ASSESSING INTEREST IN ARTISTIC GYMNASTICS

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Abstract
Despite information from world media, worldwide interest in artistic gymnastics has never been assessed. Memberships, equipment and apparel purchases, subscriptions, and other data have been used as indirect substitutes for gauging interest and participation in gymnastics. A readily available tool for assessing gymnastics interest could be of use in uncovering myriad trends. Aim of Study: This study sought to use a relatively new internet search tool called Google Trends™ (GT) to assess gymnastics interest by records of search terms used in Google™. Methods: Google™ searches involve the use of search terms that are recorded and then accessible by GT. As GoogleTM searches provide access to topics of interest nearly anywhere in the world, by anyone with internet access, then using Google Trends™, then GT could be used to harvest the number and types of searches involving the search-terms "men's gymnastics" and "women's gymnastics." The tally of the search terms was obtained using filters such as country, region, and others. GT reports the search-term trends by calculating a relative percentage based on a sample of the largest number of specific search-term use during a particular time. Although the relative percentage approach is somewhat awkward, processing large amounts of data may be considered valuable and otherwise unattainable. Results and Conclusions: Results should be interpreted cautiously. However, the analysis revealed a litany of important trends in the worldwide interest in gymnastics.

Keywords: *Media, Internet, Google.*

INTRODUCTION

When a physician seeks quick and easily obtained information about the overall health of a patient, the physician will usually take the patient's temperature. Parents have used the same approach by touching a youngster's forehead to assess whether a youngster is sick. Also, body temperature can indicate the severity of an illness based on the temperature value. Is there a metric like body temperature that one can use to get an idea of artistic gymnastics' current health? The level of interest and participation may be such a metric.

The worldwide sport of artistic gymnastics has a long history but remains enigmatic regarding interest and participation statistics (Bogage, 2017; Brown, Clark, Ewing, & Malina, 1998; Carlson, Scott, Planty, & Thompson, 2005; Petlichkoff, 1992). Numerous questions arise when assessing the interest and

healthy participation of young athletes. Questions of injury incidence and frequency are important, but a denominator's inclusion is even more helpful. For example, injury research usually includes a rate value, such as the number of injuries per 1000 participants or per exposure to training. Ratios of such information provide incidence and rate, thereby enhancing the overall understanding of the phenomenon of interest. There does not appear to be a simple metric indicating the overall status of artistic gymnastics. Moreover, even participation statistics are usually single "snapshots" of a particular condition at a specific time. Assessing the global interest in artistic gymnastics presents numerous challenges, such as accuracy of a particular statistic, whether individual countries have artistic gymnastics data, the purpose for which the data and statistics were acquired, and many others.

National and international governing bodies for gymnastics should have indicators that allow each associated entity to determine the history, current state, and predicted future artistic gymnastics status. Business entities such as gymnastics equipment and apparel companies have vested interests in gymnastics' growth or decline. Most countries that want to be contenders for competitive world honors also need an idea of other contenders' current status and overall development. Unfortunately, there is no central or easily accessible data to obtain such information. In business, sales figures and memberships are relatively easy to gather within each company or enterprise, but sharing these values may be difficult because of proprietary concerns, costs of collection, different collection methods, and varying data assumptions. For example, the price of a gymnastics participation report from the Sports and Fitness Association (SIFA) is USD 295.00 (Kerman, 2020) and covers only United States participation.

The use of "Big Data" has become ubiquitous in business and medicine (Albert, Glickman, Swartz, & Koning, 2017; Hand, 2020; Lewis, 2003; Mavragani & Ochoa, 2019; Morgulev, Azar, & Lidor, 2018; Sagiroglu & Sinanc, 2013; Schneier, 2015; Siegel, 2016; Stein et al., 2017). The worldwide sport of gymnastics could use a big data approach to assess interest and popularity trends. Moreover, the current problems (as of this writing) with the COVID-19 pandemic is devastating the small but important industry of gymnastics schools and clubs. Gymnastics could use a metric to assess the past, current, and potential future state of gymnastics interest. A robust tool that puts access to big data into the hands of ordinary citizens, scientists, medical personnel, coaches, and others could be a breakthrough for gauging interest in many aspects of modern life, including gymnastics. Google Trends™ may be such a tool that is easily accessible and offers the opportunity to quantify gymnastics interest.

Google Trends™ (GT) is an online service offered by Google, LLC. GT samples search-terms from its worldwide search engine and its log of the use of terms as indicators of searchers' interests over time. "Where there is sufficient data available, GT awards a score of between 0 and 100 to inputted search-terms on a month-by-month / day-by-day basis and on a geographical basis." (Trends, 2013) The scores provided by GT are somewhat awkward in that the scores have no direct quantitative meaning. "For example, two different terms could achieve scores of 100 in the same month, but one received 1,000 search requests, whilst the other received 1,000,000. This is because the scores have been scaled between 0 and 100. A score of 100 always represents the highest relative search volume." (Trends, 2013) GT's output or reporting includes a line graph that follows relative general search use of specific terms. As such, a rising line may not indicate that the search-term has increased over time, or a decreasing line or track may not indicate a decline of search-

term use. The scores generated are relative to an overall change in the search-term use based on internet use. Scaling the scores between 0 and 100 would depend on how the relative search volume for the terms on the day compares to the highest relative search volume within the time range. Google Trends provides its scores based on an analysis of a portion of search volume. Thus, scores are obtained from a sample of available data rather than all available data. Although these limitations may seem crippling, GT has entered extensive use within business, epidemiology, medicine, and others (Garrison, Dormuth, Morrow, Carney, & Khan, 2015; Hunter et al., 2017; Mavragani & Ochoa, 2019; Nuti et al., 2014; Sagiroglu & Sinanc, 2013; Tran et al., 2017; Trends, 2013; Wiley, Steffens, Berry, & Leask, 2017; Zhou, Ye, & Feng, 2011).

