What Can Twitter Tell Us about Skin Cancer Communication and Prevention on Social Media?

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Keywords

Skin cancer · Social media · Health promotion · Twitter communication patterns

Abstract

Background: Skin cancer places a substantial burden on the health system in Australia. The modernisation of skin cancer prevention interventions by using social media may enhance their contemporary reach and relevance, especially among the youth. This study aimed to analyse Twitter posts in Australia to establish a baseline of skin cancer and sun-related communication trends. **Methods:** Tweets posted over the summer of 2018/2019 relating to relevant keywords and hashtags such as “slipslopslap” and “sunscreen” were analysed using quantitative and qualitative methods. The number of tweets, related communication patterns, and possible factors for sudden changes in tweet volume were studied. **Results:** Results showed that Australians are using Twitter to communicate about their sun-related and skin cancer experiences and to share advice and information on this matter. Overall, Australians use Twitter more frequently to talk about sunscreen (number of tweets between December 2018 and February 2019 = 5,842) and/or skin cancer ($n = 3,936$), but not so often to communicate about other sun-

protective behaviours ($n = 1,972$) or skin cancer prevention campaigns ($n = 108$). The number of tweets is greatly affected by the increase in temperature. Celebrities, non-health-related organisations with a high number of followers, and individuals sharing their own skin cancer experiences achieve a substantial number of likes and retweets and thus influence on Twitter regarding skin cancer-related communication. **Conclusions:** The results allow deeper understanding of important determinants for effective social media use for health promotion and public health messaging in the future. Linking tweets with temperature, sharing by celebrities or non-health-related organisations and individuals with a high following can all contribute to greater spread of skin cancer and sun-related messages.

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Introduction

Worldwide, skin cancer is a significant public health concern. Its incidence continues to increase, to now being one of the most commonly diagnosed cancers in many

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Fig. 1. Flowchart of Methods.

countries of the world [1]. The age-standardised incidence rate of melanoma in Australia is approximately eleven times higher compared to the world average [2] and it is the most common cancer diagnosed among young people [3]. Australia has a remarkably long history of skin cancer prevention campaigns, such as Slip Slop Slap!, which were successful in creating a community that is often aware of the importance of adopting safe sun behaviour [4]. Nevertheless, sun protection behaviours are still far from being ideal and young people, in particular, are the group least compliant [5–7].

Advances in technology require health promotion interventions to follow the actual media consumption patterns of the population, with a move away from traditional media consumption, such as television [8], to the predominant use of digital technologies. Approximately 99% of Australians aged 18–29 years use social media [9] and evidence suggests that it has become an important part of their daily life [10], including seeking information about health [11, 12]. Social media thus offers unique opportunities to reach a large proportion of this hard-to-reach group and potential for health promotion interventions [13, 14].

Innovative “infoveillance” methods for public health surveillance are becoming increasingly available and applied for the real-time analysis of health-related communication patterns on the Internet [15]. Social networking analysis of Twitter data has been used to study health-related communication patterns and trends on a wide range of topics including influenza [16], obesity [17], and cancer [18]. It has also been used to analyse the reach of health promotion campaigns [19, 20], including for skin cancer prevention in the USA [21]. Such analyses could also be informative for health promotion planning in Australia.

Applying both quantitative and qualitative methods, the main objective of this study was to analyse commonly used skin cancer and sun-related Twitter keywords and hashtags (#) over the summer of 2018/2019.

The study was intended to answer the following questions:

- What are the number, related communication patterns, and content of tweets being shared regarding skin cancer and sun-related communication over the summer months in Australia?

Table 1. Tweets gathered and excluded and descriptive statistics

	Before cleaning			After cleaning (1,000 random tweets analysed)		
	tweets retrieved	manually cleaned	excluded	tweets/day	minimum	maximum
Slipslopslap	1,068	no		10 (5–14)	1	45
Sunsmart	1,972	no		9 (6–15)	0	54
Sunscreen	5,842	yes	175	9 (7–13)	2	57
Skincancer	3,936	yes	107	10 (6–14)	2	33
NSCAW	109	yes	1	3 (1–10)	1	20

Data are presented as *n* or median (IQR), as appropriate. NSCAW, National Skin Cancer Action Week.

- Is temperature a main factor influencing changes in communication patterns?
- What is the reach of tweets concerning the National Skin Cancer Action Week?
- Which are the most retweeted and liked tweets and what may have motivated this?

Methods

For further details, see the online supplementary material (see www.karger.com/doi/10.1159/000506458 for all online suppl. material) (Fig. 1; Table 1) [20, 22–25].

