

The Sentiment Analysis of Tweets as a New Tool to Measure Public Perception of Male Erectile and Ejaculatory Dysfunctions

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ABSTRACT

Introduction: Twitter is a social network based on “tweets,” short messages of up to 280 characters. Social media has been investigated in health care research to ascertain positive or negative feelings associated with several conditions but never in sexual medicine.

Aim: To assess perceptions related to erectile dysfunction (ED) and premature ejaculation (PE) among Twitter users.

Methods: Data collection was performed on a daily basis between May 24–October 9, 2018 (138 days) via an automated script. Data collection was then performed after data cleaning. The statistical software R and the *rtweet* packages were used in both phases.

Results: We collected 11,000 unique tweets for PE and 30,546 unique tweets for ED. After data cleaning, we analyzed 7,020 tweets on PE and 22,648 tweets on ED by analyzing the most recurring words and the clusters describing word associations. The most popular words for ED were “Treatment,” “Health,” and “Viagra,” whereas “Sex,” “Sexual,” and “Cure” were the top 3 for PE. Word clusters suggest the presence of some recurring themes, such as medical terms being grouped together. Additionally, tweets reflect the general feelings triggered by specific events, such as pieces of news pertaining to sexual dysfunctions.

Clinical Implications: Tweets on sexual dysfunctions are posted every day, with more tweets on ED than on PE. Treatment is among the chief topics discussed for both conditions, although health concerns differ between PE and DE tweets.

Strength and Limitations: This is the first analysis conducted on Tweets in the field of andrology and sexual medicine. A significant number of tweets were collected and analyzed. However, quantitative assessment of the sentiment was not feasible.

Conclusion: Sexual dysfunctions are openly discussed on social media, and Twitter analysis could help understand the needs and interests of the general population on these themes. **Sansone A, Cignarelli A, Ciocca G, et al. The Sentiment Analysis of Tweets as a New Tool to Measure Public Perception of Male Erectile and Ejaculatory Dysfunctions. Sex Med 2019;XX:XXX–XXX.**

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Key Words: Twitter; Sentiment Analysis; Premature Ejaculation; Erectile Dysfunction; Sexual Dysfunction; Public Perception

INTRODUCTION

In recent years, after the exponential increase of the use of mobile devices, the Internet has reshaped patterns of

communication: instead of direct interaction between 2 individuals, social networks allow for “open” messages, which can be often seen or commented on by other users. Acronyms have

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been used to convey feelings of joy, surprise, and fun; emoticons and emojis have become increasingly common in e-mails and messages, helping to describe the “tone” of each conversation with minimal effort. A recent article in *The BMJ*¹ goes as far as suggesting the use of emojis in biomedical literature: although the article is clearly intended as a joke, it is somewhat interesting to consider how medical research has often used pictorial charts, such as the Visual Analogue Scale,^{2,3} to close the gap between patient-defined and clinician-perceived outcomes.⁴

Social networks are perhaps among the most interesting Internet phenomena of the last decade. Whatsapp, WeChat, Facebook, Renren, Qzone, Instagram, Twitter, Weibo, and other similar platforms have allowed the sharing of thoughts, pictures, and videos, all at a finger’s distance. Twitter, a social network based on short messages of up to 240 characters called “tweets,” is among the most popular social networks in a large majority of countries.

