To Be or Not to Be: Negotiating Leisure Constraints with Technology and Data Analytics amid the COVID-19 Pandemic


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Abstract

The COVID-19 pandemic is having an unprecedented impact on the leisure industry. Mandatory directives such as *social distancing* and *stay-at-home/shelter-in-place* orders reduce disease transmission and protect the health and well-being of the public. However, such strategies might impair active leisure participation. We identify challenges and constraints of engaging in active leisure activities during the pandemic and explore how the general public can use technology and big data analytics to negotiate constraints during this uncertain time. Creative applications of big data analytics demonstrate that negotiating active leisure constraints and battling the pandemic are not contradictory goals. We recommend society to harness the power of these data-driven tools to effectively navigate interpersonal, structural, and intrapersonal constraints to active leisure while improving the efficiency with which we combat the spread of COVID-19.

*Keywords:* COVID-19, big data analytics, leisure constraint negotiation, smart technology
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Since the initial outbreak in Wuhan, China, the COVID-19 pandemic is having an unparalleled impact on the leisure industry. Local, regional, and federal governments have focused on containment, mitigation, and therapeutic strategies to slow the spread of the coronavirus, resulting in organised leisure services being suspended, postponed, and cancelled (Combs, 2020). Reports indicate that the leisure and hospitality sector lost 7.7 million jobs and posted the highest unemployment rate (47%) for all sectors in April 2020¹ (Franck, 2020). The rapidly escalating public health crisis has forced society into unchartered territory, which creates profound obstacles and challenges for individuals in making sensible lifestyle choices for active leisure² during the crisis. In addition, stringent measures, such as ‘social distancing’ and ‘stay-at-home’ (STH) / ‘shelter-in-place’ (SIP) orders, curfews, and temporary moratoriums have disrupted individual leisure patterns (Mervosh et al., 2020). The mandatory directives are designed to reduce the risk of contracting the disease and protect the health and well-being of the public. These mandatory strategies, in the meantime, trigger a domino effect requiring individuals to face trade-offs when making decisions for active leisure.

A likely result is a decrease in physical activity participation and an increase in sedentary behavior (Yamada et al., 2020). With people around the world forced to stay indoors and isolate themselves from their peers, changes in behaviour could potentially lead to a host of physiological and mental health problems unrelated to the danger of the novel coronavirus itself.

¹ The U.S. May job report indicated that the leisure and hospitality industry had a strong rebound with a record-breaking addition of more than 1.2 million jobs in May 2020 (U.S. Bureau of Labor Statistics, 2020).
² Active leisure refers to the performance of an activity which requires moderately intense physical exertion. It is undertaken during an individual’s discretionary time and perceived by the individual as either beneficial or enjoyable (Annear et al., 2014; Beaton & Funk, 2008).
Based on data from SafeGraph (2020), consisting of anonymised locations of a representative sample of the U.S. population derived from tracking 45 million smartphone devices, the proportion of individuals who did not leave their residence increased 74% from early March (22.3%) to the end of April (38.7%). These figures suggest a shift in leisure patterns toward more sedentary activities that take place predominantly within the home. Cumulatively, these avoidance activities can cause a critical degradation of active leisure habits.

Conceptually, however, individuals could still safely practice physically active leisure through technology-mediated interventions (e.g., online exercise classes) and platforms (e.g., social media) during the crisis to receive social, hedonic, and healthy benefits (Berg et al., 2015). Decreased commitments from activities such as daily commutes could also provide more discretionary time that can be allocated to physically active leisure. To resolve this tension, user-generated big data (e.g., social media, mobile technologies, and secondary databases) combined with data-driven analytics, may provide unique insights to understand the impact of ongoing COVID-19 pandemic on active leisure participation at the population level. This approach captures large-scale real-time information and extracts underlying patterns that are uncontaminated by undesirable human errors and biases, which could be present in traditional reactive data collection techniques (e.g., surveys, direct observation, and cross-sectional case studies) (Provost & Fawcett, 2013).