Results

Number of Tweets

The hashtag and keyword search identified a total of 12,927 tweets available for analysis within the 3 summer months of 2018/2019 and the National Skin Cancer Action Week (NSCAW). The total number of tweets gathered for each dataset and related descriptive statistics are described in Table 1. The datasets “sunscreen” and “skin-cancer” contained the highest number of retrieved tweets: 5,842 for sunscreen and 3,936 for skin cancer. There were 1,068 tweets gathered for “slipslopslap” and 1,972 for “sunsmart.” Only 108 tweets were collected directly relating to the NSCAW campaign.

Communication Patterns and Relationship with Temperature

Figure 2 presents the distribution of the number of tweets over time for each dataset. It can be noticed that peaks seem to occur in similar patterns during the sum-

mer. For example, a significant peak occurred on January 25, 2019, in all the datasets. Except for “skincancer,” all datasets reached their maximum number of tweets during that summer on that day. For sun smart-related tweets, the number of tweets posted on the 25th of January reached six times the median number of tweets per day: median = 9 (6–15). Figure 2 (yellow line) also presents the average maximum temperature in Sydney and Melbourne per day during the summer: median = 26.75°C (24.75–29.70°C).

Figure 2 highlights that the number of tweets increased on days with high maximum temperatures, suggesting a possible relationship. On January 25, 2019, when the maximum volume of tweets occurred across multiple datasets, Melbourne experienced its maximum temperature that summer (43°C), and New South Wales went through a heatwave on the same weekend.

Linear regression analysis confirmed a significant positive correlation between daily maximum temperature in Sydney and Melbourne and number of tweets per day for all datasets (Table 2). While Granger causality indices did not support significant relationships between temperature and number of tweets, instantaneous causality analysis retained a significant association between temperature and “slipslopslap” and “sunscreen” tweets.

Qualitative Analysis

Content Analysis

For each dataset, representative tweets from the 2 days with the highest volume are presented in Table 3. Content analysis identified three main themes: “health information,” “health advice,” and “health-related expressiveness.” “Health information” tweets shared new treatments or new results, such as: “Sun safety professionals now recommend individuals apply sunscreen every day.”

Table 2. Relationship between number of tweets and average daily maximum temperature in Sydney and Melbourne

Dataset	Simple linear regression			Causality (<i>p</i> value)	
	Durbin-Watson	coefficient (B) and its significance	<i>R</i> ²	Granger causality	instantaneous causality
Slipslopslap	1.59	1.01 (<i>p</i> < 0.001)	0.217	0.069	0.003
Sunsmart	1.48	0.78 (<i>p</i> < 0.001)	0.130	0.318	0.306
Sunscreen	1.37	1.12 (<i>p</i> < 0.001)	0.257	0.170	0.002
Skincancer	1.76	0.57 (<i>p</i> = 0.007)	0.080	0.414	0.324

Fig. 2. Distribution of the number of tweets and maximum temperature over time. Upper panels: daily number of tweets for each dataset (blue lines). Lower panel: average maximum temperature in Sydney and Melbourne over time (orange line).

Tweets containing “health advice” included three main subthemes: tweets containing general advice, such as “Have a good weekend. Don’t forget the sunscreen”; tweets containing advice to sun protect at social events, such as “People going to St Kilda tomorrow, wear a hat, stay hydrated and use sunscreen”; and tweets informing the importance of sun protection because of high temperature or ultraviolet radiation index (UVI), such as “Today it’s going to be hot across Australia! A reminder to slip, slop, slap, stay cool and hydrated.” From the 156 tweets shared on the 25th of January about “sunscreen,” “sunsmart,” and “slipslopslap,” approximately 25% of

tweets contained warnings and information about high temperature, whereas only 8% mentioned the UVI. “Health-related expressiveness” tweets shared sun-related actions, thoughts, or feelings, such as “Hat on and sunscreen. Just drank approximately 800 mL of water before leaving the house”; or reported personal experiences of skin cancer, such as “Friends use sunscreen and get skin checks regularly! This is what I look like, two days after surgery to remove a Stage 1A Melanoma.” From the 33 tweets shared on the 27th of January, approximately 79% contained messages about personal skin cancer experiences.

