2020 STEM Fellowship Undergraduate Big Data Challenge

Correlation Between the Use of User-Image-Based Social Media and Eating Disorder Rates

May Jagodkin[1], Joanna Roy[1], Sarina Xi[1], and Shiqi Xu[1]

[1]University of Toronto

July 7, 2020

Abstract

In recent years, researchers have identified elevated social media use as a potential risk-factor for the development of eating disorders due to its impact on users' body image [1] [2] [3] [4] [5] [6] [7] [8] [9]. Namely, the use of user-image-based (UIB) platforms—those focusing on photos of the users themselves—can lead to a hypervigilance of one's body, perceived flaws, and a fixation on posted "likes" and comments pertaining to visual appearance [10]. This paper examines the correlation between use of user-image-based social media platforms and eating disorder rates in Canada, the United States, and the United Kingdom, investigated using Python 3 libraries with data retrieved from CIHI, NHS, and Statisca. The analysis is performed using linear regression models that compare the age distribution of social media usage to the age distribution of eating disorder rates in each country. The root mean square value is used to determine whether a valid linear relationship exists. These models expose a potential correlation between eating disorders and the use of certain user-image-based platforms such as Snapchat and Instagram. The differences between traditional media and social media formats are examined to explain the trends. However, more detailed data is required to illustrate significant correlation between the eating disorders and the use of user-image-based platforms. As such, further investigation is required to fully understand and examine the relationships.

Keywords
social media, self-image, Canada, United States, United Kingdom, eating disorder

1 Introduction

Over the past decade, the number of internet and social media users has steadily increased, with approximately 7 in 10 Americans using it to connect with one another [11]. However, several studies [1] [2] [3] [4] [5] [6] [7] [8] [9] have suggested a link between the use of social media and the prevalence of eating disorders, particularly with respect to social media platforms that are user-image-based (UIB).

A social media platform is considered *user-image-based* or *UIB* if its posting[1]user interface emphasizes the image format (Figure 1a), and if its users regularly post images and/or videos of themselves (Figure 1b). The two parameters represent the perceived intentionality on the social media platform's part as well as the response of its users to its posting interface. *UIB* refers to a specific focus on images of people, including of the user (i.e. selfies). Additionally, a platform is considered *semi-user-image-based* (*semi-UIB*) if it satisfies the latter parameter, and *non-user-image-based* (*non-UIB*) if it satisfies neither parameters.

By Figure 1, Instagram and Snapchat are considered UIB social media platforms; Facebook is considered a semi-UIB social media platform; and LinkedIn, Pinterest, Twitter, Tumblr, and Reddit focus on alternate forms of content (non-UIB).

UIB social media tend to be centered on users' personal interaction with one another, compared to the passive engagement with celebrities and models that occurs in traditional media (e.g. magazines, television). Moreover, many of these platforms contain "comment sections" that frequently remark on photo appearance [10]. These

[1]Here, *posting* is defined as the circulation of original content, and *sharing* as the circulation of content created by other users.

(a) By focus of posting user interface (XX indicates focus/emphasis; see Figure 2 for posting prompts)

	Platform prompts user to post images	Platform prompts user to post videos	Platform prompts user to post standalone text	Platform prompts user to post/share articles
Facebook	x	x	XX	
Instagram	XX	x		
LinkedIn	x	x	XX	XX
Pinterest	XX			XX
Snapchat	XX	XX		
Twitter	x		XX	
Tumblr	x	x	x	x
Reddit	x		XX	x

(b) By focus of user content

	Users regularly post images of selves	Users regularly post videos of selves	Users regularly post standalone text (except IM)	Users regularly share articles
Facebook	x	x	x	x
Instagram	x	x		
LinkedIn			x	x
Pinterest				x
Snapchat	x	x		
Twitter			x	x
Tumblr			x	
Reddit			x	x

Figure 1: Social media platforms: categorized

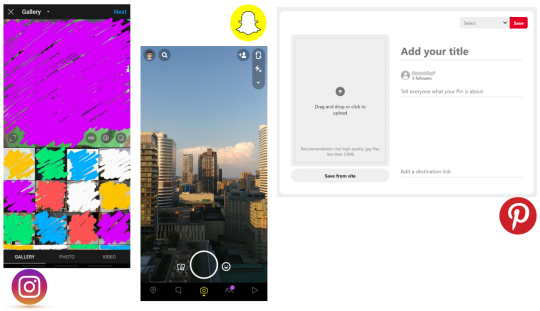
features can increase the users attention to their body image, a risk factor for the development of eating disorders.