GT has been analyzed for reliability and validity with mixed results (Arora, Stuckler, & McKee, 2016; Cervellin, Comelli, & Lippi, 2017; Hunter et al., 2017; Nuti et al., 2014; Tran et al., 2017; Wiley et al., 2017; Zhou et al., 2011). "Google Trends is being used to study health phenomena in various topic domains in myriad ways. However, poor documentation of methods precludes the reproducibility of the findings. Such documentation would enable other researchers to determine the consistency of GT results for well-specified queries over time. Furthermore, greater transparency may improve GT's reliability as a research tool (Nuti et al., 2014). Despite GT's limitations, a search of PubMed.gov showed 484 records for the term "Google Trends," indicating that the service is used in medical settings. Sports- or athletic-related uses of GT resulted in six citations covering interval training (Rynecki, Siracuse, Ippolito, & Beebe, 2019), sports supplement usage (Catalani et al., 2018), forecasting sports popularity (M. Ryan, Harrison, & Ismael, 2017), the Ironman Triathlon (Mnadla et al., 2016), anabolic steroid use (Tay Wee Teck & McCann, 2018), and nocturnal leg cramps (Garrison et al., 2015).

Despite methodological shortcomings, the use of GT to ascertain interest in gymnastics merits consideration. However, there are caveats; one must be willing to tolerate the fact that GT results are estimates. As yet, the investigator cannot peer inside the "black box" of GT's internal calculations and specific data. Judging the time-line of interest in artistic gymnastics and a cautious willingness to use GT as a simple, available, and perhaps brittle tool for assessing such interest may be an important initial step that has not been used in the past.

The purpose of this paper was to assess worldwide interest in men's and women's artistic gymnastics based on an online search engine and participant data. The data were obtained from Google Trends™ on 30 June 2020 and were stored for further analyses using GT functionality (i.e., reports, graphics, and comparisons). Also, other sources, such as the International Gymnastics Federation participation statistics, were included.

METHODS

Search-terms were used to obtain the desired data from GT. Searches of GT for this project involved the selection and use of search-terms that would be logically used by others. In short, we performed a search using search-terms about search-terms. Search-terms' choice was essential, mainly when multiple search-terms could be synonymous but may not garner similar usage in the worldwide application for Google™. The approach of using specific keywords or search-terms is called "filtering" in much the same way that a filter stops some things from carrying on while permitting others (Dewan & Sur, 2018; Mavragani & Ochoa, 2019; Nuti et al., 2014).

When using GT, there are several filter choices. These choices include:

1. time-line, beginning from 2004 to the present,
2. worldwide, region of the world, and/or country,
3. categories such as arts and entertainment, news, sports, or travel, and
4. an additional filter to search for images, news, shopping, or YouTube™ material.

Our primary search attention involved to the period from January 2004 to 20 June (Cervellin et al., 2017; Dewan & Sur, 2018; Mavragani & Ochoa, 2019)20, worldwide artistic gymnastics, and all Google™ searches involving "women's gymnastics" and "men's gymnastics." This time-line represented the complete search analyses available from GT for men's and women's gymnastics. We did not include news, shopping, or video data after checking them for relevance to the study's purpose.

GT searches of the search-terms *women's gymnastics* and *men's gymnastics* resulted in finding the highest number of "hits." Other terms, such as "artistic women's gymnastics," resulted in reports that were inadequate and uncertain, such as no results or results so low that GT could not provide a trend.

In addition, data on participation were obtained from the International Gymnastics Federation website (F.I.G., 2020) from U.S. data when making some comparisons. Participation is an obvious indication of interest, and therefore these data were also included to enhance the study's scope.

Bias: a limitation of this study is the unknown characteristics of the GT algorithms. Bias in these data may arise as a result of this limitation. Other search engines were queried using the search term "trends." The search engines were DuckDuckGo.com, Bing.com, TrendHunter.com, DogPile.com, Yippy.com, GoogleScholar.com, Webopedia.com, Yahoo.com, and Archive.org. None of these search engines had a function similar to GT, all but one of these search engines listed Google Trends as the top search result. The closest results involved business, merchandise, and fashion trends.

Given that gymnastics is a worldwide activity, a language may have been a factor in search results. Unfortunately, GT appears to be the only search engine that supports keyword use over time. Thus, we were forced to engage in a near "circular" approach by using GT to determine the prevalence of different languages used in GT. The term "gymnastics" (English) is also "gymnastique" (French), ginnastica (Italian), and gymnastik (German). A GT search involving all of these terms showed that they are rarely used in GT searches (Figure 1).

In practice, medical studies of disease and injury epidemiology often use GT (Arora et al., 2016; Avilez, Zevallos-Morales, & Taype-Rondan, 2017; Cervellin et al., 2017; Cha, Hwang, & Yang, 2019; Dewan & Sur, 2018; Garrison et al., 2015; Mavragani & Ochoa, 2019; Mnadla et al., 2016; Nuti et al., 2014; Rynecki et al., 2019; Tran et al., 2017; Trends, 2013; Zhou et al., 2011) and other sources such as social media and other electronic health records.

Data analysis. This study was exploratory and hypothesis-generating rather than hypothesis testing study (Biesecker, 2013; Huberty & Morris, 1989; Porter, 1993). Data and information obtained were entirely from Internet sources with all of the attendant cautions that accompany such data (Cervellin et al., 2017; Nuti et al., 2014; Shenk, 1997; Stoll, 1995; Tran et al., 2017). Data were obtained and analyzed from GT using descriptive statistics and linear and natural logarithm regression trends (Microsoft Excel).