While conventional data collection techniques are valuable for their ability to collect and analyze data specific to premeditated research designs under a theory-deductive paradigm, they fall short in measuring and monitoring the types of rapid, large-scale, and real-time changes in human mobilities at the population level (Baron & Russell-Bennett, 2016), which have characterised the COVID-19 pandemic. Typical reactive cross-sectional data collection is also
time-consuming. It might be difficult, if not impossible, to collect accurate longitudinal series or topic trends of, for instance, visitation data on thousands of parks across the United States, through direct human observation or online surveys beyond researchers’ capabilities and resources.

On the other hand, this information can be collected instantaneously and continuously from numerous geographical locations with little to no human intervention through big data. Recent advancement in computational power and democratization of big data analytical tools (e.g., machine learning) affords researchers the automaticity to develop scalable methods to summarize, analyze, and predict collective active leisure trajectories using a data-driven approach. For instance, big data analytical tools can help us create interactive visual representations to uncover counterintuitive underlying patterns that otherwise would not have been envisioned using conventional approaches (e.g., an increase in exercise frequency among users of wearable fitness technology during the pandemic; Capodilupo & Miller, 2020).

Hence, identifying challenges impacting engaging in active leisure activity, and better understanding how to utilise big data and data-driven analytics to guide people through this uncertain time are of paramount values. To that end, we contribute to the existing literature by (1) identifying challenges and constraints of performing active leisure activities during the COVID-19 pandemic within the sound theoretical frameworks of leisure constraints and negotiation, and (2) demonstrating how general public could use technology and big data analytics to negotiate these constraints in promoting active leisure during the COVID-19 pandemic. Taken together, the plurality of theoretical continuity and practical utility of our results provide a rich glimpse into the American public’s engagement in active leisure through
leveraging the power of big data and related analytical and visualization tools during the COVID-19 crisis.

**Challenges of Performing Active Leisure Activities during the Pandemic**

COVID-19 has disrupted daily routines as local, regional, and national governing bodies have implemented social distancing measures on all nonessential in-person business activities (Mervosh et al., 2020). This disruption has restricted access to organised recreational and fitness services requiring individuals to adopt indoor physical activity routines at home and alter healthy habits. Protections implemented to halt the spread of the virus could potentially lead to people “engaging in avoidance activities that, consequently, lead to an increased risk and potential worsening of chronic health conditions” (Chen et al., 2020, p. 103). These avoidance patterns could include fewer excursions from the home and a decrease in active leisure participation. Decreased levels of physical activity and increased sedentary behaviours relating to the self-isolation in the COVID-19 pandemic could cause harm to persons’ mental and emotional health as well, including a higher risk of depressive symptoms and anxiety (Schuch et al. 2020).

Theoretically, mandatory guidelines operate as leisure constraints that prevent and alter leisure choice. Raymore (2002) proposed a holistic framework comprising both constraints and facilitators of leisure participation. Where constraints inhibit, prohibit, or reduce enjoyment from leisure participation (Jackson, 1997), facilitators enable, promote, encourage, or enhance participation behaviour (Raymore, 2002). Research indicates that individuals negotiate constraints that fall into three categories: interpersonal, structural, and intrapersonal (Alexandris et al., 2017). Interpersonal constraints can include social isolation and lack of camaraderie and access to constructive interactions with one’s peers due to social isolation (Godbey et al., 2010). Social distancing and government-mandated SIP orders restrict volition, interaction, and
communication with people outside of one’s place residence, which can heighten feelings of isolation and loneliness. Structural constraints can include lack of access to leisure facilities, equipment, and built environment (e.g., in-person workout classes) (Alexandris et al., 2017). With most recreational gyms closed during the pandemic and other fitness facilities reopening with social distancing measures in place that prohibit gatherings of more than a few people (Puhak, 2020), many lack access to conventional active leisure facilities and activities, making it difficult for them to maintain typical routines of active leisure (e.g. participating in running events, group biking, and family camping). Lastly, intrapersonal constraints can include stress (e.g., pressure from work constraining leisure) and other internal psychological factors, which can discourage and inhibit commitment to active leisure participation (Ridinger et al., 2012). Most intrapersonal constraints to active leisure likely existed prior to the issuance of SIP and quarantine orders. However, they can still be aggravated by the lack of access to mitigation measures (e.g., counselling for self-esteem issues, guided workouts, or classes to gain necessary skills and knowledge, etc.) (Alexandris et al., 2013).