It is estimated that at least 1 million Canadians [12] and 30 million Americans suffer from eating disorders[13], which are known to increase the risk of other mentally and physically compromising conditions [12]. Therefore, exploring the correlation between social media use and the prevalence of eating disorders is beneficial to address underlying causes and to raise awareness on the impact of social media on mental and physical health. This report seeks to explore these correlations by examining age distributions of social media use and eating disorder rates in Canada, the United States, and the United Kingdom using linear regression models. It is hypothesized that the use of UIB social media platforms are positively correlated with the rate of eating disorders due to the often idealistic and body-centric nature of such platforms.

2 Materials & Methods

First, data for the age distributions of eating disorders were collected from the Canadian Institute for Health Information (Canada) [14], National Health Service (UK) [15] [16], and Statista (US) [17]. Then, data for social media users as a

(a) Platforms Whose posting user interface focuses on images



(b) Platforms whose posting user interface focuses on non-image forms of content

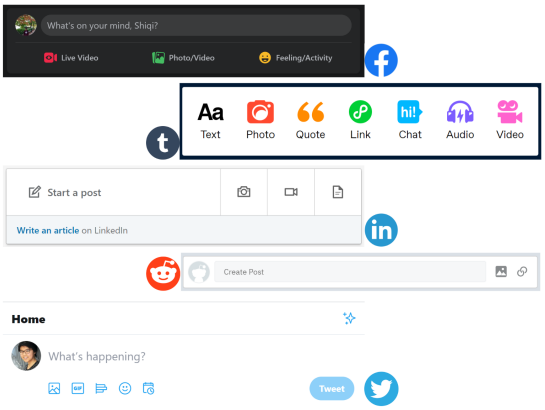


Figure 2: Posting user interfaces of platforms

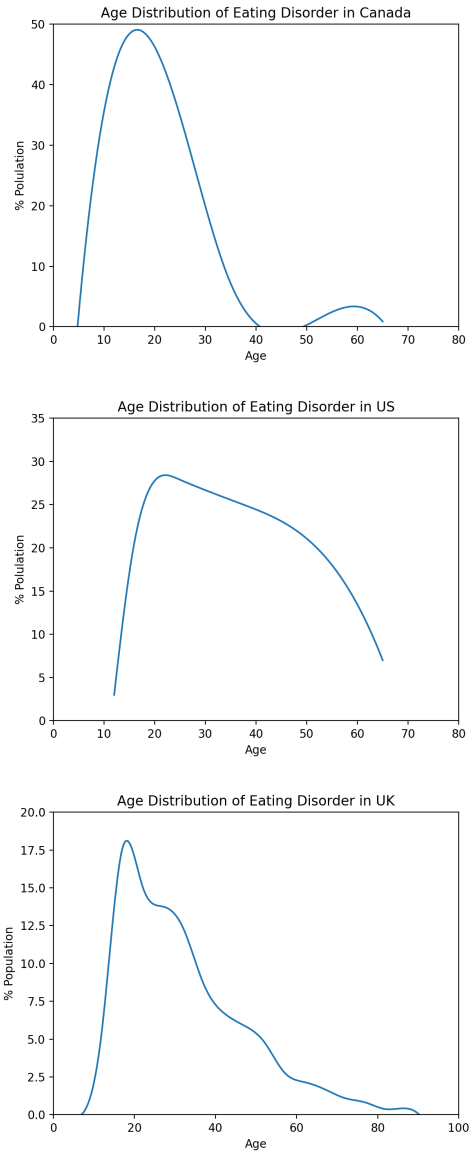


Figure 3: Age distribution of eating disorder in Canada, US, and UK

percentage of internet users by age were sourced from Statisca [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28], where they have been collected using social media marketing tools or traffic monitoring tools such as NapoleonCat. By using pandas in Python 3 to retrieve the data from CSV files, two sets of distribution graphs were created, as shown in Fig. 3 and Fig. 4, using matplotlib in Python 3 to visualize and observe the age distribution of social media users and the age distribution of eating disorders.

The two sets of distribution graphs were then fitted using a linear regression model in the Python sklearn library, in which specific social media platform usage is plotted against eating disorder rates, as shown in Figures 5, 6, 7, 8, and 9. The fitted lines are able to predict, to the determined margin of error, the percentage of individuals with eating disorders in an age group given the percent of users on a specific social media platform in the same age group. Similarly, matplotlib was used to create the linear regression graphs.