RESULTS

The data were extracted from GT and binned by months. A total of 185 months was surveyed. Figures 2 (women) and 3 (men) show the relative percentages of Google™ search interest for *women's gymnastics* and *men's gymnastics*. These two search-terms were used because the use of the term "artistic" for men's and women's gymnastics was clearly not the generally used search-term and produced distorted results.

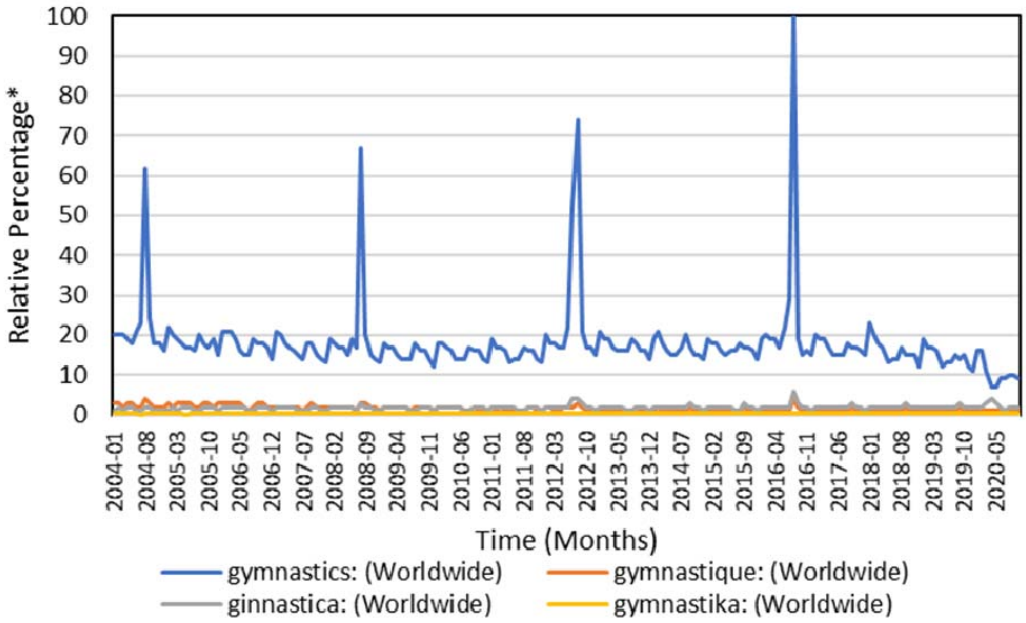

Figure 1. Comparison of common translations of the term "gymnastics" with terms from other languages in search queries with GT.

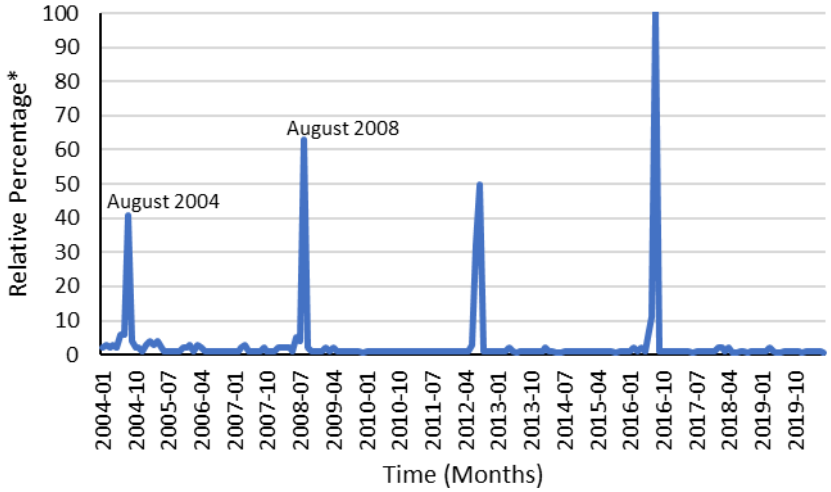

Figure 2. GT search results for "women's gymnastics" 2004 to 2020. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016).

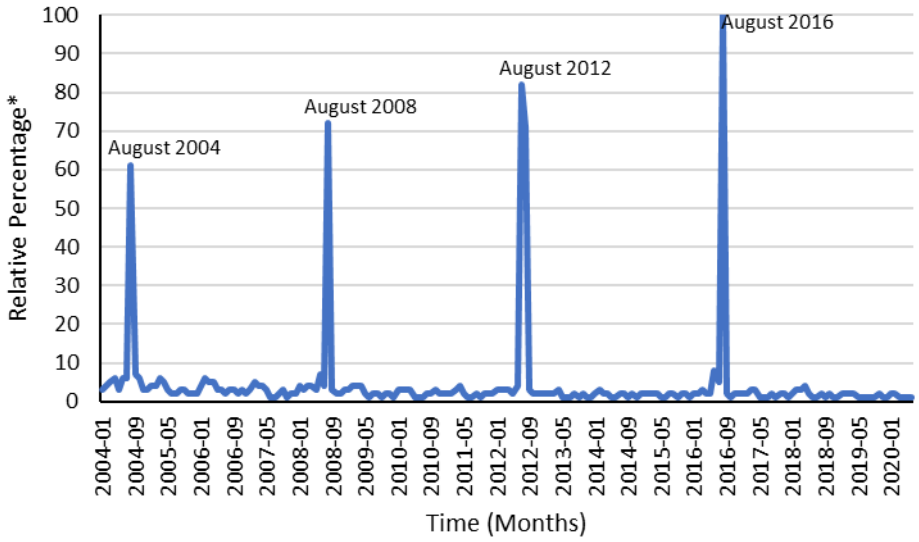

Figure 2. GT search results for "men's gymnastics" 2004 to 2020. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016).

