



## A hot topic for health: Results of the Global Sauna Survey

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### ABSTRACT

**Objective:** Sauna-bathing is an ancient tradition that is gaining popularity across the world as a wellness tool. There is a growing body of medical evidence supporting the role of saunas, or whole-body thermotherapy, as a form of treatment for a range of health issues. However, the demographics, motivations and experiences of current sauna bathers have not yet been explored on a global scale. This study is designed to explore these themes.

**Design:** An online 71-item questionnaire compiling information on the individual characteristics, sauna-related habits and perceived health and wellness experiences of regular sauna bathers was conducted from October 2016 to October 2017. The validated 'SF-12' quality of life scoring tool was incorporated into the questionnaire to measure physical and mental indicators of well-being.

**Results:** Of 572 logins recorded, 482 valid responses were generated. Both men (51.3%) and women (48.7%) were represented, and respondents were predominantly well-educated (81.8%), non-smoking (90.6%), regularly-exercising (78.8%) individuals of normal-to-overweight status (87.1%) who sauna-bathed approximately 1–2 times per week. The key reasons indicated by respondents for sauna-bathing included relaxation/stress reduction, pain relief and socializing. Nearly a third of respondents reported medical conditions and of this subset, those with back/musculoskeletal pain and mental issues cited the greatest improvements in their conditions with sauna-bathing. Of all respondents, 83.5% reported sleep benefits after sauna use. Analysis of well-being scores after stratifying respondents into three groups by sauna-bathing frequency (group I: < 5 times per month; group II: 5–15 times per month; group III: > 15 times per month) revealed group II respondents had slightly higher mental well-being scores (Kruskal–Wallis testing:  $H = 6.603 > \chi^2$  of 5.991,  $p = 0.0368$ ,  $df = 2$  with post hoc analysis using Mann–Whitney  $U$  test:  $p = 0.016$ ) as compared to respondents who were sauna-bathing less frequently (group I). No respective differences were detected between the physical well-being scores of any of the three groups. Adverse reactions to sauna-bathing were recorded as mostly minor (93.1%), including primarily symptoms of dizziness, dehydration and headache. However, there were two reports (0.3%) of chest pain and eye irritation requiring hospitalization.

**Conclusions:** This cross-sectional study documents that sauna-bathing participants, particularly those from Finland, Australia and the United States, are motivated to use saunas predominantly for relaxation, reporting health benefits especially around mental well-being and sleep, with relatively few adverse effects. While these results reinforce some of the known health benefits of sauna bathing, they indicate that further research and better dissemination of existing evidence is needed to fully develop the sauna's potential as a therapeutic intervention.

## 1. Introduction

### 1.1. Background

Sauna bathing in various forms has been used for centuries for

health, hygiene, social and spiritual purposes and is currently undergoing a worldwide resurgence, largely as a result of an increasing individual and public health focus on wellness.<sup>a,2</sup> Recent long-term observational studies emerging from Finland demonstrate strong associations between frequent sauna bathing and a reduced incidence of

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<sup>a</sup> This was evident at the 2018 XVII International Sauna Congress in Finland/Sweden, held every 4 years in June on 'National Sauna Day', which recorded the largest ever number of attendants, with hundreds of men and women of all ages and languages traveling from dozens of countries to discuss the health, cultural and architectural aspects of sauna bathing.

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cardiovascular events,<sup>3</sup> cerebrovascular events (i.e. strokes),<sup>4</sup> respiratory diseases (i.e. pneumonia,<sup>5</sup> asthma and chronic obstructive pulmonary disease<sup>6</sup>), dementia<sup>7</sup> as well as lowered markers of systemic inflammation<sup>8</sup> and higher quality of life.<sup>9</sup> These findings suggest sauna bathing has preventive health benefits comparable in many respects to regular exercise.<sup>10–12</sup>

In addition to epidemiological studies, specific medical interest in sauna bathing or ‘whole body thermotherapy’ is ‘heating up’, as demonstrated by an increase in citations and reviews of health-related studies involving various types of sauna interventions.<sup>13,14</sup> The clinical use of dry sauna bathing (i.e. traditional Finnish style and/or infrared, etc.) has been documented to have beneficial health effects and improve cardiovascular, respiratory, immunological, metabolic and athletic performance.<sup>11,13,15–21</sup> The precise drivers of these effects remain unclear. While recent studies suggest the beneficial health effects of sauna bathing may be due to endothelial-dependent vasodilatation metabolic and immune pathways, more research is needed.<sup>10,11,15,22–25</sup> Routine sauna bathing has been reported to be relatively safe provided bathers use common sense and avoid concurrent alcohol consumption.<sup>13,26–29</sup> Of note, there is small-scale evidence to suggest reversible impairment of male spermatogenesis with regular sauna bathing, however further study is required to validate this evidence.<sup>13,30</sup>

While there is growing interest in the health impacts of sauna bathing and a multitude of anecdotal reports on sauna-related blogs and websites, there is comparatively little data in the English-speaking scientific literature on the general characteristics and motivations of people who already use the sauna regularly, particularly on a global basis. There are various studies that have surveyed the sauna habits of distinct populations (i.e. Finnish octogenarian men<sup>9</sup> and MSM – men who have sex with men<sup>31–33</sup>), however the health-related outcomes of these studies are not generalizable to the public (e.g. women). Thus, although there is mounting medical evidence suggesting saunas should play a greater role as a lifestyle wellness/therapeutic tool, there is an ongoing need to document health information around existing sauna use, as is presented in this study.

## 1.2. Objectives

We aimed to explore the current demographics, motivations, health and wellness experiences of sauna bathers worldwide via an online questionnaire.

## 2. Methods

### 2.1. Design and objectives

This study used a cross-sectional, descriptive survey to document the following information about sauna bathers:

- Demographics (i.e. age, gender, education and country of residence)
- Personal health and lifestyle information (i.e. general state of health, quality of life measures, medical conditions and severity, diet/exercise habits and other lifestyle habits)
- Motivations for sauna activities (intentions and importance)
- Sauna characteristics and associated habits (i.e. frequency, timing and types of sauna used, temperature settings, and who is in the sauna)
- Health and wellness experiences (beneficial and adverse effects, effects on sleep, and effects on existing medical conditions)

### 2.2. Questionnaire

A descriptive electronic survey comprising 71 questions was constructed using Qualtrics survey software (Qualtrics, Australia) in English. The survey questions were ordered into the following categorical blocks: (i) age and demographics; (ii) motivations to sauna; (ii)

sauna types and experiences, including adverse effects; (iii) medical conditions with linked additional questions related to sauna effects; (iv) health and quality of life; and (v) diet and lifestyle habits. Two validated external tools were incorporated within the survey questions: ‘SF-12’ health quality measure tool of twelve questions and ‘Starting the Conversation – Diet Evaluation’ involving five questions of the original 8-question tool.<sup>34–37</sup>

The survey contained a variety of question formats including yes/no, multiple choice, multi-variable response, slider continuous responses, linked questions and open-ended questions. Some questions provided prompters and open text space for respondents to elaborate on their numeric, ordinal and/or nominal variable responses.