3 Results

For all three countries, the age range with the highest percentage of eating disorders is approximately 18–21. This appears to align the most with the UIB platforms, especially Snapchat, whose maximum point coincides at the same age group in Canada, the US, and the UK.

In the linear regression models in Figures 5–9, the root mean square errors for UIB as well as semi-UIB social media platforms (Instagram, Snapchat, Facebook) ranged from 0.5–3%, while those for non-UIB platforms that feature more text and images without people ranged from 10–16%.

Furthermore, the models for UIB platforms are more likely to display a positive slope as shown in the three graphs in Fig. 5. They display a close-fit linear positive relationship between the percentage of Snapchat users in various age groups and the percentage of individuals who have eating disorders in corresponding age groups.

Instagram, also a UIB platform as defined above, presents a close-fit positive linear relationship for the US and the UK. The fitted line for Canada has an overall positive trend with a larger margin of error (Fig. 6).

Facebook (Fig. 7), a semi-UIB platform, does not fit well in the linear model. All three fitted lines have a larger margin of error compared to the Snapchat models. Moreover, the Canadian and UK data show no correlation between eating disorders and Facebook usage whereas the model for the US has a overall negative trend.

The models for LinkedIn (Fig. 8), a non-UIB platform, exhibit a negative slope for the US and the UK while nearly no slope for Canada. As for twitter, while the US and UK models (Fig. 9) display an overall positive slope, their errors are the most significant among all of the graphs. Similar to LinkedIn, the Canadian data graph for Twitter also shows no correlation.

More data and analysis are required to improve the results and confirm whether an absolute correlation exists between the use of UIB social media platforms and individuals with eating disorders.

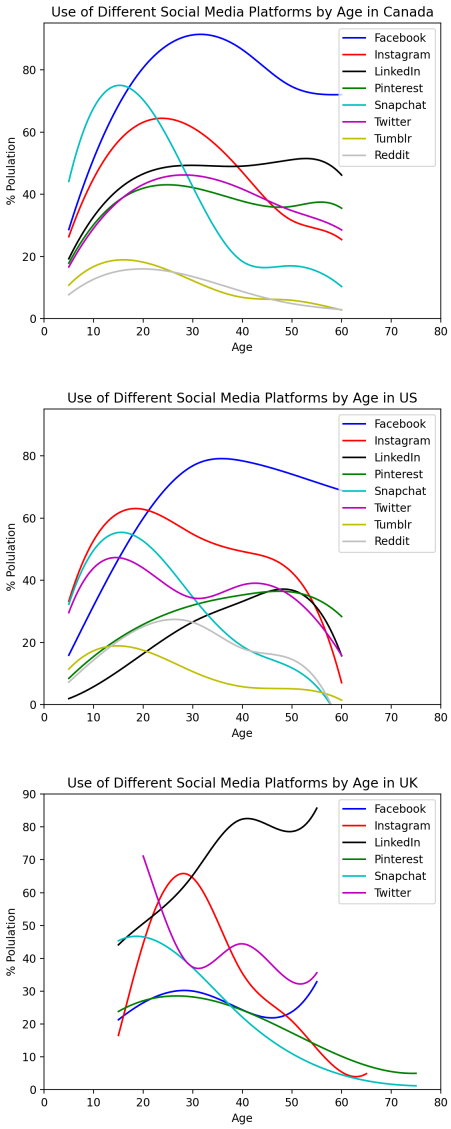


Figure 4: Age distribution of social media usage in Canada, US, and UK

4 Discussion

Data sets from Canada, the US, and the UK were chosen because these three countries are all developed and have similar cultures, thus providing a degree of consistency in their data; mental health is also a realm that has been explored to a similar extent by researchers and governments in Canada, the US, and the UK.

A linear regression model was chosen because the data for social media and eating disorders have similar units, percent of population for each age group as well as its simplicity of use to see a positive, negative, or null correlation. Had more complex variables been involved, such as time spent on social media or severity of eating disorders, a different regression model may have been suitable.