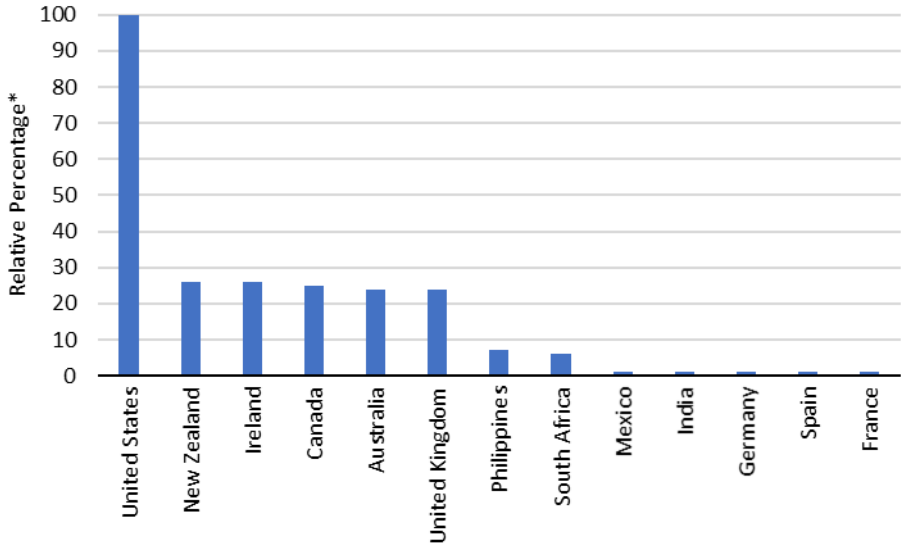

Figure 4. Women's gymnastics GT search interest by country. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016)..

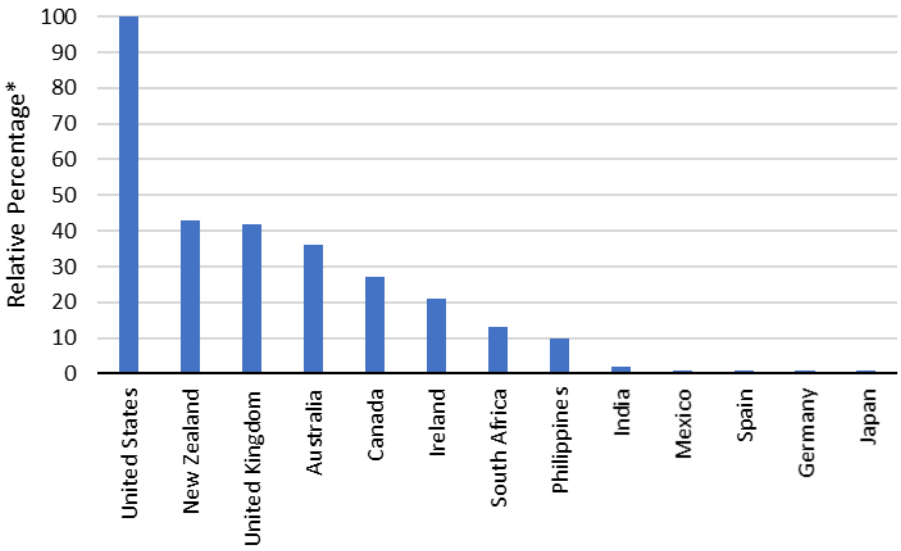

Figure 5. Men's gymnastics GT search interest by country. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016).

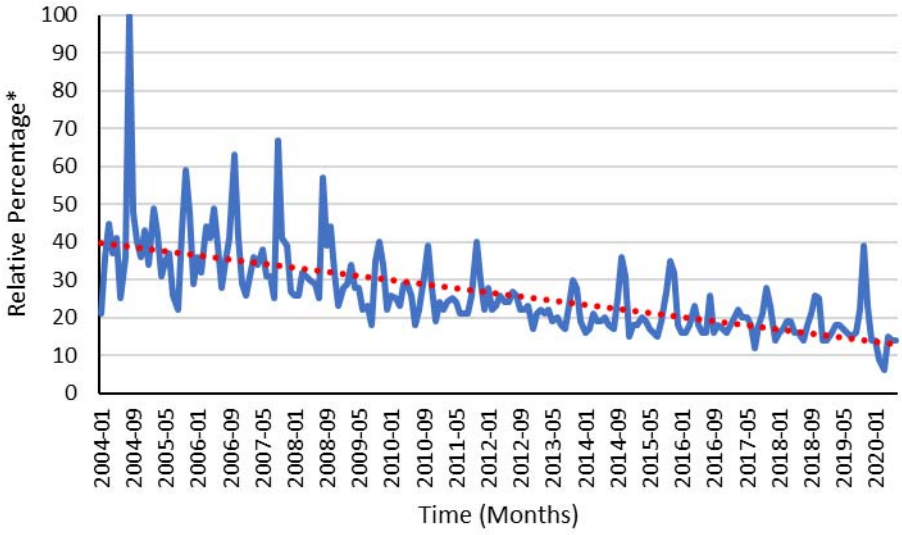

Figure 6. Trend of Google Trends™ searches using "International Gymnastics Federation" as the search-term. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016).