The survey required approximately 10–15 min to complete. Participation was entirely voluntary and anonymous. No strict inclusion or exclusion criteria were imposed on respondents, other than completing the ‘yes’ response to the initial question providing informed consent. If ‘no’ response was selected to this question, the questionnaire was automatically terminated and recorded as such. A full copy of the questionnaire can be accessed in [Supplementary Materials](#).

### 2.3. Ethical considerations

This study was approved by the RMIT University College Human Ethics Advisory Network (CHEAN).

### 2.4. Recruitment

Respondents were recruited via electronic social media where the study was advertised on local natural health clinic Facebook pages, public Facebook sauna groups and electronic newsletters of interested integrative healthcare businesses between October 2016 and October 2017. These initial advertisement methods led to widespread networking with sauna-related blogs, sauna-related industry newsletters and to further recruitment via media articles and the server email lists of interested businesses. The Finnish Embassy in Canberra, Australia, also kindly agreed to distribute the survey link on their electronic newsletter in early 2017.

### 2.5. Data analysis

Data was analyzed on a question-by-question basis. Numerical data were analyzed and summarized using descriptive statistics with results presented as the percentage (%) of participants providing a specified response (numerator) compared to the total number of participants who responded to the specified question (denominator). As some survey questions allowed for multiple responses, the denominator may be greater than the actual number of survey respondents. Data with continuous variables were explored with histograms, skewness and kurtosis values to assess the normality of distribution before further analysis was conducted. These results are expressed either as a mean with standard deviation (SD) or a median with 25th–75th interquartile range (IQR), depending on the distribution of the data. Statistical data analysis was conducted using Microsoft Excel 2016 (with supplemental Data Analysis ToolPak), IBM-SPSS Statistical software (version 25) and/or within the Qualtrics Software platform (RMIT 2017–2018 account with Qualtrics, Australia).

## 3. Results

A total of 572 logins were recorded but after accounting for duplicate entries ( $n = 4$ ), entries with denied consent ( $n = 2$ ) and entries with insufficient data ( $n = 84$ ), there were 482 valid responses generated. A valid response entailed completion of at least one additional question, aside from the introductory question providing informed consent. A total of 378 respondents (78.4%,  $n = 378/482$ ) responded to every question in the questionnaire.

**Table 1**

Demographics of participants.

(Results based on responses to four questions – one with single response to a variable continuous slider and the others with single responses to multiple-choice questions).

Variable	Subcategory	Result (% = number of responses/'n' total number of responses to specified question)
Age (mean $\pm$ SD)	Range 17–80 years	45 $\pm$ 13.5 years ( $n = 415$ )
Sex (%)	Female	48.7% (199/409)
	Male	51.3% (210/409)
Education – highest level (%)	Higher degree	45.7% (188/411)
	Bachelor's degree	36.0% (148/411)
	High school	17.3% (71/411)
	Did not finish high school	0.97% (4/411)
Country – living residence (%)	Finland	28.4% (111/391)
	Australia	25.3% (99/391)
	United States	20.5% (80/391)
	United Kingdom	4.6% (18/391)
	Sweden	3.3% (13/391)
	Italy	3.1% (12/391)
	Denmark	2.1% (8/391)
	Germany	2.1% (8/391)
	Canada	1.5% (6/391)
	The Netherlands	1.3% (5/391)
	Belgium	1.0% (4/391)
	New Zealand	1.0% (4/391)
	Other <sup>a</sup> (< 1% of $n = 391$ )	5.9% (23/391)

<sup>a</sup> Other countries of respondents included Azerbaijan, Colombia, Estonia, France, Hungary, India, Japan, Lithuania, Norway, Portugal, Russia, Slovenia, Switzerland, Thailand, Tunisia, Ireland, and United Arab Emirates.

### 3.1. Demographics

The age of respondents ranged from 17 to 80 years with a mean age of 45 years old (standard deviation 13.5 years,  $n = 415$ ). Nearly one-half (48.7%,  $n = 199/409$ ) of respondents were female and most (81.7%,  $n = 336/411$ ) had attained a university degree or higher. Of the 29 countries represented, most respondents lived in Finland (28.4%,  $n = 111/391$ ), followed closely by Australia (25.3%,  $n = 99/391$ ) and the United States (20.5%,  $n = 80/391$ ) with remaining countries representing less than 5% each (Table 1).

### 3.2. Personal health and lifestyle information

Most respondents (90.7%,  $n = 359/396$ ) reported good (35.9%), very good (39.1%), or excellent (15.7%) state of health. Over half (58.3%,  $n = 231/396$ ) reported having a normal body mass index (BMI) while more than a third (35.4%,  $n = 140/396$ ) were overweight or obese (BMI range:  $> 25$ ). Nearly one third (32.1%,  $n = 135/420$ ) reported having a medically-diagnosed health condition with the most common being back pain (34.6%,  $n = 46/135$ ), followed by musculoskeletal problems (27.1%,  $n = 36/135$ ) and mental health issues (25.6%,  $n = 34/135$ ) (Table 2).

Most of the sauna bathers exercised regularly at least 30–60 min daily (100%,  $n = 288$ ), for 1–2 days per week (100%,  $n = 344$ ), 3–5 days/week (78.8%,  $n = 344$ ), and/or  $> 5$  days/week (53.2%,  $n = 344$ ) at variable levels of intensity (Table 2).

The vast majority were non-smokers (90.6%,  $n = 356/393$ ) and most (80.2%,  $n = 315/393$ ) consumed alcoholic beverages regularly, with over half (56.7%,  $n = 190/335$ ) reporting potentially heavy drinking patterns (defined as  $> 4$  standard drinks in men and  $> 3$  standard drinks in women on any given day in the past month) (Table 2).

Many dietary patterns were described, yet 61.5% ( $n = 198/322$ ) of sauna bathers reported having 'no restrictions' in their diet most of the time and half (49.6%,  $n = 131/322$ ) reported eating some 'organic' food (Table 2).