The Internet has become a public plaza of sorts, in which people can share opinions, argue with others, or search for all kinds of content. The analysis of opinions, sentiments, attitudes, and emotions toward specific entities, such as products, topics, or events, is called *sentiment analysis*. This is usually performed by collecting a large amount of text data, such as newspaper articles, figure captions, social media posts, or product reviews and investigating the “sentiment” conveyed by the text at different levels, from isolated words, to complete sentences, to full documents.⁵ The results from this kind of analysis can be used to summarize the opinion toward a well-defined topic; in the field of medicine, sentiment analysis can help clinicians’ understand the needs and interests of the general population, therefore, ultimately improving healthcare. Sentiment analysis based on tweets has been successfully used in the past for several health concerns, such as caloric balance⁶ and cancer-related feelings,⁷ as well as the spread of disease during influenza outbreaks.⁸ Medical contents are a debated topic on the Internet: whereas many scientific societies use Twitter, as well as other social media, to spread correct information regarding sensible topics, most websites lack the reliability of peer-review, can contain biased information and might even lead to misconceptions concerning healthcare.⁹ However, the anonymity granted by Internet has some benefits: performers and patients might look for online consultations¹⁰ or could discuss potentially shameful topics without the need to reveal their identity.¹¹ Indeed, it is somewhat common for men affected by erectile dysfunction (ED) to deny this condition.¹² Similarly, the most diffuse sexual complaint, ie, premature ejaculation (PE) may dramatically reduce self-esteem.¹³ Moreover, most men with ED or PE do not seek assistance from their physician, and most of those who do are not satisfied with the results.^{14,15} Therefore, sexual dysfunctions are among the most searched medical topics.^{16,17} We aimed to assess public perception of these topics by performing a sentiment analysis of tweets pertaining to both sexual dysfunctions.

METHODS

Data Collection

We gathered data from new tweets containing the words “erectile dysfunction” or “premature ejaculation” (in English language) via an automated script involving the R package *rtweet*.¹⁸ The script was run for 138 days, between May 24–October 9, 2018; the script would collect new tweets daily, then purge duplicate tweets and retweets, strip them of weblinks, emojis, and emoticons, and store them in an incremental backup aimed to preserve data. The search engine relies on Twitter’s search API (application program interface) and is limited to recent Tweets published in the past 7 days; hence, the need for a daily run of the script. After a precollection period of 2 weeks in which we measured the average number of tweets per day, we set the script for collecting up to 5,000 tweets per day for each search term, ie, >30 times the average daily number of tweets for the most-cited search term.

Data Analysis

Data analysis was performed with the statistical software R (version 3.5.0, R Core Team), using the aforementioned package *rtweet*,¹⁸ as well as the packages *dplyr* and *tidytext* for data cleaning, and *ggplot2* for figure drawing.^{19–21} Correlation analysis was performed using the *widyr* package,²² and relevant plots were drawn using the *ggraph* package.²³

RESULTS

At the end of data collection, we gathered a total of 11,000 unique tweets for PE and 30,546 unique tweets for ED. We then performed data cleaning by removing identical tweets were not automatically recognized as duplicated. After data cleaning, we analyzed 7,020 tweets on PE and 22,648 tweets on ED, with a mean daily rate of 50.9 and 164.1 tweets, respectively (Figure 1). 3,931 tweets on PE and 10,247 on ED did not include data concerning geo-localization of the author; among the remaining tweets, most came from the United States (PE: 1,765 tweets, 57.14%; ED: 7,042 tweets, 56.79%), the United Kingdom (PE: 613 tweets, 19.84%; ED: 3,109 tweets, 25.07%), and Canada (PE: 255 tweets, 8.26%; 1,089 tweets, 8.78%). The 50 most common monograms occurring in tweets pertaining to PE and ED are reported in Figures 2 and 3. “Treatment,” “Health,” and “Viagra” were the top 3 most-popular tweeted words in Tweets on ED, whereas “Sex,” “Sexual,” and “Cure” were the top 3 for PE.