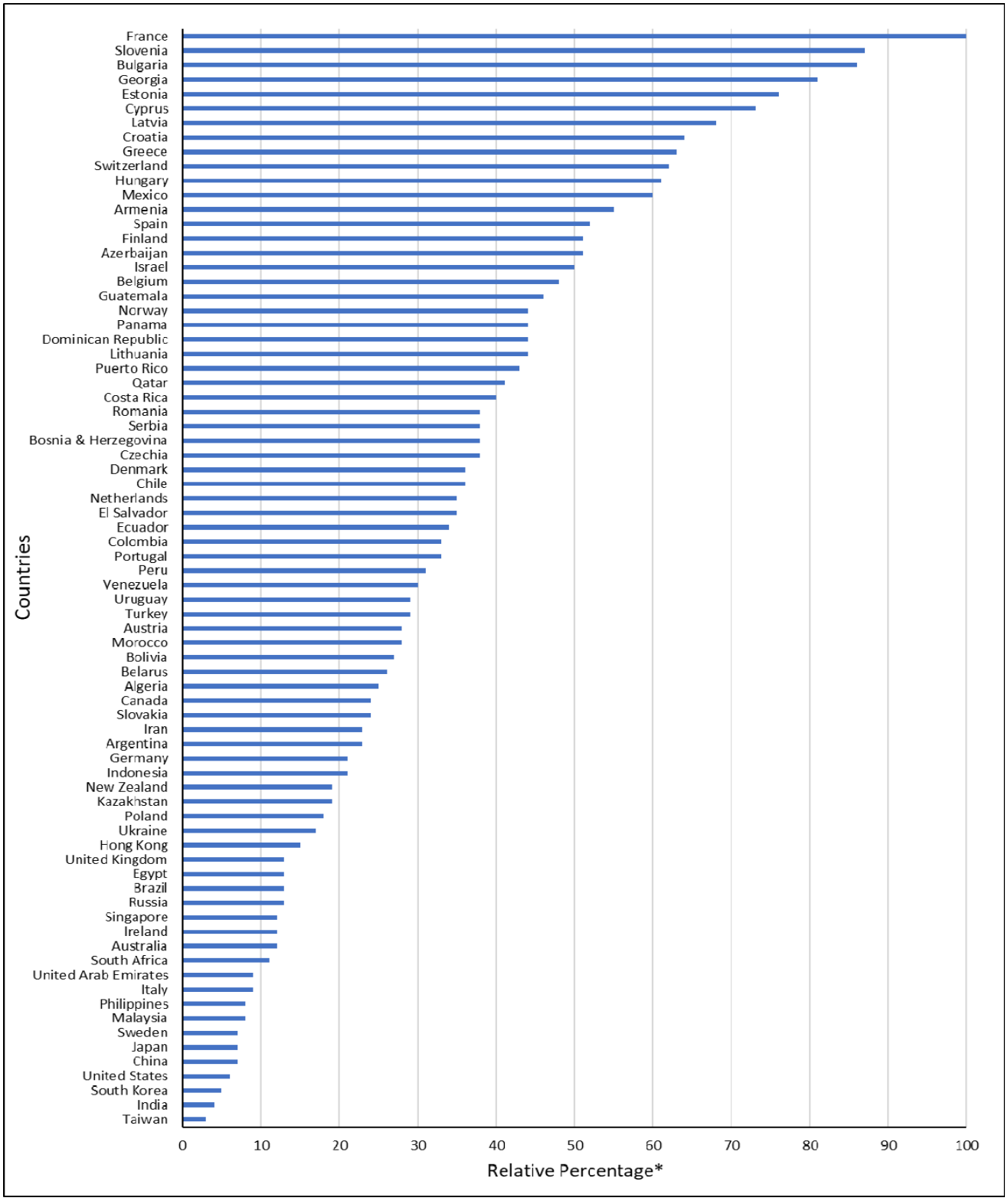

Figure 7. GT searches using the search-term "*International Gymnastics Federation"* by country. *Relative percentage calculated from a sample from the largest volume of search-term use (August 2016).