### 3.3. Motivations of sauna bathers

All respondents (100%,  $n = 460$ ) selected 'relaxation/stress reduction' as a reason for sauna bathing. Other leading reasons ( $> 80\%$  of  $n = 460$ ) motivating respondents to sauna bathe included 'enjoyment/invigoration', 'relieve aches and pains', 'social – to meet and talk with friends', 'improve circulation', 'routine bathing', 'cleanse skin/enhance beauty', 'detoxification' and 'improve sleep' (Table 3).

Additional motivations reported in free text responses included: "cultural", "ethnic heritage" (13 entries); "winter bathing", "winter swimming" and "to get warm" (10 entries); "lifestyle", "health/wellness" (6 entries); and "Aufguss"<sup>b</sup>-related (5 entries),  $n = 69$ .

### 3.4. Sauna characteristics and associated habits

Respondents sauna bathed primarily within a range of 4–12 times each month (median of 6 times,  $n = 443$ ), which extrapolates to a frequency of approximately 1–2 occasions per week (Table 4). Most respondents reported using traditional Finnish-style saunas (72.9%,  $n = 333/457$ , Table 5a), with temperature settings in the range of 60–90 °C (or  $\sim 140$ –195 °F) with 32.8% ( $n = 147/448$ ) specifying 80 °C (or  $\sim 180$  °F) (Table 4). There was a difference detected in the types of sauna used across nationalities with fewer Finnish sauna-bathers using infrared (1.7%,  $n = 2/117$ ) or steam saunas (5.1%,  $n = 6/117$ ) compared to their respective Australian (29.6%,  $n = 32/108$ ; 18.5%,  $n = 20/108$ ) and/or American (28.7%,  $n = 25/87$ ; 23.0%,  $n = 20/87$ ) counterparts ( $\chi^2 = 62.0848 > \chi^2$  critical value = 18.467;  $df = 4$ ,  $p < 0.001$ ) using chi square test of association (Table 5b).

Respondents reported spending approximately 13–29 min (median 16 min, IQR 16,  $n = 425$ ) per session and 32–65 min (median 49 min,

<sup>b</sup> "Aufguss" is a German word that literally translates in English to "infusion" or in the sauna, the "pouring of water over hot coals" (<https://www.collinsdictionary.com/dictionary/german-english/aufguss>). In this context, it presumably refers to a wellness/purification/entertainment ritual which is performed in the sauna by a designated aufgussmeister (steam master) (<http://www.aufguss.it>).

**Table 2**

Participant's health and lifestyle-related information.

(Results compiled from responses to seven questions of varying format: single responses from multiple choice format, two of which questions had conditionally-linked follow-up questions and one question with multivariable format allowing multiple responses).

Variable	Subcategory	Results		
		Percentage	Number of responses	Total number of responders to specified question
BMI (body mass index)	Normal (18.5–25)	58.3%	231	<i>n</i> = 396
	Overweight (> 25–30)	28.8%	114	
	Obese (> 30)	6.6%	26	
	Underweight (< 18.5)	2.3%	9	
	Not sure	4.0%	16	
Reported state of health	Excellent	15.7%	62	<i>n</i> = 396
	Very good	39.1%	155	
	Good	35.9%	142	
	Fair	7.6%	30	
	Poor	1.8%	7	
Medical/health conditions	No	67.9%	285	<i>n</i> = 420
	Yes	32.1%	135	
Medical/health conditions – specified	Back pain	34.6%	46	<i>n</i> = 135*
	Musculoskeletal	27.1%	36	
	Mental issues	25.6%	34	
	Respiratory	18.0%	24	
	Skin	15.0%	20	
	Hypertension	14.3%	19	
	Fatigue	12.8%	17	
	Cardiovascular	12.0%	16	
	Injury	12.0%	16	
	Thyroid disorder	11.3%	15	
	Insomnia	9.8%	13	
	Chronic pain	9.8%	13	
	Neurological	7.5%	10	
	Cancer	5.3%	7	
	Diabetes	5.3%	7	
	Chronic kidney disease	5.3%	7	
Drug/alcohol issue	3.8%	5		
Other/text-specified	18.8%	25		
Declined to specify	1.5%	2		
*Multiple responses allowed. Note: 330 different conditions specified by <i>n</i> = 135 participants.				
Exercise – intensity levels	Mild	92.7%,	319/344,	<i>n</i> = 344, <i>n</i> = 288 <sup>◊</sup>
		97.6%	281/288	
	Moderate	79.7%,	274/344,	
		80.2%	231/288	
	Moderate to high	58.1%,	200/344,	
		56.9%	164/288	
High	9.0%,	31/344,		
	8.7%	25/288		
Very high	2.6%,	9/344,	◊Results based on 2 multi-variable questions assessing timing and frequency with multiple responses allowed.	
	1.7%	5/288		
Exercise – time spent daily	< 30 min	47.6%	137	<i>n</i> = 288*
	30–60 min	100%	288	
	1–2 h	65.6%	189	
	> 2 h	18.8%	54	
*Multiple responses allowed in multi-variable question format.				
Exercise – frequency	1–2 days per week	100%	344	<i>n</i> = 344*
	3–5 days per week	78.8%	271	
	> 5 days per week	53.2%	183	
*Multiple responses allowed in multi-variable question format.				
Smoking	Yes	9.4%	37	<i>n</i> = 393
	No	90.6%	356	
Drink alcoholic beverages	No	19.8%	78	<i>n</i> = 393
	Yes	80.2%	315	

(continued on next page)

**Table 2** (continued)

Variable	Subcategory	Results		
		Percentage	Number of responses	Total number of responders to specified question
Heavy drinking of alcohol on any given day in past month? <sup>oo</sup>	Yes	56.7%	190	n = 335
	No	43.3%	145	
<sup>oo</sup> definition of heavy drinking: > 4 standard drinks in men and > 3 standard drinks in women				
General food content of diet: (highest responses only)	No restrictions – most of the time	61.5%	198	n = 322*
	Organic – some of the time	49.6%	131	
	Real/whole foods – most of the time	39.8%	99	

\*Multiple responses allowed in multi-variable question format.

**Table 3**

Motivations of sauna bathers.

(Results derived from responses to one multi-component question with multivariable responses).