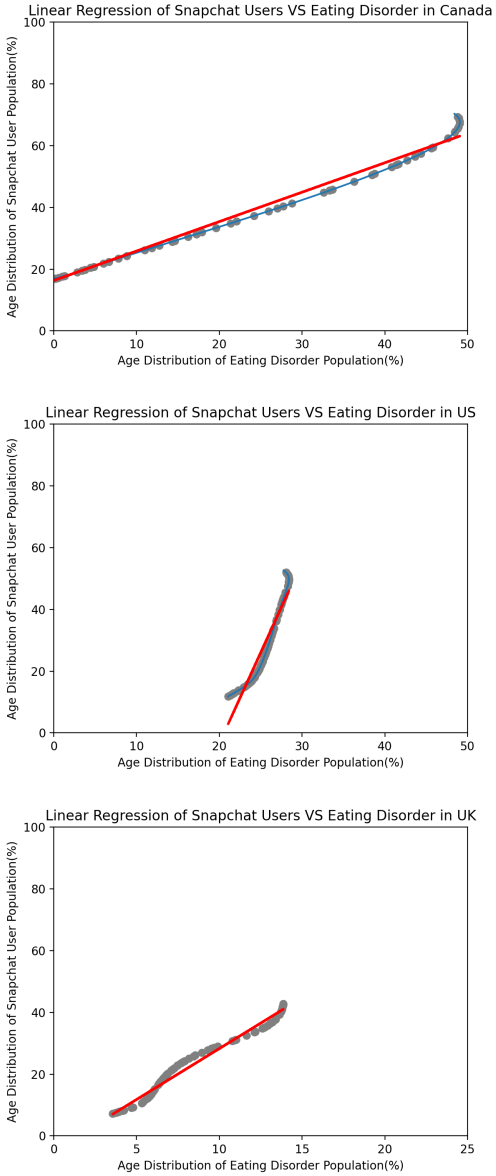
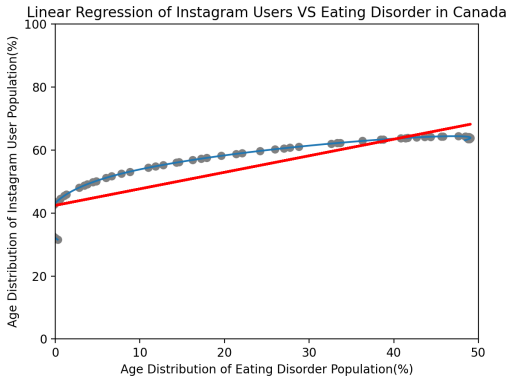
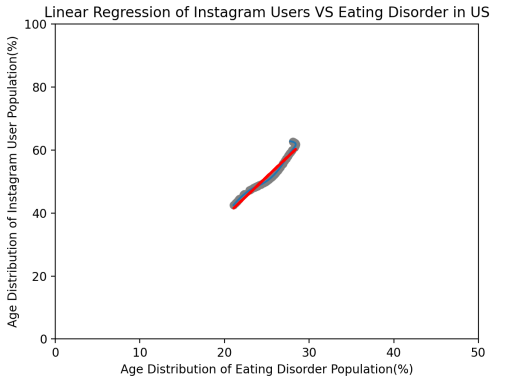


Figure 5: Linear Regression of Eating disorder vs Snapchat Usage in Canada, US, and UK





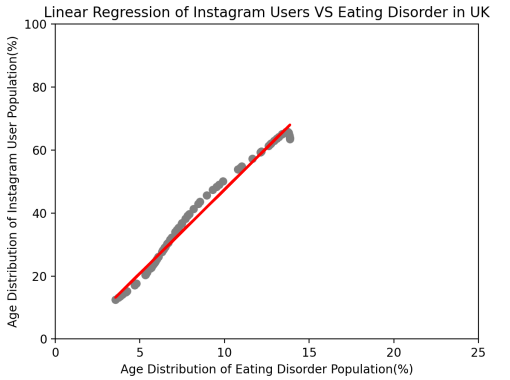
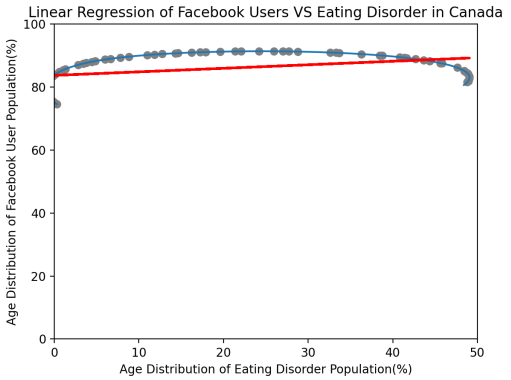
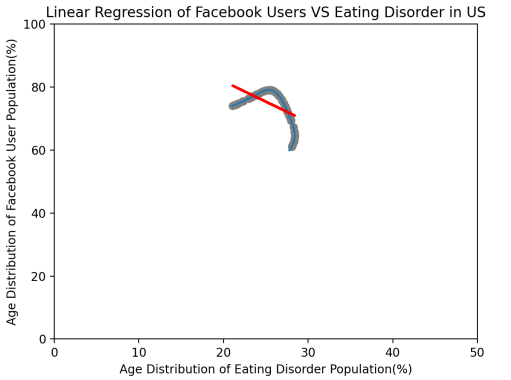