Given the topic, and the possible meanings associated with several words—used both as expletives and depictions of the sexual act—we could not perform a quantitative assessment of the sentiment conveyed by different monograms. We, therefore, performed correlation analysis on the most recurring words for both topics to measure the association between different words: the correlation index indicates how often these words, or monograms, appear together relative to how often they appear

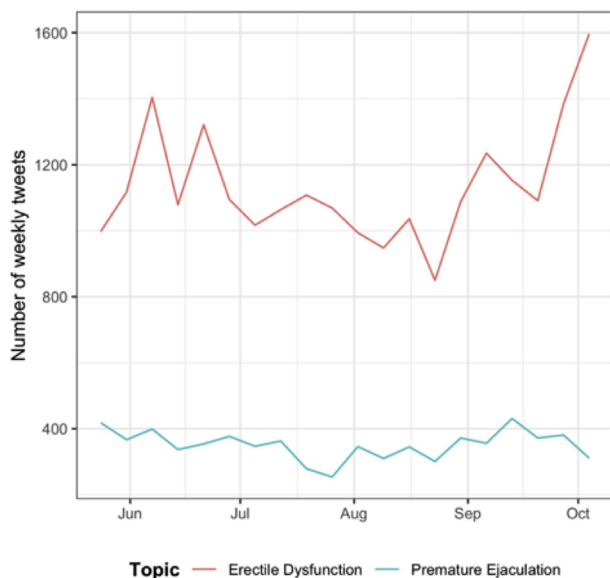


Figure 1. Time series of tweet frequency for tweets concerning erectile dysfunction and premature ejaculation (by week).

separately. By addressing how frequently words appear in the same tweets, we aimed to identify the most recurrent themes in tweets pertaining to both ED and PE. Correlation coefficients (ϕ) of 0.05 and 0.15 were considered a good measure of association between different monograms for ED and PE, respectively. Several clusters of monograms were observed, as reported in Figure 4. These word clusters depict a “net” of the most commonly associated words and allow analysis of “recurring themes” among tweets, such as medical terms (“diabetes,” “cancer,” “heart,” “study,” “risk,” and “disease”) or the 2 words “erectile” and “dysfunction” appearing among word clusters for PE.

DISCUSSION

Our study is, to our knowledge, the first assessing the use of a largely diffused social media, such as Twitter, in relation to sexual dysfunctions. We conducted this analysis to assess the need to share personal opinions on these sexual health problems and to measure the perception by the general population on 2 important aspects of sexual dysfunction. The total number of the tweets collected indicate that both ED and PE are consistently mentioned on Twitter, with >40,000 total tweets collected in almost 4 months. A comparison with other “trending” hashtags may result erratic given that millions of tweets are posted daily; however, a comparison with tweets related to other diseases would have been useful to estimate the relative size of the phenomenon, even though this is difficult to be carried out quantitatively. To provide a rough idea of the prevalence of tweets pertaining to sexual dysfunctions, a sentiment analysis study on cancer has reported 146,357 tweets collected over 10 months,⁷ whereas 951,697 tweets in a little more than 1 month were collected when assessing the influenza outbreak.⁸ Our results indicate that ED was much more cited (3:1) than PE on Twitter, even if epidemiologically believed to be less

prevalent^{24–26}; as duly noted by Rastrelli et al,²⁷ in the general population prevalence is between 15–20% for ED and between 20–30% for PE, but there are significant differences attributed to the geographic area and the age of the population studied,²⁸ as well as based on different definitions of PE.²⁹ In a large cohort of last-year high school students in Italy, PE had a higher prevalence (between 6.1–6.6%) than ED (between 2.0% and 1.6%).³⁰ Older men are more often affected by “organic” forms of ED.^{26,31} This is particularly interestingly considering that ED is highly an age-related symptom,^{32,33} and the attitudes to use social media decrease with age.³⁴ In other words, one would expect that a younger population would deal more frequently with a more-frequent sexual complaint, such as PE. The fact that this is not the case demonstrates in the real-life setting that awareness of PE as a medical problem,²⁶ deserving medical attention and having medical solutions, is far from being achieved.¹³ Indeed, although the commercial name of 1 of the drugs used for treatment of ED can be found among the top 3 most-recurring words, the PE-related tweets seem to be still looking for a solution (“Cure”). We found that 2 drugs are mentioned with their commercial brands (Viagra and Cialis, the third and the fiftieth most recurring words, respectively) when tweeting on ED, whereas the unique approved oral treatment for PE is never mentioned either as pharmacologic (dapoxetine) or commercial (Priligy) name in the tweets on this ejaculatory dysfunction. The patent lack of awareness on medical treatments for PE may explain why a well-tolerated and efficacious treatment, such as dapoxetine, is still not largely used, requiring a deeper popular education on PE. Moreover, among tweets concerning ED, the most recurring word was “treatment”; similarly, the third, fifth, and sixth most recurring words (“Viagra,” “drug,” “cure”) were pertaining to the same topic. Also interestingly, the web population seems to ignore, or is not interested in discussing, the possible counselling, behavioral, sexologic and psychotherapeutic managements of both ED and PE.³⁵ Among medical terms, “health,” “disease,” and “heart” show up among the 10 most-common words: diabetes, smoking, and cancer show up in a much lower position in the list, being respectively the 28th, 31st, and 34th most-recurring words. “Ejaculation” is at the bottom of the list, in the 48th position. This pattern of words suggest how ED may orientate tweets mainly on health concern and medical treatment.