Reason	Results			
	%	Number of responses	Maximum number of responders to specified responses	Indication of importance: 1 = low, 2 = medium, 3 = high, 0 = not indicated
			n = 460	Median score Interquartile range – in terms of importance
Relaxation/Stress Reduction	100.0%	460		3 High
Enjoyment/Invigoration	99.6%	458		3 High
Relieve aches and pains	87.8%	404		2 Med-high
Social – to meet and talk with friends	85.2%	392		2 Low-med
Improve circulation	85.0%	391		2 Med-high
Routine Bathing Regime	85.0%	391		2 Low-med
Cleanse skin/Enhance beauty	84.6%	389		2 Low-high
Detoxification	82.8%	381		2 Low-high
Improve sleep	80.0%	368		2 Low-high
Optimize exercise regime	55.4%	255		1 Low-med
Recovery from injury	54.1%	249		1 Low-med
Lose weight	52.6%	242		1 Low-med
Sexual activity	51.3%	236		1 Low
Professional – to meet and talk with business colleagues	49.8%	229		1 Low
Achieve a specific weight – i.e. jockey, wrestling	40.4%	186		1 Low
Treatment for specific medical condition	37.4%	171		1 Low
Drug and Alcohol Rehabilitation Program	35.2%	161		1 Low
Prescribed by health practitioner	33.3%	153		1 Low
Other – text specified:	30.9%	142		1 Low-high

IQR 33, n = 397) per total time in the sauna (Table 4). A home sauna was more frequently used by those who bathed several times per week (48.8%, n = 120/246) or several times per month (35.7%, n = 90/252), whereas those who bathed several times per year more frequently used saunas at a spa (26.3%, n = 99/377) or a resort (19.4%, n = 73/377) (Fig. 1).

Most respondents indicated sauna-bathing alone (70.5%, n = 320/454) or with people they knew (69.2%, n = 314/454). Almost half of sauna bathers (48.4%, n = 199/411) reported bathing with children (Table 6 – Supplementary). Only one respondent reported sauna bathing during pregnancy.

The top three activities reported in the sauna were: 1) relaxation (100.0%, n = 418/418), 2) talking with others (79.4%, n = 332/418) and 3) meditation (67.5%, n = 282/418). A variety of cooling techniques were reported with showers (66.9%, n = 299/447) being the most common, followed in popularity by cool plunges (in sea, river, ice, etc.) (45.6%, n = 204/447) and outdoor winter conditions (45.0%, n = 201/447) (Table 6 – Supplementary).

Water in various forms was the most common beverage consumed during sauna activity: tap water (63.7%, n = 286/449), filtered water

(27.4%, n = 123/449), and bottled water (22.3%, n = 100/449). Consumption of alcoholic drinks (31.6%, n = 142/449) before, during or after sauna activity was also reported (Table 6 – Supplementary).

### 3.5. Health experiences

As previously noted, nearly one-third of respondents reported having one or more medically-diagnosed health conditions (32.1%, n = 135/420). Of the 330 conditions specified by this subset of respondents, approximately two-thirds (67.4%, n = 203/301) reported that sauna bathing improved their condition, with 38.9%, (n = 117/301) reporting it made their condition slightly better and 28.6% (n = 86/301) much better (Fig. 2). More than half (52.0%, n = 143/275) of this subset reported positive effects lasting 1 day while around one in ten (9.9%, n = 25/275) reported positive effects lasting 4 days or more (Table 7– Supplementary). Over a third of these respondents (38.9%, n = 118/303) indicated that sauna use reduced their reliance on other therapies and well over half of these respondents (60.9%, n = 184/302) indicated that sauna use was part of their treatment regime (Fig. 3).

**Table 4**

Sauna settings and timing of use.

(Results compiled from four questions: three of which involved single responses to continuous slider option and the remaining question with single-choice responses to multiple-choice format).

Variable	Subcategories	Results		
		Percentage	Number of responses	Total number of responders to specified question
Temperature settings	30 °C or less, or 90 °F or less	0.0%	0	n = 448
	40 °C or 105 °F	3.8%	17	
	50 °C or 120 °F	8.5%	38	
	60 °C or 140 °F	13.4%	60	
	70 °C or 160 °F	16.1%	72	
	80 °C or 180 °F	32.8%	147	
	90 °C or 195 °F	17.4%	78	
100 °C or more, or 200 °F or more	8.0%	36		
Variable	Subcategories	Results		
		Median (IQR)	Total range	Total number of responders to specified question
Length of time spent in sauna	Per session (min)	16 (16)	5–90	n = 425
	Total time (min)	49 (33)	7–90	n = 397
Sauna use in past month	Number of times	6 (8)	0–30	n = 443

**Table 5a**

Types of sauna used.

(Results based from one multi-variable question with multiple responses allowed).

Variable	Subcategory	Results		
		Percentage	Number of responses	Total number of respondents to specified question
Types of Sauna	Traditional (Finnish, Russian, etc.)	72.90%	333	n = 457*
	Steam	22.10%	101	
	Dry	21.90%	100	
	Far-infrared	19.70%	90	
	Wet	12.00%	55	
	Combination Wet and Dry (i.e. Japanese Bath)	5.70%	26	
	Other – please specify	7.00%	32	
	Not sure	1.10%	5	
Total number of choices specified by all respondents			742	*Multiple responses allowed.

**Table 5b**

Analysis of popular sauna types used by top countries of respondents.

(Analysis using chi square test of association was conducted on filtered responses to same question as Table 5a allowing multiple responses).

	(% of total choices)			
	Traditional	Far-infrared	Steam	Total # choices
Australia	56 (51.9%)	32 (29.6%)	20 (18.5%)	108
Finland	109 (93.2%)	2 (1.7%)	6 (5.1%)	117
United States of America	42 (48.3%)	25 (28.7%)	20 (23.0%)	87
Subtotal	207	59	46	312

Chi square test of association:  $\chi^2 = 62.0848 > \chi^2$  critical value = 18.467; (df = 4),  $p < 0.001$ .

A majority (83.5%,  $n = 353/423$ ) of respondents indicated that their sleep quality was much better (39.2%,  $n = 166/423$ ) or slightly better (44.2%,  $n = 187/423$ ) as a result of sauna use and that the soporific effects lasted one night (62.1%,  $n = 259/417$ ), or two nights (15.1%,  $n = 63/417$ ) with 13.2% ( $n = 55/417$ ) reporting no effect on sleep (Table 8).