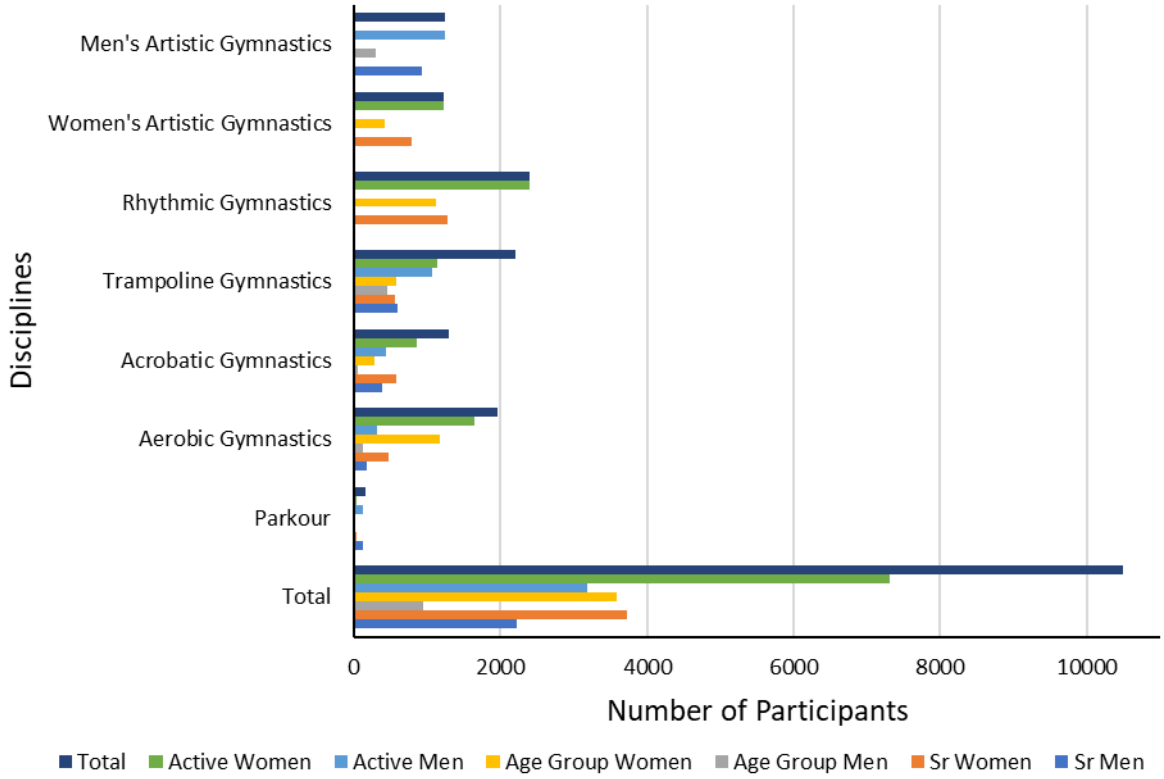

Figure 8. Athlete participation data from the FIG by gender and discipline (Sr = Senior).

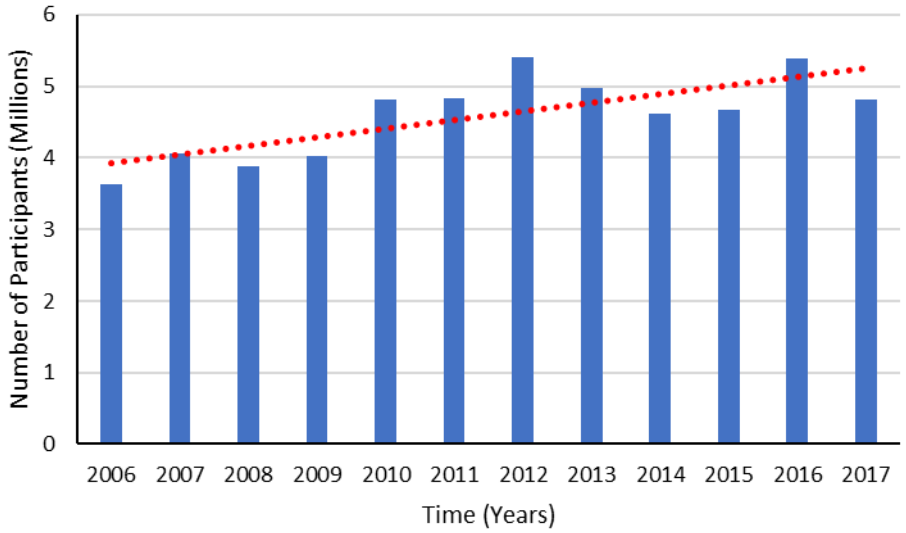

Figure 9. U.S. Gymnastics participation 2006 to 2017.

Information regarding the search interest of various countries was also considered valuable. Figures 4 and 5 show the frequencies of the relative percentages of searches from countries showing an interest in *women's gymnastics* (Figure 4) and *men's gymnastics* (Figure 5).

The world governing body for gymnastics is the International Gymnastics Federation (FIG) headquartered in Lausanne, Switzerland. The FIG is the oldest Olympic sport governing body (founded in 1881), having participated in the Olympic Games since 1896. There are 148 members of national governing bodies served by the FIG. The FIG governs eight sports, including Gymnastics for All, Men's and Women's Artistic Gymnastics, Rhythmic Gymnastics, Trampoline - including Double Mini-trampoline and Tumbling, Aerobics, Acrobatics, and Parkour. Figure 5 shows the time-series distribution of Google™ searches on the FIG. It is noteworthy that the majority of peaks of search interest correspond to men's and women's artistic gymnastics World Championships and Olympic Games. The cyclicity of these peaks is evident during the autumn period when most World Championships are conducted and August's month when the Olympic Games occur. Figure 6 also shows the trends of Google™ searches on the title "International Gymnastics Federation" via a linear regression that was applied to the search-term data to characterize the visual direction of declining use of the term ($y = -0.136(x) + 39.999$, $R = .68$, $R^2 = .46$).

The distribution of countries using the *International Gymnastics Federation* search-term (men's and women's gymnastics combined) is shown in Figure 6. Seventy-six countries are represented in Figure 6, approximately half of the total FIG nation memberships.

Gymnastics participation among the FIG disciplines is shown in Figure 8. These data from Figure 8 represent the peak of the participation pyramid in terms of the world's top athletes, male and female, from all countries. (F.I.G., 2020). The term "Senior" refers to an age eligibility requirement. The required age for women's artistic gymnastics is 16 y as of 1997. The men's age requirement is 16 y. The term "active" means that they have not retired or are not ineligible for competition.

Worldwide participation of athletes in men's and women's artistic gymnastics is unknown. However, there have been various estimates of this population. Unfortunately, the 148 countries who are members of the FIG may not keep uniformly accurate statistics of their members and non-members within their country. For example, even in the U.S., there are various artistic gymnastics-related groups and a range of organizations, goals, and histories within the sport. Figure 9 shows data acquired by a private source that provides a historical trend from 2006 to 2017 (Lock, 2020). The upward trend of participation shown in Figure 8 resulted in a linear regression equation of $y = 0.1202(x) + 3.8109$, and an R of .75, R^2 of .57. According to the Sporting Goods Manufacturers Association, in the U.S. in 2019, the total number of gymnastics participants was 4,699,000. There were 1,695,000 core gymnastics participants. Of the approximately 4.5 million gymnastics participants in the U.S., 71% of the participants are female. Of the 71% of the participants who are female, about 67,000 compete in the US Junior Olympic program, while others participate in AAU, YMCA, or other programs (Lock, 2020).