Among tweets concerning PE, medical terms show up in the 10 most-used words, including “cure” (third), and “treatment” (ninth); “erectile” and “dysfunction” are close in the list, being respectively at the sixth and eighth positions. The general population seems to be more aware than several practitioners dealing with PE that the concomitant presence of the 2 symptoms is far from being rare.^{36–38} Thus, whereas a relevant number of tweets on medical treatment is evident even for PE, health concerns seem to be not as evident as for ED, indicating how the perception of each sexual dysfunction as a real disease may be not equal.³¹

Sex, as expected, appears in both lists—at the first position for PE and at the fourth for ED. If “sex” stands for sexual

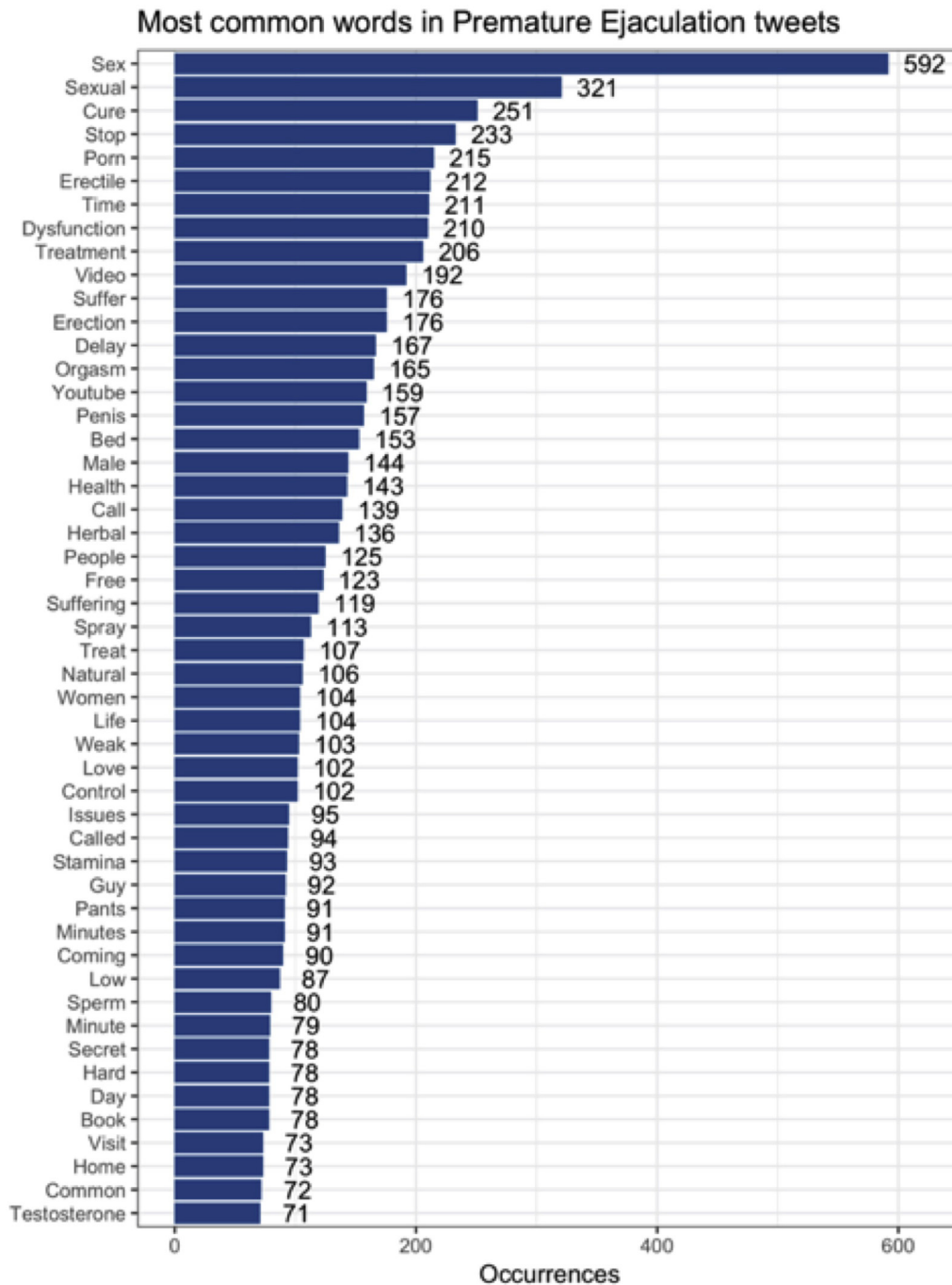


Figure 2. The 50 most common monograms occurring in tweets pertaining to premature ejaculation.

intercourse, this difference may suggest that PE is perceived more than ED as related to the quality of sexual life.¹³ Several other words occur in both lists, such as “porn” and “video,” opening a window on the public concerns related to the impact of pornography on sexual health, probably more grounded on media than on scientific evidence.^{39,40}

Word clusters, as assessed by analysis of correlation between monograms, allowed to identify several “hot topics” among tweets. As previously reported, some medical terms (such as “diabetes,” “cancer,” “heart,” and “disease”) are clustered together. It is likely

that these words come from tweets probably generated from health practitioners and medical students. Some unexpected words (such as the ones included in the triangle in Figure 4b, “red,” “vision,” “drug”) or bizarre connections (such as the one between “smoking,” “commercial,” “dick”) are likely to be the result of reaction on media in response to daily news, suggesting a role for Twitter (and possibly other social networks) as an “outlet” for sharing concerns and surprise. Indeed, both clusters refer to events that occurred in the days of data collection, which, respectively, involved an adverse reaction to a pro-erectile drug and a controversial piece of