The most frequently reported adverse effects were: 1) dizziness (49.2%,  $n = 190/386$ ), 2) dehydration (40.1%,  $n = 151/377$ ), 3) headache (23.1%,  $n = 87/377$ ), 4) burn (16.7%,  $n = 63/377$ ), 5) breathing difficulties (16.6%,  $n = 62/374$ ), 6) eye irritation (16.4%,  $n = 61/373$ ), and 7) skin rash (10.5%,  $n = 39/370$ ) (Fig. 4). Most adverse effects were rated as ‘mild’ (i.e. easily relieved by simple treatment – 93.1%,  $n = 715/768$ ) or ‘moderate’ (i.e. treated with basic first aid and/or non-prescription drugs – 6.1%,  $n = 47/768$ ). Four responses

from different respondents (0.5%,  $n = 4/768$ ) that included dehydration, headache, breathing difficulties and eye irritation were rated ‘severe’ requiring health practitioner intervention and two separate responses (0.3%,  $n = 2/768$ ) that included eye irritation and chest pain/palpitations (due to a heart attack) were rated ‘very severe’ (requiring ambulance and/or hospitalization) (Table 9).

**3.6. Quality of life measures (using ‘SF-12’ tool) and frequency of sauna-bathing**

A Kruskal–Wallis test was conducted on calculated ‘SF-12’ physical (PCS) and mental (MCS) summative scores as compared to the frequency of sauna bathers, stratified into three categories (group I: sauna bathing reports of < 5 times per month,  $n = 138$ ; group II: 5–15 times

### Frequency and Location of Sauna Use

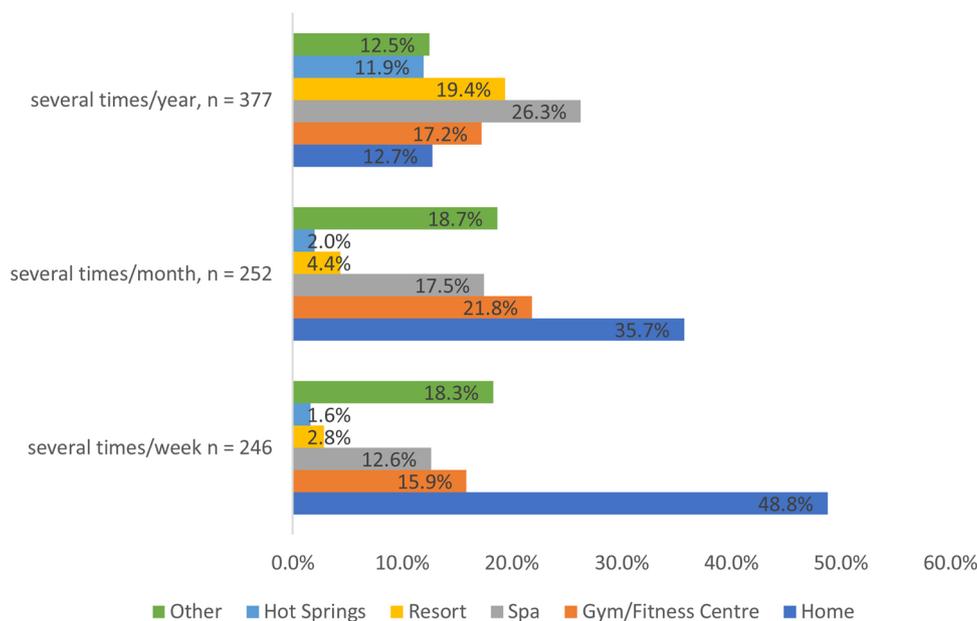


Fig. 1. Compiled from analysis of one multivariable question with multiple responses.

### EFFECT OF SAUNA-BATHING ON MEDICAL CONDITIONS\*

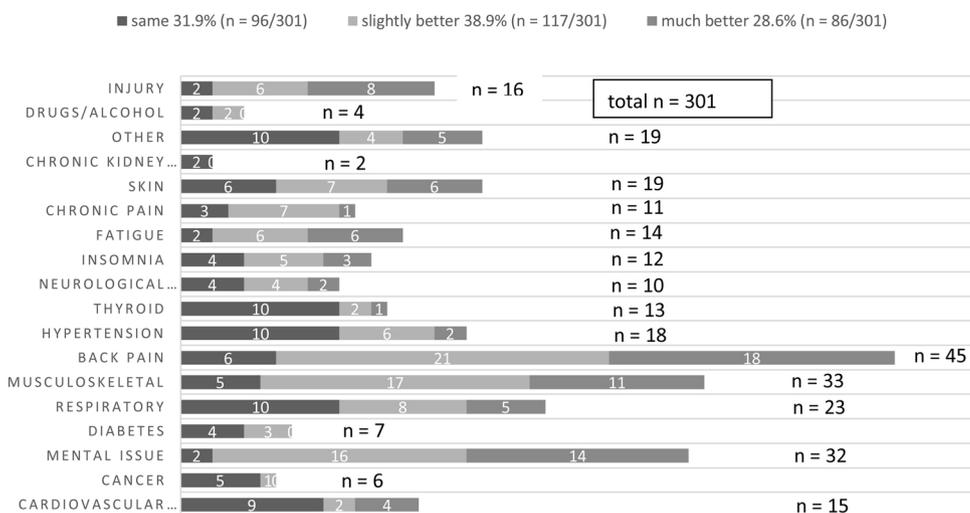


Fig. 2. Derived from filtered responses of one follow-up linked question allowing a single response in multiple-choice format. \*n = 2 reported sauna-bathing made their condition ‘slightly worse’ – one with a musculoskeletal condition and one indicated an ‘other’ condition. No one reported sauna-bathing made their medical condition ‘much worse’.

per month, n = 168; and group III: > 15 times per month, n = 55) to align with several recent observational sauna health studies.<sup>3–7</sup> SF-12 summative scores above and below ‘50’ were designed to represent above and below the ‘average’ quality of life, respectively, with every one-point difference being one-tenth of a standard deviation, originally based upon a general U.S. population, and it has since been validated for various other countries<sup>34,35</sup> (Table 10).

No significant differences in ‘physical’ well-being summative scores (PCS-12) were found between the three groups of respondents. ‘Mental’ well-being summative scores (MCS-12) however were revealed to be statistically different between the groups ( $H = 6.603 > \chi^2$  of 5.991,  $p = 0.0368$ ,  $df = 2$ ,  $\alpha = 0.05$ ,  $n = 361$ ). Those who indicated sauna bathing 5–15 times per month (group II) recorded higher scores (median MCS-12 = 53.28, n = 168) compared to group I who indicated sauna bathing < 5 times per month (median MCS-12 = 50.78, n = 138), based upon post hoc analysis with Mann Whitney U testing

between groups,  $p = 0.016$  ( $\alpha = 0.05$ ). No statistically significant differences were detected between groups II and III or groups I and III with similar post hoc analysis (Table 10).