DISCUSSION AND CONCLUSION

Perhaps one of the most apparent and common assertions in gymnastics is that interest increases enormously near the Olympic Games and World Championships. A study by the Sporting Goods Manufacturers Association (SGMA) showed that at least seven sports with links to the Olympics increased

participation from 2008 to 2009 (T. J. Ryan, 2012). Gymnastics' increased participation amounted to a 3.6% "bump" in the U.S. from 3,883,000 to 4,021,000 participants (T. J. Ryan, 2012). The regression equation from Figure 8 shows an annual increase of approximately 120,000 participants per year. The dramatic increase in gymnastics interest is demonstrated by the startling spikes of GT searches in Figures 2 and 3 and the cyclic nature of searches for the International Gymnastics Federation near Olympic Games and World Championships (Figure 6).

The overall interest in men's gymnastics showed a relative percentage increase across the four Olympic Games (Figure 3). Women's gymnastics also showed an overall relative percentage increase with a decline during the 2012 Olympic Games (Figure 2).

Examining the relative percentages of GT searches by country provided some insight into countries' ranks associated with their world competitive rankings with some startling exceptions. For example, neither China nor Russia appears in the list of countries with enough GT data to be included in the relative percentage analyses (Figures 3 and 4). It is unclear if the non-inclusion of China and Russia in Figures 3 and 4 is perhaps because of an actual lack of search-term interest, government-based internet policies and access, or some other factor (Dowell, 2006). The Chinese government's role in internet access and use is suppressive, but the magnitude of government censorship is less clear (D 'Jaen, 2007). Much the same can be said about Russia (Khurshudyan, 2020). However, there does not appear to be direct evidence of censorship in the specific instances of search-terms related to the information presented in this document. Therefore, the potential influence of censorship and suppression of both countries remains unclear. Moreover, Figure 6 shows that the use of the search-term *International Gymnastics Federation* includes both Russia and China. Other countries with lower competitive rankings such as Ireland and New Zealand showed considerable interest in gymnastics based on the number of searches, thereby indicating that world competitive rank is unlikely to be a powerful predictor of gymnastics interest.

The FIG shows a relative percentage decline in Google™ searches over the 2004 to 2020 time-line (Figure 5). Despite the FIG's international gymnastics governance, the Olympic Games are not the FIG's responsibility and lie within the purview of the International Olympic Committee (IOC). Although the "flagship" disciplines, at least in terms of Western television of the FIG, are men's and women's artistic gymnastics, artistic gymnastics has the lowest level of participation within the FIG except for Parkour (Figure 7). There is considerable potential for a United States bias based on Western television toward artistic gymnastics when Europe and Asia may present more public interest in Rhythmic and Acrobatic gymnastics (North, 2012). Such regional biases in sports interests may also hinge on the competitive ranking of a given country in Olympic and World contests based on the world medias' tendency to follow winners – primarily if the media represents the country of the champions.

Although a worldwide trend in artistic gymnastics interest appears to be increasing (Figures 2 and 3), overall participation trends are unclear. In the U.S., youth sport seems to be in decline (Bogage, 2017). A participation model of gymnastics participation has been critical of the emphasis on competitive gymnastics at the expense of "casual" gymnastics emphasizing the health and fitness benefits of gymnastics rather than a medal count, technique development, command style teaching and coaching, and skill difficulty escalation (North, 2012). Even among those disciplines that garner a large share of television coverage, the scoring systems

are almost impossible for the public to interpret and understand (Governali, Gustafson, & Yelton, 2013; Hudson, 1988; Meyers, 2016; Pajek, Cuk, Pajek, Kovac, & Leskosek, 2013). The change from the 10.0 scoring system to an open-ended scoring system was undertaken for good reasons but has left the general public scratching their collective heads trying to determine why one athlete wins over another (Governali et al., 2013). Despite the obtuse scoring systems, artistic gymnastics remains a highly popular Olympic sport.

In conclusion, GT does not support the premise that worldwide gymnastics interest is declining. In essence, artistic gymnastics is not "running a temperature." It appears that artistic gymnastics is healthy and growing slowly. The recent Covid-19 pandemic has devastated the Olympic Games, world gymnastics, and the long-term training of gymnasts. Whether the athlete's goal is competitive prowess or health and fitness, neither can be achieved while sequestered in a home or apartment. Future investigations of artistic gymnastics interest will likely find the current period an inflection point in the sport's history. What will happen to gymnastics following this inflection point is unclear. The future direction of artistic gymnastics demands careful planning and governance to maintain current interest and long-term training safety.

REFERENCES

Albert, J., Glickman, M. E., Swartz, T. B., & Koning, R. H. (2017). *Handbook of Statistical Methods and Analyses in Sports*. Boca Raton, FL: CRC Press.