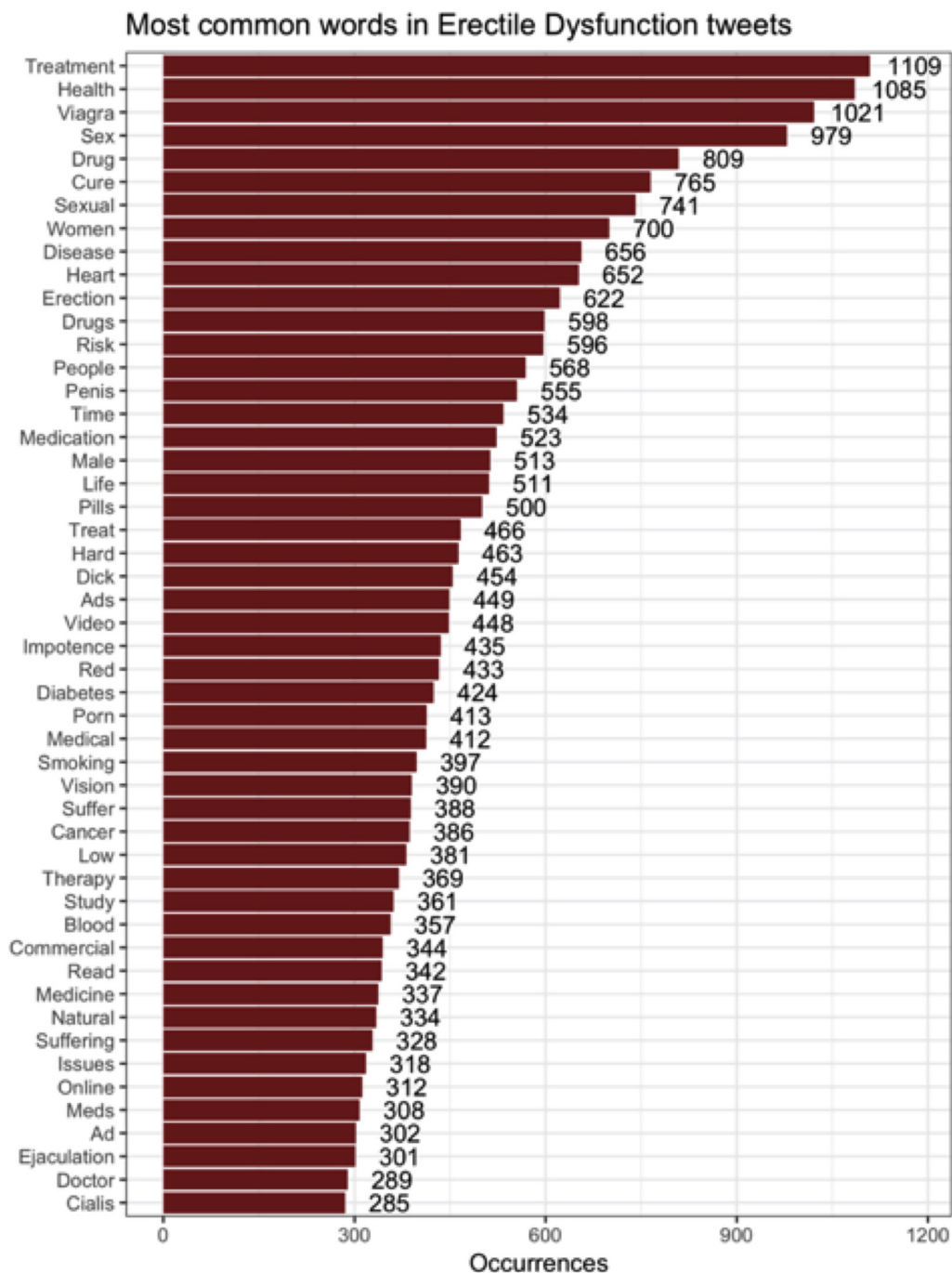


Figure 3. The 50 most common monograms occurring in tweets pertaining to erectile dysfunction.

advertising broadcast during a football match. The outrage associated with these events, which for some part involved the unwanted exposure of unintentional viewers such as kids to “adult” themes, demonstrate that sexual dysfunctions are still “worrying” topics for some people, deserving particular attention, and that social networks are the preferred platforms to share opinions in these regards. Both these events occurred in the last few days of data collection, explaining the “spike” in the number of weekly tweets depicted in [Figure 1](#).