#### 4. Discussion

##### 4.1. Summary of findings

To our knowledge, this is the first study to investigate the health-related habits of the global sauna community, to include participants from multiple countries and continents and to provide a balanced representation of women and men. Our results indicate respondents were predominantly well-educated, non-smoking, regularly-exercising individuals of normal-to-overweight status who generally reported overall good health. ‘Relaxation/stress reduction’ was the most common motivation for sauna bathing with most respondents

### IS SAUNA BATHING A THERAPY FOR YOUR MEDICAL CONDITION? (by condition)

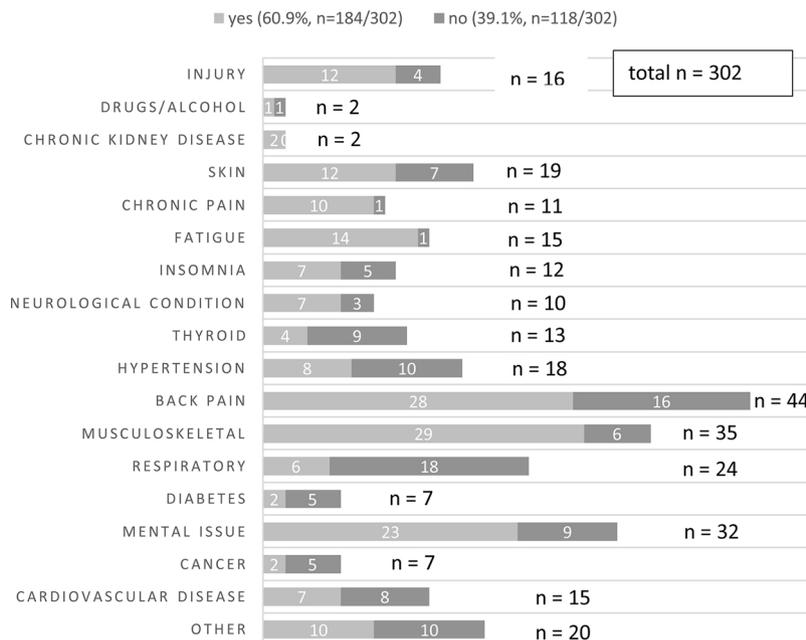


Fig. 3. Derived from filtered responses of another follow-up linked question allowing single response in a multiple-choice format.

Table 8

Effect of sauna bathing on sleep. (Results were compiled from two questions allowing single response in a multiple-choice format).

Variable	Subcategories	Results		
		Percentage	Number of responses	Total number of responses to specified question
Effect of sauna on sleep quality	Much worse	1.0%	4	n = 423
	Slightly worse	1.2%	5	
	No effect	14.4%	61	
	Slightly better	44.2%	187	
	Much better	39.2%	166	
Length of time – sauna effect on sleep	1 day/night	62.1%	259	n = 417
	2 days/nights	15.1%	63	
	3 days/nights	2.9%	12	
	4 days/nights	0.7%	3	
	5 days/nights	0.7%	3	
	More than 5 days/nights	0.5%	2	
	No effect	13.2%	55	
	Variable	4.8%	20	

describing favorable health benefits, especially around sleep and mental well-being. Most adverse reactions to sauna bathing were reported as minor and primarily included dizziness, dehydration and headache. Many reported sauna bathing for health reasons not yet well-understood by the medical community (e.g. detox) and/or for health conditions in which sauna use is not yet generally recognized as a therapeutic option (e.g. pain).

#### 4.2. Characteristics of sauna bathers

The fact that almost half of the respondents in this survey were women was a welcome finding, given that much of the research centered around sauna bathing has been focused on men.<sup>13</sup> The high degree of educational attainment reported (> 80% having a university

degree or higher) is consistent with Finnish research where the high socioeconomic status of frequent sauna bathers was suggested to be a significant confounder for improved cardiovascular health outcomes.<sup>3,38</sup> The differences in sauna type usage between the three most represented countries is worth highlighting and helps to characterize modern trends in the global resurgence of sauna bathing. For example, Australia and the United States reported greater uses of infrared sauna cabins and steam saunas as compared to the respective breakdown in Finland (Table 5b).

Over 90% of the sauna bathers reported good, very good, or excellent state of health and this is supported by the ‘SF-12’ physical and mental quality of life summary scores calculated to have medians above average (> 50.00) in all groups of sauna bathers, regardless of frequency, as outlined in Table 10. The increase in mental health well-

### ADVERSE REACTIONS TO SAUNA-BATHING\*

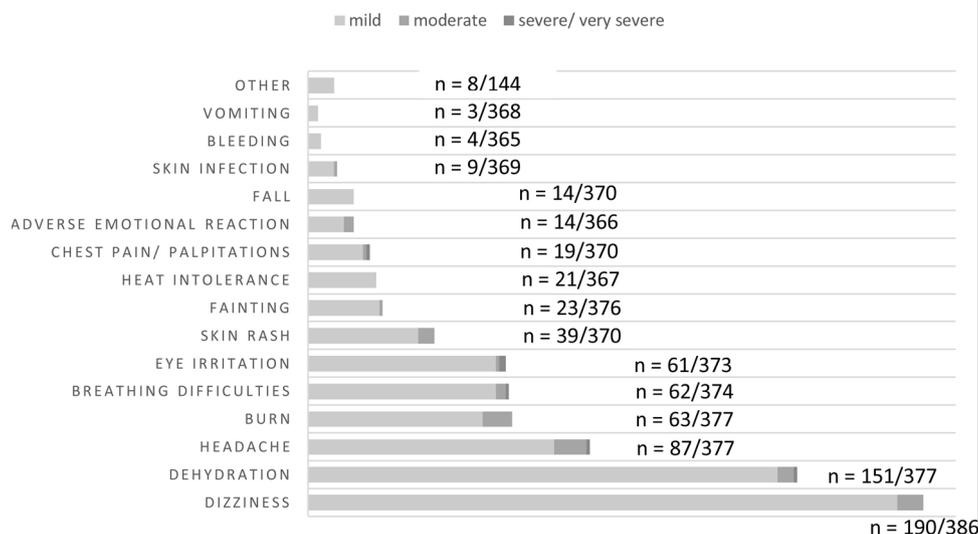


Fig. 4. Adapted from results of one multi-variable question allowing multiple responses.