Figure 6: Linear Regression of Eating disorder vs Instagram Usage in Canada, US, and UK





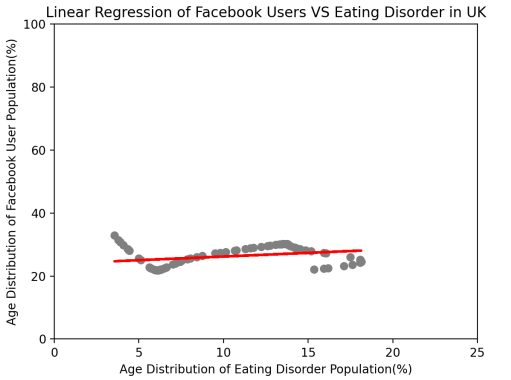
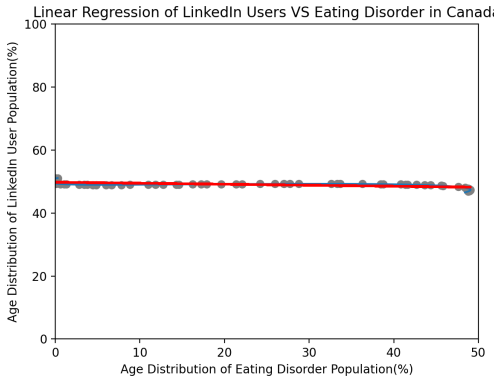
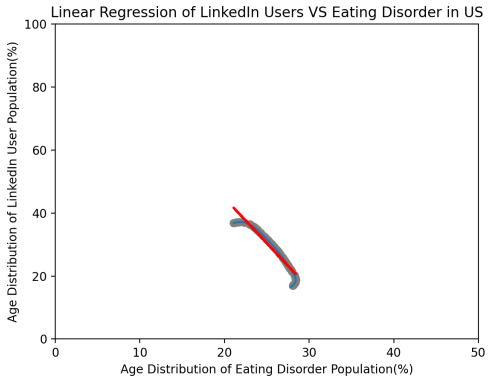


Figure 7: Linear Regression of Eating disorder vs Facebook Usage in Canada, US, and UK





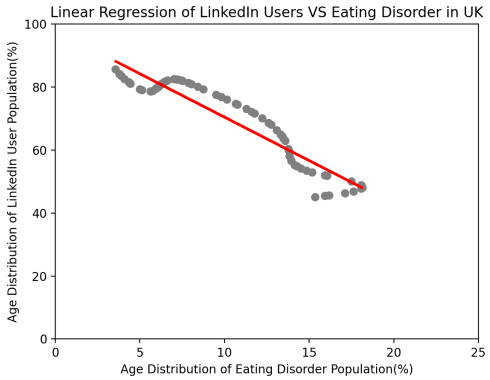
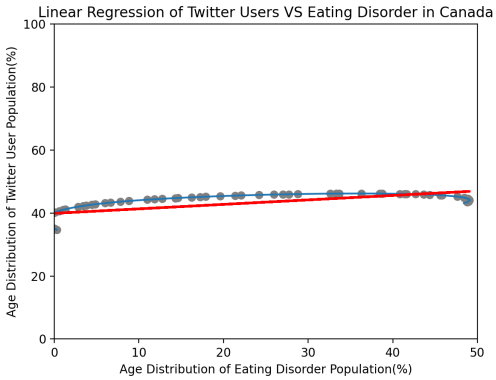
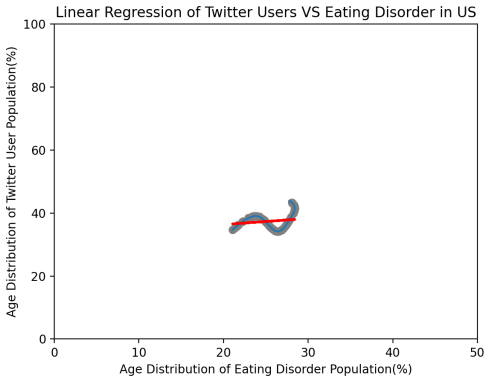