SIP policies impose additional constraints and exacerbate existing constraints, while concurrently removing or reducing facilitators (e.g., access to leisure facilities and equipment) that sustain active leisure. In the meantime, SIP policies and societal responses to them might incubate other forms of active leisure opportunities. For example, while reduced access to childcare dramatically decreases available leisure time, obligations related to caring for and entertaining children also promote families walking in neighbourhoods, parks, or trails, as long as these remaining available options consistent with social distancing guidelines. While these constraints will likely lead to a net decrease in overall participation in active leisure activities during the pandemic, they could also decrease individuals’ psychological connection with active
leisure (Beaton et al., 2009), which prevents normal progression within the psychological continuum model (PCM) (Funk & James, 2001).

Combined, constraints created by COVID-19 are likely to reduce and alter behaviour which could diminish attitudes toward physically active leisure over time (Funk et al., 2011). Without creative, data-driven solutions to these constraints, net decreases in active leisure activity could lead to adverse health effects (Schuch et al. 2020). While the abundance of constraints can be daunting, it is not prohibitive. Theoretically, constraints are an unavoidable reality of all active leisure that can prevent, reduce, and alter behaviour. For example, “[Active] leisure participation is dependent not on the absence of constraints but on negotiation through them” (Crawford et al., 1991, p. 314). The COVID-19 pandemic guidelines require negotiation strategies to overcome constraints, and a wide array of technologies and data analytics tools are available to assist with this negotiation process.

The following section features three studies to demonstrate three primary ways through which individuals and organisations can facilitate negotiation. We start by illustrating how social media could promote social support and help people maintain healthy levels of active leisure. We next outline how big data (e.g., Google mobility data) and data analytics could inform safe active leisure habits and decision-making. We then conclude with exemplifying anecdotal evidence on how people could use ‘smart’ technologies to maintain motivation for continued active leisure during the COVID-19 pandemic.

**Study 1: Negotiating Active Leisure Constraints with Social Media**

There are many health-related perils of increased social isolation. A sense of support and connectivity is a critical component to managing physical, mental, and emotional health, including, but not limited to, maintaining a healthy body mass index, reducing cardiovascular
mortality, alleviating depression, and managing blood sugars (Martino et al., 2015). Social media platforms, such as Instagram and Twitter, have emerged as powerful tools for ‘collaborative fitness’ (Lupton, 2017). Theoretically, these platforms create an integrated digital data economy to facilitate customer engagement by improving social and hedonic values of prosumption experiences of active leisure (Funk, 2017). Specifically, social media and the surrounding ecosystem promote motivation and camaraderie through the practices of collaborative fitness by allowing people to share, connect, interact, and compete within online communities (Househ et al., 2014). As such, incorporating these user-generated data and social networks as part of fitness training and health promotion are crucial preventive measures to negotiate interpersonal, structural, and intrapersonal constraints during the COVID-19 pandemic.

Methods

On January 31st, 2020, the United States declared a public health emergency due to increasing outbreaks of the COVID-19 (HHS, 2020). Since then, tags like ‘#quarantineworkout’, ‘#quarantinefitness’, and ‘#athomeworkouts’ have garnered a significant amount of attention. Fitness enthusiasts of all backgrounds and experience levels share their personal strategies for maintaining consistent, healthy active leisure. Leveraging data scrapping services powered by Octoparse 8.1, we crawled a total of 14,610 posts of Instagram data related to the three tags between January 31st, 2020, and May 3rd, 2020 from users whose geographical location resides in the United States. A machine-learning-based Natural Language Processing (NLP) technique was employed to perform text mining through the package Quanteda, version 2.0.1 (Benoit et al., 2018) in R.