Table 9

Adverse reactions of sauna bathing – graded by intensity.<sup>◊</sup>  
 (Analysis derived from filtered responses to one multi-component question allowing multiple responses).

Totals of adverse effect responses (by intensity <sup>◊</sup> )	Total n = 768 responses*
Mild	93.1% 715
Moderate	6.1% 47
Severe	0.5% 4
Very severe	0.3% 2

\* Multiple responses were allowed in multi-variable question format.  
<sup>◊</sup> **Mild** – easily relieved by simple treatment; **Moderate** – treated with basic first aid and/or non-prescription drugs; **Severe** – health practitioner treatment required; **Very severe** – ambulance and/or hospitalization required.

being scoring (SF-12 MCS) of respondents sauna bathing 5–15 times per month (group II) as compared to those sauna bathing less frequently (group I) supports the findings of relevant clinical studies.<sup>17,23,39–44</sup>

However, there was a notable absence of improvement in mental health scoring among respondents sauna bathing > 15 times per month (group III) as compared to both of the other groups sauna bathing less frequently (groups I and II). As sauna bathing is suggested to have physiological effects similar to moderate-intensity exercise,<sup>45,46</sup> it is possible this result may be due to effects similar to over-training in athletes<sup>47,48</sup> or perhaps due to people with ongoing mental health issues choosing to sauna bathe more frequently for therapeutic purposes.

Nearly all the respondents reported engaging in some degree of regular exercise with less than a third of respondents claiming to have a diagnosed medical condition. This suggests that similar to balneotherapy or hot springs bathing, sauna bathing is more commonly used for preventive health purposes than for specific medical therapy.<sup>49</sup> Over a third of sauna bathers classified themselves as overweight (28.8%) or obese (6.6%) which would suggest that frequent sauna bathing is well tolerated by this population. This is a promising finding as other recommended healthy lifestyle tools (i.e. exercise) are not as well tolerated by overweight or obese individuals.

The two main risk factors for rare cases of death in the sauna are heavy consumption of alcohol and sauna bathing alone.<sup>26,29</sup> Over 80% of participants reported regular drinking of alcoholic beverages and over half of these imbibers indicated engaging in ‘heavy drinking’, defined as ‘greater than 4 standard alcoholic drinks in men and greater than 3 standard alcoholic drinks in women, on any given day in the past

Table 10

Quality of Life and Frequency of Sauna-Bathing, (n = 361).  
 (Quality of life summative scores were derived using validated ‘SF-12 tool’ analysis of single-choice responses to twelve multiple choice questions and then compared to three stratified groups created from single-choice responses to one sliding-variable question.)

Frequency of sauna-bathing	n	Median SF-12 <sup>‡</sup> PCS Summative Scores (IQR <sup>∞</sup> , total range)	Median SF-12 <sup>‡</sup> MCS Summative Scores (IQR <sup>∞</sup> , total range)
< 5 times per month	138	53.03 (5.84, 24.74–59.87)	50.78 <sup>◊</sup> (10.52, 19.44–62.18)
5–15 times per month	168	53.57 (5.66, 23.24–59.97)	53.28 <sup>◊</sup> (9.94, 17.56–65.36)
> 15 times per month	55	53.41 (8.56, 26.66–60.67)	51.18 (8.65, 28.60–64.22)
H value		1.504	6.603*
χ <sub>0</sub> <sup>2</sup> (critical Chi square with df 2, n = 361, α = 0.05)		5.991	5.991*
p value		0.4714	0.0368*

<sup>‡</sup> SF-12 summative scores validated for ‘50.00’ to represent ‘average’ with every one-point difference being one-tenth of a standard deviation, based originally upon U.S. populations.

<sup>∞</sup> IQR = interquartile range, 25th–75th percentile.

\* Significant  $H > \chi_0^2$  calculated with Kruskal–Wallis testing,  $\alpha = 0.05$ .

<sup>◊</sup> Significant difference ( $p = 0.016$ ,  $\alpha = 0.05$ ) detected between group I and group II median and distribution of SF-12 MCS summative scores with post hoc analysis – Mann Whitney U test between groups. Differences between groups I and III ( $p = 0.728$ ,  $\alpha = 0.05$ ) and between groups II and III ( $p = 0.119$ ,  $\alpha = 0.05$ ) did not reach statistical significance.

month’ within the survey. Nearly a third (32.1%) of participants reported imbibing during sauna bathing and over 70% of respondents reported sauna bathing alone at times. Even without knowing the exact overlap of behaviors, this suggests an opportunity for more effective public health messaging around the risks of alcohol intake while sauna bathing.

#### 4.3. Motivations and experiences of sauna bathers

It is remarkable that 100% (n = 460) of respondents selected ‘relaxation/stress reduction’ as a reason for sauna bathing (Table 3) and 100% (n = 418) selected ‘relaxation’ as an activity that actually occurs while in a sauna. This points to sauna use as having the potential to assist in addressing the growing number of chronic disease states in

which ‘psychological stress’ is considered to be strongly associated with pathogenesis (i.e. depression, cardiovascular disease, viral reactivation syndromes involving HIV and herpes viral infections, rheumatoid arthritis, and prolonged wound healing, etc.).<sup>50–52</sup> Of these disease states, only cardiovascular disease<sup>11,16</sup> and, to a much lesser extent, depression<sup>44</sup> and rheumatoid arthritis<sup>53</sup> have been the focus of sauna interventional studies. As a result, the clinical prescribing of sauna use for stress reduction may present as a fruitful area for future research.

Of the other leading motivations for sauna use reported by 80% or more of the sauna bathers, only a few have any rigorous research validation. These include: ‘improved circulation’ interpreted as improvement in cardiovascular status<sup>11,16</sup> as previously discussed, and ‘relieve aches and pains’ which has been demonstrated in some sauna interventional studies involving populations with chronic pain states.<sup>17,42,53</sup> While some motivations such as ‘enjoyment/invigoration’, ‘social – to meet and talk with friends’ and ‘routine bathing regime’ do not necessarily require medical validation, they could benefit from further social-scientific verification and exploration. Other identified motivations including ‘detoxification’<sup>43,54,55</sup> and ‘cleanse skin/enhance beauty’ require further controlled sauna studies and currently lack acceptable physiological models to support the use of sauna as a therapeutic intervention.