Table 3. Example of tweets from the 2 peak days for each of the datasets

Dataset	Peak days	Example of tweets
Slipslopslap	January 25	Today it's going to be hot across Australia! A reminder to slip, slop, slap, stay cool and hydrated Media for ANZJPH article on sun safety; slip, slop slap every morning
	January 4	Slip slop slap it's going to be hot; Melbourne weather The new year is usually the time we start new habits; good sun protection slows the signs of ageing and prevents skin cancer!
Sunsmart	January 25	Sun safety professionals now recommend individuals apply sunscreen every day Temperatures are going to rise this long weekend it's important to stay cool and hydrated this weekend
	January 3	Extremely hot conditions, with temperatures in the mid 40s; be sun smart, and carry water with you Be careful in the heat on Friday – Stay hydrated and be sunsmart
Sunscreen	January 25	Maybe you are not using enough sunscreen – here's how much experts now say you need Hat on and sunscreen; just drank approximately 800 mL of water before leaving the house
	January 4	Have a good weekend; don't forget the sunscreen! People going to St. Kilda tomorrow, wear a hat, stay hydrated and use sunscreen
Skincancer	January 27	Friends use sunscreen and get skin checks regularly! This is what I look like, two days after surgery to remove a stage 1A melanoma Protect babies and infants; an important risk for melanoma in later life is sun exposure as an infant
	January 1	Researchers in Australia find which cells can halt the growth of melanoma cells This is a good way to start the New Year with research showing how we can fight melanoma

NSCAW Campaign

There were 108 tweets directly relating to the NSCAW campaign by 61 unique users. Of these, 65% were original tweets and 35% retweets. The main contributors were health organisations, responsible for approximately 50% of all tweets ($n = 22$, including 10 cancer-related organisations), and individuals ($n = 21$). Regarding cancer organisations, the main contributors were the Cancer Council Australia, followed by the Cancer Council Western Australia and the SunSmart Western Australia, who contributed 8, 7, and 7 times, respectively. Other organisations and celebrities made fewer contributions ($n = 16$ and $n = 2$, respectively). Most tweets posted by health organisations were original tweets (approximately 70%), while 70% of the tweets posted by individuals were retweets.

Overall, the campaign had the potential to attain approximately 2,777,370 impressions. Even though they only contributed twice, celebrities generated considerably more impressions ($n = 2,093,252$) than any other group.

Most Retweeted and Liked Tweets

Table 4 displays examples of the most retweeted and liked tweets from the datasets “slipslopslap,” “sunsmart,” “skincancer,” and “NSCAW.” Non-health-related organisations and celebrities with a high number of followers achieved a substantial number of likes and retweets. Personal experiences of skin cancer were highly retweeted and liked even if posted by individuals with a small number of followers.

Discussion

Social media has become a virtual place where individuals share experiences, interact with others, and seek information. Results show that Australians are using Twitter to communicate about their sun-related and skin cancer experiences and share information and advice on this matter. While many tweets were about personal sunscreen use ($n = 5,842$) or skin cancer ($n = 3,936$), fewer

Table 4. Examples of the most retweeted and liked tweets

Dataset	Examples of most retweeted tweets	Tweeted by	Examples of most liked tweets	Tweeted by
Slipslopslap	High temperatures are expected at the Avalon Airshow 2019, hydrate and slip, slop, slap	Organisation	City sunset showed scintillating splendour! Melbourne's Monday is marked by much magnificent meteorology, but such wonderful sunshine sets the scene for sunburn so slip, slop, slap, slide and seek!	Organisation
	If you are planning to attend AusOpen this week it would serve you well to Slip, Slop, Slap, Slide and Seek! Stay hydrated and beware of high UV levels	Organisation	Might be a day for the beach? Hot weather, stay cool slipslopslap?	Celebrity
Sunsmart	At the moment Australia is the hottest place on Earth; it's now 42c and rising in Melbourne with extreme UV; be sun smart	Individual	The Small Master of Sun Safety	Organisation
	You could get a sunburn in about 10 min without sun protection, please be SunSmart	Individual (partner of a celebrity)	This person with stage 4 melanoma is running a campaign to make SunSmart cool through LEGO	Celebrity
Skincancer	Friends use sunscreen and get skin checks regularly! This is what I look like, two days after surgery to remove a stage 1A melanoma	Individual	I had surgery to remove a melanoma from my back; fortunately, we caught it early; very thankful for my practice which delivered a composed mind as I navigated this process	Individual
	Concerned that a mole might be skin cancer? Remember the ABCDEs; if you notice any of these signs, talk to your doctor	Health organisation	Use sunscreen; just got a skin cancer cut out of the side of my face	Individual
NSCAW	It's National Skin Cancer Action Week and we are encouraging everyone to OwnYourTone and embrace your natural skin tone; protect yourself from UV radiation and abstain from tanning	Celebrity	Loved discussing the risks of skin cancer today on the TV show; OwnYourTone; prevention better than cure	Celebrity
	Wonderful day today launching NationalSkinCancerActionWeek to remind about the importance of sun protection to reduce skincancer risk; this summer embrace your natural skin tone, no tan required	Cancer organisation	Thank you to our ambassador for discussing the risks of skincancer and raising awareness of NationalSkin-CancerActionWeek	Cancer organisation