Figure 8: Linear Regression of Eating disorder vs LinkedIn Usage in Canada, US, and UK





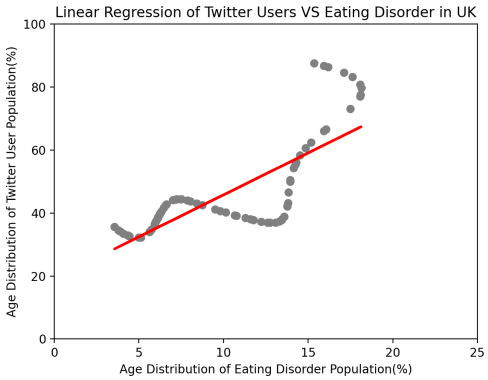


Figure 9: Linear Regression of Eating disorder vs Twitter Usage in Canada, US, and UK

Due to availability, data for Canada and the US were each collected from a single study containing all platforms, while the data for the UK was collected from multiple studies, each focusing on one social media platform. Therefore, the UK sample populations likely varied in the level of bias towards heavy internet users, causing data to be scaled differently. This explains the visual deviation seen in the UK social media chart (Fig. 4). Despite this inconsistency, UK data was included as each individual data set still displays the distribution of users across age groups—the key information that allows for comparison of social media use with eating disorder rates.

The root mean square errors from the linear regression models (Fig. 5–9) show that UIB and semi-UIB social media platforms (Instagram, Snapchat, Facebook) have a better linear fit than non-UIB platforms: 0.5–3% vs. 10–16%.

The results suggest a positive correlation between the use of UIB social media platforms and eating disorders. It also shows either no correlation or a negative correlation between non-UIB platform usage and eating disorders, as seen in the models of LinkedIn (Fig. 8) and Twitter (Fig. 9).

It is observed that teenagers and young adults, the highest percentage of whom use UIB social media, also have the highest rate of eating disorders. In contrast, older individuals, a lower percentage of whom use UIB social media, have a lower rate of eating disorders. This is in accordance with the literature, which suggests that social media affects the mental health of individuals, and increases risk for negative body image and eating disorders [1] [3] [6][29]. UIB social media platforms, such as Snapchat and Instagram, contain beauty ideals and representations of "the ideal body type" that lead adolescents to compare themselves with the images, leaving them less satisfied with how they look [2] [30].

It is also important to address the difference between "traditional" media and more novel forms of social media. For the purposes of this study, traditional media refers to one-sided platforms with little interaction between the viewer and provider. Examples include TV and movies, newspapers, and magazines. Social media has a two-sided relationship with the user and provider as there is more interaction and each party holds a participatory role. Although both forms of media feature images and videos, the following distinctions are made to understand why social media may play a role in the development of eating disorders.

Primarily, social media is more interactive than traditional forms of media, as participants act as both providers and receivers of media content, as well as interact with one another in a way that humanizes the content [31][32]. Social media sets a standard of perfection among networks of peers that, in traditional media, is limited to the one-sided idealization of celebrities and other strangers [33].

Moreover, social media incentives intensive editing and critiquing of the user-image before posting the photos, which has been found to increase body and eating related concerns primarily in girls [9]. Flaws are identified and fixed; and unrealistic improvements are made. Some platforms even offer filters to "beautify" the user [33][30], allowing them to present a lifestyle they want others to see: the image they have long seen depicted in traditional media and by other users of the social media platforms. Therefore, social media becomes first and foremost a method of presenting the user's ideal version of themselves, but over time, users can develop a "body dismorphia" [30], a condition associated with eating disorders [34] when one becomes preoccupied with perceived defects in their body [35][33]. As such, individuals begin to believe that this idealistic depiction of themselves is how they *should* look.

Most relevant to eating disorders, social media appeals users to niche markets, whereas traditional media tends towards a broader appeal [32]. Thus, instead of simply presenting a universal ideal—such as featuring a supermodel in a magazine—social media users are able to find "inspiration" on accounts that feature extreme dieting, exercise regimes, extravagant eating, celebrity weight-loss methods, and more [33][36]. Users can connect to these accounts in a much more personal way, making them more likely to be influenced by their messages and mimic the behaviors they promote [31].