‘Improving sleep’ was also cited as a popular motivation for sauna use. As most respondents reported improved sleep quality lasting 1–2 nights post sauna activity, this suggests that sauna bathing may enhance sleep. Nonetheless, there are few studies evaluating sauna bathing’s impact on sleep and the physiological mechanisms underlying these effects. However, research demonstrates strong correlations between the speed of core body temperature reduction, peripheral vasodilation and the normal onset of sleep.<sup>56–61</sup> Thus sauna-induced peripheral vasodilation may potentiate whole body cooling and thereby improve sleep onset, while the enhanced cardiovascular activity associated with sauna bathing may increase perceived tiredness, yet neither of these hypotheses fully explain the prolonged effects. This provides another interesting topic for future studies into the effects of sauna use on well-being.

The use of sauna bathing as a social activity was explored. We found that half of the participants regularly used saunas with people they did not know, presumably in public facilities, and similarly nearly half reported having used a sauna with children at some point. Only one participant reported sauna bathing while pregnant. This latter finding runs contrary to previous Finnish literature that reports relatively high rates of sauna use among pregnant women.<sup>62,63</sup> This may reflect a general lack of awareness surrounding recent, more lenient medical recommendations for pregnant women regarding heat exposure.<sup>64</sup>

The propensity to engage in sexual activities in saunas was listed as a motivator of sauna use by more than half of respondents. Although generally classed as a motivator of ‘low’ importance, these findings suggest that the link between sauna use and sexual wellbeing, even beyond the MSM population, may benefit from further studies.

The reported adverse effects of sauna bathing such as dizziness, dehydration, headache, and burns are all consistent with prior literature.<sup>16,17,40,55</sup> However, the prevalence and severity of eye irritation with sauna bathing (16.4%,  $n = 61/373$  with one report of hospitalization) was unexpected, as this runs somewhat contrary to studies that have found locally-applied, sauna-like ophthalmic therapies to be beneficial for individuals with conditions such as blepharitis and meibomian gland dysfunction.<sup>65,66</sup> These adverse ophthalmic effects may be mediated by eye dryness or perhaps hypersensitivity responses of the eyelid’s meibomian glands, which are specialized sweat-producing sebaceous glands.<sup>67</sup> More importantly, the sole report of a participant experiencing a heart attack directly after sauna bathing suggests that, although rare, sauna bathing can indeed induce serious adverse outcomes. Nonetheless, contraindications to sauna bathing still require further definition.

Of the subset of respondents with diagnosed medical conditions,

more than two thirds reported improvements after sauna bathing lasting from hours to days. When looking at the breakdown of sauna-responsive health conditions, ‘hypertension’ and ‘cardiovascular’ conditions were not among the top medical conditions of respondents despite the strongest evidence from observational and interventional sauna studies suggesting cardiovascular benefits, which indicates people may not be aware of the scientific literature surrounding the benefits of sauna use.<sup>3,11,16</sup> However, sauna bathing is rarely part of conventional medical treatment plans for those conditions widely reported to improve with sauna use (back pain, musculoskeletal pain, mental health issues, respiratory and dermatological conditions).<sup>68</sup> Therefore, if sauna use as a wellness and/or therapeutic intervention becomes increasingly recommended to patients, health care providers and the general public will necessarily benefit from systematic evidence-based guidelines.

#### 4.4. Limitations of this study

A major limitation of this study is its cross-sectional design, which can only capture a limited snapshot of information about sauna use around the world. This was evidenced by the limited geographic spread of participants, with most living in just three of the 29 reported countries. Significantly, of the 29 countries represented, only a small proportion of the data was obtained from countries with important sauna traditions such as Sweden, Russia, Germany, Japan, Switzerland, Hungary, Norway, Italy, Denmark, Canada, United Kingdom, Thailand, Estonia, Lithuania and countries in the Middle East. Moreover, no data was obtained from Austria, Latvia, Bulgaria, Poland, Korea, Turkey, China and other countries well-known to have a high prevalence of sauna activities. Issues with language restrictions and social media recruitment likely contributed to these omissions. Consequently, the generalizability of results is somewhat limited. However, this does not negate the importance of obtaining this preliminary set of global data that supports traditional and anecdotal understandings of sauna use as a wellness technology with therapeutic potential.

Due to the online nature of the survey, a further potential limitation of this study is the inability to authenticate the responses provided by participants (e.g. age, gender and medical diagnoses). Furthermore, this study is not a randomized sample collection, as it maintains an inherent positive bias toward individuals who are more likely to use saunas on a more frequent basis than the general population. Self-reporting may invariably limit the reliability of the health, medical and sauna use information (e.g. temperature, duration and frequency) collected throughout the study. Many of the survey questions relied on a degree of subjective judgment on the part of participants, and responses may therefore vary depending upon emotional and environmental context, health literacy, and various social biases. The need for more controlled studies to further investigate all these important factors is indicated.

In addition, the current terminology used to describe sauna bathing (i.e. traditional sauna, Finnish-style sauna, Turkish Hamman-style, steam sauna, wet vs. dry sauna, far-infrared vs whole-spectrum infrared sauna cabins, etc.) is inconsistent and non-standardized. This proved challenging in the design of the survey questions and the interpretation of results. This limitation highlights the need for a standard lexicon to be developed around sauna bathing so future studies can be conducted using a validated and consistent set of descriptors.

## 5. Conclusions

Sauna bathing is currently used by a wide range of ages and nationalities. This study demonstrated that sauna use has perceived health benefits that vary from generalized effects such as relaxation, stress relief, invigoration, and socializing to more specific effects such as aiding circulation, improving sleep, improving mental health, enhancing ‘detoxification’, and relieving back/musculoskeletal pain. The few reported incidences of adverse reactions to sauna bathing were mild

and included mostly dizziness, dehydration and headaches. While severe adverse events were rare, further research is needed to determine any specific contraindications. The study's findings indicate many people sauna bathe for health reasons not yet well understood or recognized by the scientific community (e.g. detox, pain) and conversely, few people use sauna for health conditions such as cardiovascular-related disorders where benefits have been evidenced. Overall, the results of this study confirm previously described health and wellness benefits of sauna use and indicate the need for further research and greater education around the use of saunas as a therapeutic intervention.

### Authors' contributions

Marc Cohen and Joy Hussain conceived the strategy to use a cross-sectional study design to better understand health behaviors around sauna-bathing. Joy Hussain designed, conducted and completed analysis of the study as part of her PhD project and wrote the first draft of the manuscript. MC and RG supervised this project as part of JH's PhD candidature. All authors contributed to the writing of the subsequent drafts, and reviewed, edited, and approved the final manuscript.

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### Financial disclosure

None declared.

### Conflict of interests

None declared.

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### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.ctim.2019.03.012>.

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