We conducted a standardised data preprocessing procedure to form a corpus with the contents written in English. The procedure removed irrelevant information such as @ mention
symbols, URLs, and user-handles. We also eliminated extra white spaces, transformed texts to lower cases, deleted punctuations, and ran a stemming and lemmatisation algorithm to restore words to their root forms. Finally, common English stop words (e.g., of, so) were deleted, followed by the construction of a document-term matrix for the main thematic and frequency analyses.

Results

The visualisations of text-mining results were displayed in Figures 1 and 2. The results indicated that even during a time of reduced direct physical interaction, people find ways to maintain a social element of active leisure and engage in constructive, meaningful exchanges with their peers. The notion of quarantine workout, as displayed in Figures 1 and 2, was a viral trend on Instagram. For instance, one of the popular challenges on Instagram during the scrapped timeframe, referred to as “the push up challenge”, involves participants filming themselves doing ten push-ups (Taluja, 2020). After doing this, people then post the video and tag ten other accounts to issue them the same challenge, thus spreading it mimetically. While the physical benefits of doing ten push-ups are negligible, the challenge’s popularity and visibility were an encouraging reminder of the continued importance of physical exercise. This ‘collaborative fitness’ aids individuals in combating both loneliness and harmful sedentary behaviours induced by the necessary isolation of social distancing.

Interpretation and Conclusion

While leisure activities during the pandemic that can be practised from a distance like interacting with others via social media can help foster new relationships of presumed intimacy, they are not necessarily more substantive and “meaningful” than actual face-to-face connections (Cavallo et al., 2012). It is important to understand that social media is not a functional
replacement for intimate personal relationships. Social media can be used as a tool to help
ameliorate feelings of isolation or loneliness by fostering a sense of community. It can encourage
healthy active leisure by facilitating positive interaction and collaboration between users
interested in similar activities. It can also provide users with access to structured workout plans
and other tools they would not otherwise have. We also recommend that it is important to
balance helpful but distant social media connections with more personal and intimate
relationships, such as relationships between family, friends, roommates, and significant others
via video chat or virtual streaming service, while being active and following the public health
guidelines (e.g., wearing a face covering) (ODPHP, 2020).

**Study 2: Negotiating Active Leisure Constraints with Big Data**

Initial indications are that home fitness has remained a priority despite the widespread
SIP orders. The rising popularity of quarantine fitness hashtags illustrates one means that
individuals are negotiating constraints and maintaining healthy active leisure. However, there is
no reliable way to track how COVID-19 has affected people’s active leisure or whether or not
social media trends have a tangible causal impact on behaviour. In that sense, social media is not
necessarily the most accurate indicator of personal behaviour (Stephens-Davidowitz & Pinker,
2017), especially because it often comprises non-representative populations. The findings would
be more susceptible to the survival and self-selection biases wherein some segments of a
population would be excluded in results because of their nonparticipation in the study (Hofacker
et al., 2016).

Other forms of large-scale granular data (e.g., search engine queries, Google GIS data)
can be useful for extracting the counterintuitive patterns of large-scale active leisure participation
behaviour (e.g., an increase in park visitation at the population level during the pandemic).
Analogous to its social media counterparts, big data, such as information acquired from search engine queries, are impersonal and largely free of implicit biases, making them a valuable predictive tool for understanding human behaviours (Dergiades et al., 2018). For instance, the ubiquity of GPS-enabled technology and modern big data capabilities could potentially prove useful in enabling continuations of some pre-pandemic outdoor leisure activities. Mobile applications such as Google Maps and Apple Maps come pre-installed on most modern smartphones. These applications can use GPS data from personal devices to track pedestrian traffic patterns. Google has already begun using its data to benefit public health initiatives with the launch of COVID-19 Community Mobility Reports (Google, 2020).