These results indicate that social media, particularly UIB platforms, warrant further investigation as an underlying cause of eating disorders. More detailed analysis would be beneficial to identify specific post-types and aspects of the platforms that underlie the correlations as well as to compare eating-disorder prevalence in specific demographics with social media usage, as in the work of Walcott et. al [37]. Raising awareness of such correlations is necessary to help users identify and counteract eating disorder development triggered by social media.

However, there are many variables at play and this study only examined a subset of available data using limited analysis techniques. We do not suggest that our results show a definitive correlation. In contrast, further investigation is needed.

Firstly, more comprehensive data sets of eating disorder and social media usage distributions by age should be analyzed. This would consist of more detailed age breakdowns, encompassing a broader definition of eating disorder (e.g. not solely hospitalization frequency, but also diagnosis or self-reported rates), or providing anonymous demographics by user. The resulting smoothed graphs would be more accurate and reliable, which could expose other notable trends and further explain those that are outlined above.

Furthermore, many social media sites offer APIs in which user data can be accessed. We can take advantage of these and similar resources to determine what key words and accounts are most searched for by users who subsequently report eating disorders. By using natural language processing tools such as VADER (Valence Aware Dictionary and Sentiment Reasoner), an analytic tool for sentiment analysis in social media, and the Natural Language Toolkit(NLTK) in Python, we can write algorithms to predict eating disorders, as is being done for depression and other mental illnesses [4][38][39]. Social media giants, when aware of the specific risk-factors, can engage users with messages and posts that counteract the detrimental effects of the platform. This could be done by altering their algorithms and user interfaces to deliver content in a less body-centric manner. Social media giants could then represent themselves as being more "socially conscious", incentivizing user engagement on their platforms.

Additionally, an algorithm can be created to measure the image-to-character ratio, as well as the prevalence of user-centered images, on various social media platforms to give an "image-centric" score. This will allow a more rigorous definition of "user-image-based social media platforms" and detailed analysis to produce clearer results.

Conclusions

We are taught not to "judge a book by its cover", and yet it is what these platforms promote. We judge people based on how they look, and the split-seconds of their lives that they portray after hours of editing and self-criticism. But people are more than that—there is a human behind that post.

The purpose of this study was to examine the correlation between use of UIB social media platforms and eating disorders, then attempt to explain certain factors underlying the correlation. The current data and analysis does not show an absolute statistical correlation between the rate of eating disorders with the percentage of UIB social media platform users, however, an overall positive trend is observed, which aligns with current literature [1] [2] [3] [4] [5]. This study and the future work outlined above, in conjunction with existing literature can provide a comprehensive characterization of the relationship between social media usage and eating disorders.

Acknowledgements

We would like to thank Anish Verma for taking time out of his busy schedule to provide us with valuable advice and guidance, and Ryan Zhang, a friend from the University of Toronto, for reviewing this report. Furthermore, we would also like to thank the STEM Fellowship for this opportunity to learn about data science and engage in public health research.

References

[1] Ellen E Fitzsimmons-Craft, Melissa J Krauss, Shaina J Costello, Glennon M Floyd, Denise E Wilfley, and Patricia A Cavazos-Rehg. Adolescents and young adults engaged with pro-eating disorder social media: eating disorder and comorbid psychopathology, health care utilization, treatment barriers, and opinions on harnessing technology for treatment, Nov 2019.

[2] Ijeoma Opara and Noemy Santos. A conceptual framework exploring social media, eating disorders, and body dissatisfaction among latina adolescents, Jul 2019.

[3] Jasmine Fardouly and Lenny R. Vartanian. Social media and body image concerns: Current research and future directions, Sep 2015.

[4] Mike Conway and Daniel O'Connor. Social media, big data, and mental health: current advances and ethical implications, Jan 2016.

[5] Julie L Andsager. Research directions in social media and body image: Request pdf, Nov 2014.

[6] Yolanda (Linda) Reid Chassiakos, Jenny Radesky, Dimitri Christakis, Megan A. Moreno, and Corinn Cross. Children and adolescents and digital media. *Pediatrics*, 138(5), 2016.

[7] Jaime E. Sidani, Ariel Shensa, Beth Hoffman, Janel Hanmer, and Brian A. Primack. The association between social media use and eating concerns among us young adults. *Journal of the Academy of Nutrition and Dietetics*, 116(9):1465–1472, 2016.