related to skin cancer prevention campaigns. This was also evidenced by the lower number of tweets relating to the keywords “slip slop slap” ($n = 1,068$) or “sun-smart” ($n = 1,972$). Surprisingly, the tweet volume referring to the 2018/2019 NSCAW campaign was minimal when compared to all other datasets ($n = 108$). The results of the qualitative analysis showed that while health and skin cancer organisations actively supported the campaign, and 70% of individual tweets were retweets, those messages did not appear to reach or resonate with a large proportion of the population, similar to previous findings which also indicated that messages were mostly shared internally [26]. This is in contrast to some other studies that reported high reach of public health campaigns on Twitter. For example, Thackeray et al. [20] found a high volume of tweets about breast cancer awareness month. In the USA, nearly 1,300 tweets were shared about the “Don’t Fry Day” campaign, generating above 12 million impressions, over a 5-day period [21]. This suggests that the use of social media campaigns in Twitter has, at least theoretically, the ability to fulfil its purpose and be shared by a large number of users. More comparative effectiveness research is needed to understand how to best achieve good reach within the target population using this platform [27].

The statistical analyses performed showed significant correlation and possible causality between the number of tweets shared per day and the ambient temperature, with the volume of tweets increasing significantly on days with high temperatures and less so on days with high UVI. The predominant sharing of sun protection advice on high-temperature days may contribute to the myth that sun protection is only necessary when the temperature is high. Results from the most recent National Sun Protection Survey reported a clear gap in Australians’ knowledge regarding the leading causes of sunburn [28]. The report found that 24% of the interviewees believed that temperature was the main risk factor for sunburn and fewer than 10% of participants recognised that sun protection is necessary when the UVI level is 3 or higher, regardless of temperature. Previous research has shown that people receive similar amounts of personal UV radiation on cool days and hot days due to greater intentional sun exposure on days with lower temperature [29]. The results of this study provide further evidence that public health agencies need to continue efforts to improve the public’s understanding of the lack of correlation between UV intensity and ambient temperature.

Another interesting finding is that for some datasets, such as “slipsloplap,” a higher number of retweets and

likes were achieved when posted by non-health-related organisations or celebrities. This is consistent with previous health research, which demonstrated that tweets endorsed by celebrities are more likely to be seen and shared [20, 21]. Health and skin cancer organisations may not achieve broad reach because their number of followers is not as substantial. When analysing the NSCAW campaign, Cancer Council Australia was the account that shared the highest number of tweets; however, probably because of its limited number of followers, it did not achieve great impact. As also concluded by Thackeray et al. [20], health organisations may benefit from linking themselves with accounts with a high number of followers to reach a higher proportion of the Twitter community. The sharing of personal skin cancer experiences was one theme that seemed to have a broad reach, even if not shared by individuals with a high number of followers. These types of tweets were often highly retweeted, which indicates that they captured the public’s attention. Research has already demonstrated that the sharing of one’s own cancer diagnosis has the potential to enhance engagement and communication on social media [30, 31].

Limitations

There is no validated data-filtering method in the literature regarding this area, and the search terms applied may not have been optimal for all datasets. Some relevant tweets may therefore have been unintentionally missed and a greater number, or different type, of tweets may have been retrieved if the search terms were changed or broadened. Although methods were applied to control the presence of unrelated tweets, some datasets were not manually checked and are likely to have a small number of tweets that do not directly refer to the intended issue, thus slightly overestimating the frequency of use. An important and well-documented limitation of research using social media data is the issue of representativeness. Users who tweet about skin cancer and sun-related behaviours may not be representative of the overall Twitter community, and Twitter users may not be representative of the offline population.

Conclusion

Due to Twitter’s extensive reach and use, and its relevance to the topic of skin cancer prevention, public health professionals should consider extending its use for the communication of skin cancer-related information. The results of this study provide important insights into how

Twitter may be used effectively for health promotion and public health messaging in the future.

Linking tweets with temperature and sharing by celebrities or non-health-related organisations and individuals with a high following can all contribute to greater spread of skin cancer and sun-related messages.

Key Message

Twitter provides insights into sun protection communication and related social media activities.

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Statement of Ethics

Ethics approval was granted by the Queensland University of Technology Human Research Ethics Committee prior to the initiation of any data analysis (UHREC Ref. No. 1900000035). Only

accounts with privacy settings allowing the broader public to have access to the content of the tweets were included in this study. Since the study only utilised data published online, no participants were approached. When quoting a tweet, tweets were slightly re-phrased and mentions and hashtags were removed to prevent tweets from being identified.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

C.V.S.: quantitative and qualitative data analysis and drafting, writing, and revision of the manuscript. D.J.: statistical analysis. M.J.: writing and critical revision of the manuscript. All authors read and approved the final manuscript.

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