Hence, the increase in home workout-related fitness search terms combined with the Google COVID-19 community mobility reports could offer more credible evidence of analyzing and predicting active leisure developments to guide safe participation habits. In other words, by tracking where and how people are participating in active leisure through the big data, it is possible to facilitate safe, socially distant participation for all through the public dissemination of said data.

**Methods**

To demonstrate, we retrieved the daily Google search volumes in the United States for keywords related to active leisure from January 31st, 2020 to May 3rd, 2020. Google Trends (http://trends.google.com) by Google provides a daily and weekly index of the volume of queries searched across different geographical locations. Researchers have used Google Trends data to predict people’s travel behaviours (e.g., Dergiades et al., 2018; Yang et al., 2015). Figure 3 presents a trend analysis of three query volumes of ‘home workout’, ‘home gym’, and ‘quarantine exercises’.
Next, employing raw datasets sourced from the Google COVID-19 Community Mobility Reports, we created a visualisation to show the percent change in park visitation behaviours in Tableau (See Figure 4). These mobility reports aggregate GPS data from consumer devices that have opted into location tracking services. These reports are comprehensive, breaking down pedestrian mobility trends like changes in the cumulative amount of time spent at parks, grocery stores, the workplace, transit stations, and residences (Rice & Pan, 2020). Data are divided by county, state, and country, and displayed as a percentage change relative to a baseline from corresponding days of the week during the January and February.

Moreover, using the COVID-19 data repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, we also created an interactive heatmap in Tableau to track the rate of change in accumulative confirmed COVID-19 cases across 3,141 counties and the District of Columbia in the United States by May 3rd, 2020.

Results

First, as Figure 3 demonstrates, the frequency of all these searched terms rose sharply after the White House declared a national emergency on March 13th, 2020 (White House, 2020). Although the home fitness solution emerged as a way to negotiate constraints, how individuals navigated recommended social distancing guidelines for outdoor activities is equally important.

Second, the results of a heatmap visualization (as shown in Figure 4) highlighted the proportion of changes in visits to parks compared to a baseline breakdown with weekdays within each of the 50 states and the District of Columbia between March and May. The baseline was generated using the moving median, for the corresponding weekdays, during the interval between January 3rd and February 6th, 2020 (Google, 2020). Counterintuitively, park visitation

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3 In accordance with Dong et al. (2020), confirmed cases are reported individuals who test positive for the COVID-19, including the number of presumptive positive cases, by a federal state, territorial or local public health agency.
rates did not follow predicted patterns in many states. Most states saw a marked increase in park visitation during March and May. Visitation did dip significantly in April, but it appears that as more states begin lifting SIP orders and other social distancing measures, more people are returning to parks once again.

Third, in Figure 5, we illustrated the colour changes based on the severity of infection with the COVID-19. The goal was to clarify if a locality experienced either a sustained increasing or decreasing rate of the confirmed cases. Along the spectrum, the lightest colour represents counties in which the number of confirmed cases increased at a declining rate for less than 2 weeks. The midpoint pigment represents localities in which no change in new confirmed cases was detected in the preceding fortnight. The darkest navy blue refers to counties in which the number of confirmed cases continued to grow at an increasing rate for more than 14 days.

**Interpretation and Conclusion**

Taken collectively, these data and analytical solutions are valuable to those looking for opportunities to participate in outdoor active leisure while minimising their risk of exposure to others. By referencing data like the kind visualised in Figure 4, policy makers can better guide residents to plan their park excursions to coincide with days with low rates of visitation to maximise the practice of safe social distancing protocols.

Figures 4 and 5 could also be used conjointly to create simple, real-time risk assessments of morbidity, parks, and public spaces around the community. By cross-referencing park visitation rates with infection trends, it would be possible to create an evaluative tool to gauge the inherent risk of visiting a park in a given geographic area at a given time. This information would be invaluable for navigating potential structural constraints and finding ways to safely incorporate outdoor active leisure activities into one’s routine. An increase in safe, outdoor
active leisure could in turn help ameliorate intrapersonal constraints by reducing feelings of loneliness and anxiety (Gladwell et al., 2013).