Strength and Limitations

This is the first analysis conducted on Tweets in the field of andrology and sexual medicine, conducted on a solid amount of data—7,020 tweets pertaining to PE and 22,648 tweets concerning ED. The methodology used for research has pinpointed a series of recurring “hot topics,” which suggests possible topics for future research. However, this study has several limitations: first and foremost, quantitative assessment of the sentiment was not feasible, because words included in

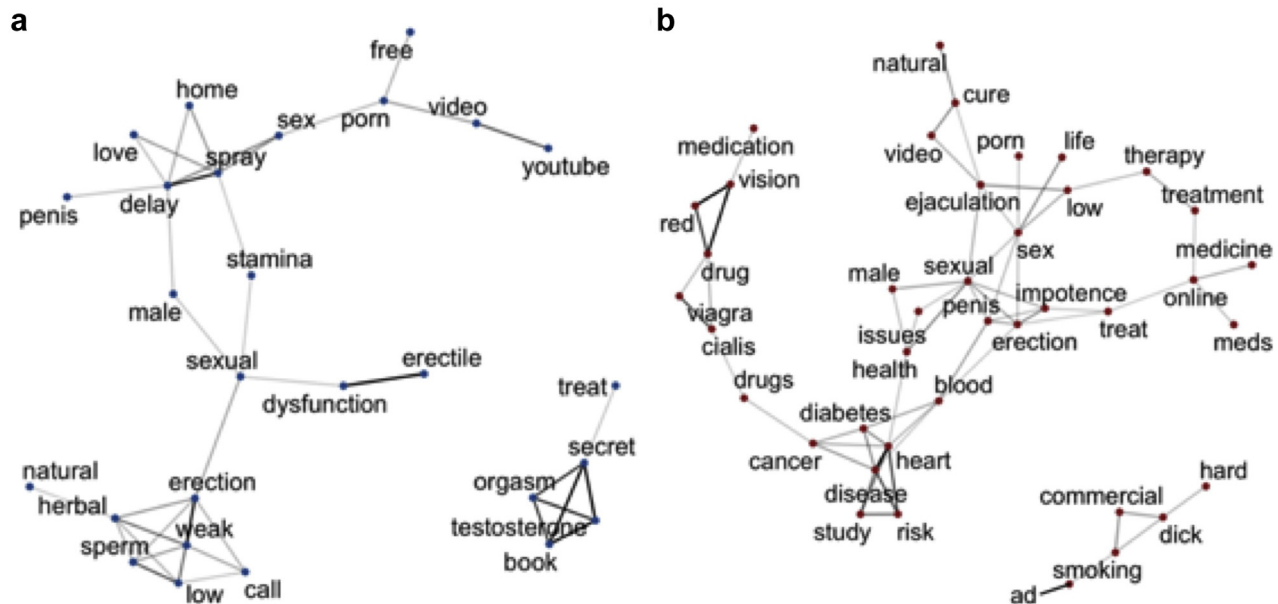


Figure 4. Correlation between monograms in tweets pertaining to sexual dysfunctions. Line thickness is a measure of the association between words. Panel a shows word combinations indicating a correlation >0.15 among tweets pertaining to premature ejaculation. Panel b shows word combinations indicating a correlation >0.05 among tweets pertaining to erectile dysfunction.

sentiment analysis could be misinterpreted as both depictions of the sexual act and expletives. Although we were able to filter “spam” tweets, there is no way to understand how many of the tweets included in analysis have been published by healthcare professionals.

CONCLUSIONS

Using a new approach to explore the real-life setting, this study proves that Twitter users are discussing topics concerning sexual health openly on social media, with different aims and motivations, ranging from scientific interest to public outrage. Despite being supposedly less prevalent, as a sexual complaint, than PE, ED is far more discussed on social media. The words more frequently represented in tweets pertaining to ED and PE are aimed at treatment of either condition. A quantitative assessment of the sentiment conveyed by the most recurring words is quite difficult; however, correlation analysis could be a surrogate for this kind of assessment. When addressing words showing high degrees of correlation among the same tweets, we identified several clusters of words suggesting that tweets are largely influenced by daily events. These findings, altogether, suggest that Twitter could be useful in the field of sexual medicine, highlighting relevant topics for sexual dysfunctions, as well their perceptions and social implications.⁴¹

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