the CoLC taken as October 2021, the first reported increase in energy costs by the Office of National Statistics. Abbreviations: HWB: hot water bottle, CoLC: cost-of-living crisis. Key: blue: Winter, green: Spring, red: Summer, yellow: Autumn.

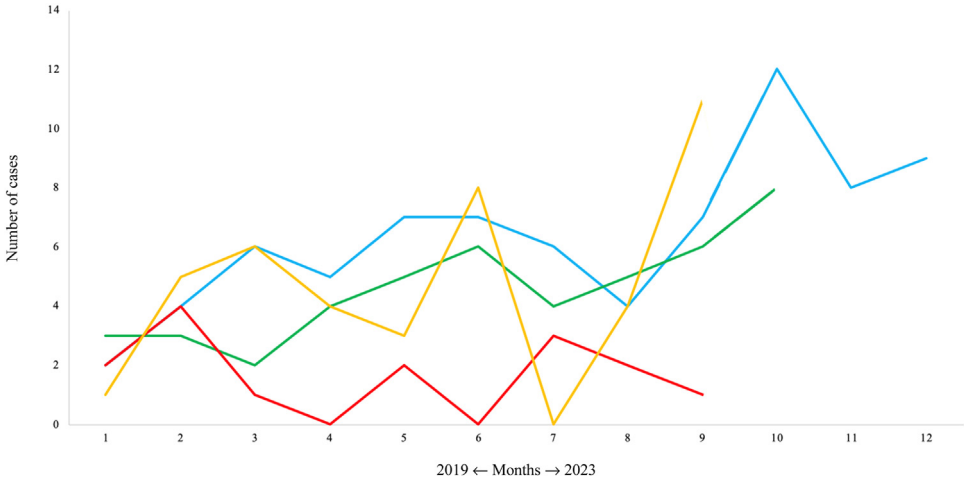

Figure 2. Monthly changes in incidence, in chronological order and grouped according to season. Abbreviations: HWB: hot water bottle. Key: blue: Winter (December to February), green: Spring (March to May), red: Summer (June to August), yellow: Autumn (September to November).

for example, at the same rate of cooling, females experience lower core temperatures and a reduced shivering response compared to male counterparts[14] though have greater core temperature rises in heat stress thought to be a result of lower sweat output, greater body fat, and lower body mass.[15] Additionally, observational studies assessing differences in temperature perception between the sexes have identified a greater sensitivity to temperature extremes by female subjects thought to be due to autonomic differences.[16,17]

Incidence

A significant increase in the monthly incidence of HWB-related burns was identified following the CoLC. Additionally, Winter was found to have significantly greater HWB-related injuries. Following the CoLC, monthly utility bills have increased, with the Office of National Statistics reporting the highest

rate in Winter 2022/23 at 128.9%.[18] The UK Meteorological Office, the UK's national weather service, reported a mean temperature of 5.2 °C in Winter 2019/20 (above average),[19] 3.5 °C in Winter 2020/21 (below average),[20] 5.2 °C in Winter 2021/22 (above average),[21] and 4.3 °C in Winter 2022/23 (average).[22] Our trends identified incidence does not correlate with reported national mean temperatures, with the largest rise in monthly incidence in Winter 2022/23. They do follow trends in energy prices however.[18] Thus, changes in incidence are likely to reflect an inability to sufficiently heat homes and the use of HWB as an alternative heat source. Though reasons for HWB use were not recorded, previous studies have highlighted warmth and pain relief as common uses of HWB.[7] Epidemiological trends in HWB-related burns have been under studied in the UK; therefore, it is unclear if the COVID-19 pandemic may have influenced this change.

Socioeconomic differences

The CoLC has been projected to affect the most deprived disproportionately[2]; however, our findings indicate the average IMD rank of patients has not changed from pre-CoLC. It should be noted that the IMD rank is a generalised scoring of poverty in a small area rather than the individual specifically. A study by Goltsman et al. (2015) from Australia found that HWB burns were more commonly seen in the 50% most deprived regions in a similarly sized sample from New South Wales.[23] The county of Buckinghamshire is the 7th least deprived local authority/region (out of 151) in the UK, highlighting a reduced variance in deprivation.[24] Therefore, any correlation between socioeconomic circumstance and HWB burns is unlikely to be identified in this small cohort and a larger inter-regional study including more and less deprived regions would need to be assessed. However, the IMD rank did differ significantly between male and female patients, with significant influence from the pre-CoLC cohorts. This can, in part, be explained by the Winter 2020/21 and Spring 2021 being colder on average[20,25] and the female sex having greater sensitivity to extremes of temperature,[26] therefore the most deprived requiring HWB use even without pressure from the CoLC. This then normalised during the CoLC as a greater proportion of society struggled with rising energy costs.

Severity and management

No statistically significant differences in management were identified prior to the CoLC and during. As management is dictated by severity of injuries, which also did not show significant difference, the similarity between the cohorts is to be expected. HWB-related burns tend to be superficial and rarely span >10% TBSA, with previous studies that have also reported the majority of cases being managed non-operatively.[7]

Limitations

Absolute values were used; therefore, burns injuries may have increased as a whole, relative to changes in population size. However, data from the Office of National Statistics shows the population of Buckinghamshire has increased by 1% between 2011 and 2021 (or 50,000 people), suggesting results in this study are unlikely to be purely related to changes in population. Our study presents a small cohort and only one defined area; therefore, our results are not reflective of the entire nation or other areas that may have different socioeconomic circumstances.

Future direction

In future iterations of the study, a formal and comprehensive analysis should be conducted to assess the financial burden caused by treating HWB prior to and during the CoLC. Moreover, the source of referral/presentation should be investigated as access to the emergency department/primary care pre- and post-CoLC may confound results. As results may not be nationally representative, a multicentre audit and analysis on HWB should be conducted to assess the extent of this issue. Future iterations should also consider examining the incidence of HWB prior to the COVID-19 pandemic, incorporating average local monthly temperatures into analyses, and discussing reasons for HWB usage with patients.

Conclusion

The increase in HWB burns coincides with the increase in general cost of living that has occurred in the UK since October 2021. Although only a single area was investigated, the finding does not correlate with deprivation. Suggestions to encourage safer use of HWB include rigorous testing of the device according to industry standards, as well as clear instructions and safety precautions with every HWB purchase. In the future, national policies similar to those seen in Australia and New Zealand[8] may be appropriate.

Declaration of competing interest

The authors declare no conflicts of interest.

Ethics statement

All methods were carried out in accordance with relevant guidelines and regulations pertaining to this study. Data used in this study was anonymised; thus, ethical approval was not necessary. Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of authors' study.

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Data availability statement

The data supporting the findings of this study are available from the corresponding author, M.S.S., upon reasonable request.

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