It should be stressed, however, that such an evaluative tool is contingent upon widespread and reliable testing for the virus. Without accurate data on local infection trends, data-based recommendations for outdoor active leisure would be, at best, ineffective, and at worst, actively harmful.

**Study 3: Negotiating Active Leisure Constraints with ‘Smart’ Technologies**

Modern ‘smart’ technologies — mainly various fitness wearable devices, workout equipment, and clothing that track fitness data in real-time — presents another promising data-based avenue for addressing the problem of maintaining healthy levels of active leisure. During the COVID-19 pandemic, global wearable technology sales have grown by 20% compared to the equivalent of the first quarter of 2019. Among which, Apple’s smartwatch increases global market share to 55% featuring its peak level within the past two years (Strategy Analytics, 2020). Some newer lines of smartwatches (e.g., Apple Watch, Fitbit) can track real-time biometric data for users, including heart rate, step count, calories burned, and more.

These devices provide data to inform users of leisure activity, monitor progress, and motivate behaviour (Baker et al., 2017). Fitbit data suggests that people are lounging more, with overall steps down 12% during the pandemic (Fitbit, 2020). To respond, the newest Apple Watch and Fitbit wrist bands track the amount of time spent sitting, standing, and exercising intensively (Thomson et al., 2019). These watches can use this data to notify users if they are not reaching daily active leisure goals, which can help in navigating intrapersonal constraints such as anxiety or self-esteem issues related to decreased physical activity. Recent empirical evidence
from users of wearable fitness technology (e.g., WHOOP) indicated an increase in exercise frequency by an average of 1.1% during the pandemic (Capodilupo & Miller, 2020).

Smartwatches can also be used to navigate interpersonal constraints by transmitting biometric data to qualified specialists including trainers, nutritionists, and health professionals. For instance, the University of Alabama football programme, for example, sent Apple Watches to all of their players after they were sent home in March (Pickman, 2020). Team trainers and nutrition staff use the biometric data from these watches to monitor players’ sleeping habits and heart rates. With access to these data, such specialists could theoretically even monitor their clients’ active leisure habits and share tailored workout programmes with them. It should be noted that sharing biometric data with trained professionals might be inaccessible to non-wearable-technology users.

Another recent development is the increasing prevalence of online fitness classes with live results tracking. By far the most popular example of this type of online fitness platform is the Peloton series of exercise equipment and live classes. Peloton reported a surge in sales volume over $500 million, up 66% from the previous year (Owens, 2020). Peloton incorporates Apple Health Services into its exercise equipment. This allows the company’s live classes to both provide users with a guided active leisure regimen and track and display live data to encourage a sense of competition and connection with other participants in the class. Data tracked include distance covered, calories burned, and GPS tracking for outdoor classes. Some classes will selectively display the scores of top users in various performance metrics like distance covered and calories burned, which provides those top participants with a sense of accomplishment and recognition while providing others with a tangible goal for progress.
Another popular example is the Keep app, which Instagram text mining has revealed as a search term related to quarantine fitness (see Figure 1). Keep offers self-guided fitness classes and tracks participation and results from each workout. It is also compatible with the aforementioned smart devices so it can incorporate biometric data into reports that can be accessed by users and even shared with friends and followers. These regularly scheduled classes can also help navigate the constraints imposed by forced isolation by providing a sense of community and structure in a time where the world is severely lacking in both. And the data that these online classes compile can hence help users navigate intrapersonal constraints (e.g., feelings of inadequacy) by providing a tangible sense of progression and achievement.