[8] Annalise G. Mabe, K. Jean Forney, and Pamela K. Keel. Do you "like" my photo? facebook use maintains eating disorder risk. *International Journal of Eating Disorders*, 47(5):516–523, 2014.

[9] Siân A. Mclean, Susan J. Paxton, Eleanor H. Wertheim, and Jennifer Masters. Photoshopping the selfie: Self photo editing and photo investment are associated with body dissatisfaction in adolescent girls. *International Journal of Eating Disorders*, 48(8):1132–1140, 2015.

[10] Alexandra R. Lonergan, Kay Bussey, Jasmine Fardouly, Scott Griffiths, Stuart B. Murray, Phillipa Hay, Jonathan Mond, Nora Trompeter, and Deborah Mitchison. Protect me from my selfie: Examining the association between photo based social media behaviors and self reported eating disorders in adolescence, Apr 2020.

[11] Demographics of social media users and adoption in the united states, Jun 2019.

[12] About eating disorders in canada, Apr 2020.

[13] Eating disorder statistics • national association of anorexia nervosa and associated disorders.

[14] Indicator metadata; 30-day readmission for mood disorders.

[15] Conor Stewart. England: anorexia diagnoses 2017/18, by age, Jul 2019.

[16] Conor Stewart. England: bulimia diagnoses 2017/18, by age, Jul 2019.

[17] Statista Research Department. Hospitalizations share due to eating disorder by age group u.s. 1999-2009, Sep 2011.

[18] J. Clement. Social media user age in canada 2018, Aug 2019.

[19] J. Johnson. Facebook users: age distribution in great britain 2013-2018, Feb 2020.

[20] J. Johnson. Uk: Instagram users by age 2020, May 2020.

[21] J. Johnson. Instagram monthly visitors in the uk 2018, by age, Feb 2020.

[22] J. Johnson. Twitter users: age distribution in great britain 2013-2018, Feb 2020.

[23] J. Johnson. Uk: Snapchat users by age group 2018, Feb 2020.

[24] J. Johnson. Snapchat visitors in the uk 2018, Feb 2020.

[25] J. Johnson. Linkedin users: age distribution in great britain 2014-2018, Feb 2020.

[26] J. Johnson. Uk: Pinterest users by age group 2018, Feb 2020.

[27] J. Johnson and Mar. Uk: most active social networks 2019, Mar 2020.

[28] J. Clement. U.s. social media account ownership by age 2018, May 2018.

[29] Grace Holland and Marika Tiggemann. A systematic review of the impact of the use of social networking sites on body image and disordered eating outcomes. *Body Image*, 17:100–110, Mar 2016.

[30] AJ Willingham. Social media filters mess with our perceptions so much, there's now a name for it, Aug 2018.

[31] Richard M. Perloff. Social media effects on young women's body image concerns: Theoretical perspectives and an agenda for research. *Sex Roles*, 71(11-12):363–377, 2014.

[32] Maria Cristina Morra, Francesca Ceruti, Roberto Chierici, and Angelo Di Gregorio. Social vs traditional media communication: brand origin associations strike a chord. *Journal of Research in Interactive Marketing*, 12(1):2–21, 2018.

[33] Susruthi Rajanala, Mayra B. C. Maymone, and Neelam A. Vashi. Selfies—living in the era of filtered photographs. *JAMA Facial Plastic Surgery*, 20(6):443–444, 2018.

[34] Bdd symptoms and related disorders.

[35] M. Ali, A. Elrasheed, and G. C. S. Cousin. Dysmorphic disorder. *British Dental Journal*, 209(5):198–198, Sep 2010.

[36] Angus Crawford. Instagram eating disorder content 'out of control', Mar 2019.

[37] Walcott, Delores D.|Pratt, Helen D.|Patel, and Dilip R. Adolescents and eating disorders: Gender, racial, ethnic, sociocultural, and socioeconomic issues., Nov 2002.

[38] Munmun De Choudhury, Michael Gamon, Scott Counts, and Eric Horvitz. [pdf] predicting depression via social media: Semantic scholar, Jan 1970.

[39] Raina M. Merchant, David A. Asch, Patrick Crutchley, Lyle H. Ungar, Sharath C. Guntuku, Johannes C. Eichstaedt, Shawndra Hill, Kevin Padrez, Robert J. Smith, H. Andrew Schwartz, and et al. Evaluating the predictability of medical conditions from social media posts.