**Concluding Remarks**

We conclude by arguing that negotiating active leisure constraints and combating the COVID-19 pandemic are not two mutually exclusive and paradoxical trade-offs of a continuum. While it can be difficult to find novel ways of entertaining oneself amidst the pandemic, how-to guide the public to benefit from using live big data and smart technologies to overcome challenges of engaging and maintaining an active lifestyle is paramount. Active leisure participation is significantly related to positive social (e.g., social support, social capital) (Coleman et al., 1993; Misener & Mason, 2006) and psychological outcomes (e.g., quality of life, life satisfaction, happiness; Sato et al., 2014). The reduced level of leisure activities resulting from the social distancing and isolation significantly impact one’s social and psychological well-being. Creative application of big data could provide society with the tools needed to effectively navigate some of the current interpersonal, structural, and intrapersonal constraints to active leisure while also improving the efficiency with which we combat the spread of COVID-19.
Limitations and Future Directions

While we, as scholars, recommend the adoption of these data-based tools and strategies to maintain active life for the public, we also acknowledge the limitations and pitfalls against the naive usage of big data and technology. In the current research note, user-generated contents from Instagram were scrapped and analyzed as a representation of established social media platforms. Although collected textual information on users’ chronicle life events were insightful, other alternative mainstream and novel social media outlets (e.g., Facebook and TikTok) could be further explored to corroborate the findings by examining the changes in an individual’s leisure lifestyle through multimodal data (e.g., text-based statements, emojis, photos, and short-form videos) during and beyond the COVID-19 pandemic in the future studies.

Second, critiques regarding undesirable biases (e.g., self-selection and behavioral biases) and inaccuracies embedded in the social media data should also be noted (Olteanu et al., 2019). For instance, the underlying premise of using big data such as user-generated contents from social media assumes that the representativeness of these digital information can capture a full spectrum of active leisure activity of the population of interest. However, it is not uncommon to observe the violation of this assumption in the present context. That is, the relationship between the studied population (e.g., social media users, Google Community Mobility Reports using people who consent to share their geographical location data) and a target population (e.g., society at large including segments most vulnerable to the COVID-19 pandemic due to their demographic profiles and underlying healthy conditions) is undetermined.

Moreover, inauthentic self-presentation through the disguise of perfection within social media posts (Su et al., 2020) could complicate the interpretation of findings. The resultant decision-making in public policy guiding individuals to maintain a physically active lifestyle
During the COVID-19 pandemic should not be overlooked. Failure to identify both the methodological and ethical boundaries of social media big data could lead to unintended consequences of producing compromised inferences (Olteanu et al., 2019). Therefore, future research could leverage cutting-edge machine learning techniques to evaluate and cross-validate the quality of these live big data, including validity and representativeness, to adequately address these limitations and challenges.

Third, echoing the previous research on digital divide (Warschauer, 2003), it should be noted that our recommendations might be merely applicable to individuals and communities with access to internet, mobile technology, and aforementioned digital solutions. Hence, given the potential existence of underlying disparities of digital access and usage of the discussed big data, digital information, and smart wearable technologies, further evidence-based intervention studies and longitudinal investigations should be warranted to address the impact of the digital divide on health disparities as an important future research agenda after the COVID-19 pandemic. Particular focuses could be bestowed to examine if big data and technologies are effective as a health promotion catalyst for all walks of life. Finally, future studies could conduct an individual-level analysis using attitudinal survey data to better understand the impact of COVID-19 pandemic on changes in various behavioral outcomes of active leisure participation and their linkages with variations in one’s perceived leisure constraints, if any, as a result of COVID-19 crisis.
References


Figure 1. Word cloud visualization of Instagram data related to quarantine fitness.
Figure 2. Top 30 most appeared words in mining Instagram data related to quarantine fitness
Figure 3. Trend Analysis of Three Popular Searched Phrases related to Active Leisure in Google during the COVID-19 pandemic.
Figure 4. Visualization of changes in park visitations during the COVID-19 pandemic.
Figure 5. Heatmap of changes in severity of confirmed cases of the COVID-19 by May 3rd, 2020 in the United States. © 2020 Mapbox © OpenStreetMap.