Arora, V. S., Stuckler, D., & McKee, M. (2016). Tracking search engine queries for suicide in the United Kingdom, 2004-2013. *Public Health, 137*, 147-153. doi:10.1016/j.puhe.2015.10.015

Avilez, J. L., Zevallos-Morales, A., & Taype-Rondan, A. (2017). Use of enhancement drugs amongst athletes and television celebrities and public interest in androgenic anabolic steroids. Exploring two Peruvian cases with Google Trends. *Public Health, 146*, 29-31. doi:10.1016/j.puhe.2017.01.011

Biesecker, L. G. (2013). Hypothesis-generating research and predictive medicine. *Genome Research, 23*(7), 1051-1053. doi:10.1101/gr.157826.113

Bogage, J. (2017). Youth sports study: Declining participation, rising costs and unqualified coaches. Retrieved from https://www.washingtonpost.com/news/recruiting-insider/wp/2017/09/06/youth-sports-study-declining-participation-rising-costs-and-unqualified-coaches/

Brown, E. W., Clark, M. A., Ewing, M. E., & Malina, R. M. (1998). Participation in youth sports: benefits and risks. *Spotlight on Youth Sports, 21*(2), 1-4.

Carlson, D., Scott, L., Planty, M., & Thompson, J. (2005). *What Is the Status of High School Athletes 8 Years after Their Senior Year? Statistics in Brief. NCES 2005-303*. Retrieved from Jessup, MD:

Catalani, V., Prilutskaya, M., Al-Imam, A., Marrinan, S., Elgharably, Y., Zloh, M., . . . Corazza, O. B. S., 8, 34. . (2018). Octodrine: New Questions and Challenges in Sport Supplements. *Brain Sci, 8*(2), 34. doi:10.3390/brainsci8020034

Cervellin, G., Comelli, I., & Lippi, G. (2017). Is Google Trends a reliable tool for digital epidemiology? Insights from different clinical settings. *J Epidemiol Glob Health, 7*(3), 185-189. doi:10.1016/j.jegh.2017.06.001

Cha, Y.-S., Hwang, S.-M., & Yang, P.-J. (2019). Achilles Tendon Injury and Seasonal Variation: An Analysis Using Google Trends. *Korean J Sports Med, 37*(4), 155-161. Retrieved from http://synapse.koreamed.org/DOIx.php?id=10.5763%2Fkjsm.2019.37.4.155

D 'Jaen, M. D. (2007). Breaching the Great Firewall of China: Congress Overreaches in Attacking Chinese Internet Censorship. *Seattle University Law Review, 31*, 327-351.

Dewan, V., & Sur, H. (2018). Using google trends to assess for seasonal variation in knee injuries. *Journal of Arthroscopy and Joint Surgery, 5*(3), 175-178. doi:https://doi.org/10.1016/j.jajs.2018.02.002

Dowell, W. T. (2006). The Internet, Censorship, and China. *7 Geo. J. Int'l Aff, 111*, 112.

F.I.G., F. I. d. G. (2020). Population. Retrieved from https://www.gymnastics.sport/site/pages/about-population.php

Garrison, S. R., Dormuth, C. R., Morrow, R. L., Carney, G. A., & Khan, K. M. (2015). Seasonal effects on the occurrence of nocturnal leg cramps: a prospective cohort study. *CMAJ: Canadian Medical Association Journal, 187*(4), 248-253. doi:10.1503/cmaj.140497

Governali, P., Gustafson, W., & Yelton, J. (2013). Coaches Column. *Journal of Health, Physical Education, Recreation, 29*(9), 44-45. doi:10.1080/00221473.1958.10630434

Hand, D. J. (2020). *Dark Data*. Princeton, NJ: Princeton University Press.

Huberty, C. J., & Morris, J. D. (1989). Multivariate analysis versus multiple univariate analyses. *Psychological Bulletin, 105*(2), 302-308.

Hudson, M. A. (1988). World gymnastics officials say score fixing is hard to control. *Los Angeles Times*, 1,8.

Hunter, P. V., Delbaere, M., O'Connell, M. E., Cammer, A., Seaton, J. X., Friedrich, T., & Fick, F. (2017). Did online publishers "get it right"? Using a naturalistic search strategy to review cognitive health promotion content on internet webpages. *BMC Geriatrics, 17*(1), 125. doi:10.1186/s12877-017-0515-3

Kerman, A. (2020). *Gymnastics participation report*. Retrieved from https://www.sfia.org/reports/812_Gymnastics-Participation-Report-2020

Khurshudyan, I. (2020). Russia is bolstering its internet censorship powers – is it turning into China? Retrieved from https://www.independent.co.uk/news/world/europe/russia-internet-censorship-norway-putin-a9306666.html

Lewis, M. (2003). *Moneyball: The Art of Winning an Unfair Game*. New York, NY: W. W. Norton & Company.

Lock, S. (2020). Participants in gymnastics in the U.S. from 2006 to 2017 Retrieved from https://www.statista.com/statistics/191908/participants-in-gymnastics-in-the-us-since-2006/#statisticContainer

Mavragani, A., & Ochoa, G. (2019). Google Trends in Infodemiology and Infoveillance: Methodology Framework. *JMIR Public Health Surveill, 5*(2), e13439. doi:10.2196/13439

Meyers, D. (2016). *The End of the Perfect 10*. New York: Touchstone.

Mnadla, S., Bragazzi, N. L., Rouissi, M., Chaalali, A., Siri, A., Padulo, J., . . . Knechtle, B. (2016). Infodemiological data of Ironman Triathlon in the study period 2004-2013. *Data Brief, 9*, 123-127. doi:10.1016/j.dib.2016.08.040

Morgulev, E., Azar, O. H., & Lidor, R. (2018). Sports analytics and the big-data era. *International Journal of Data Science and Analytics, 5*(4), 213-222. doi:10.1007/s41060-017-0093-7

North, J. (2012). *Further development of the gymnastics participant model.* (Project Report). Leeds Beckett University, Leeds Metropolitan University. Retrieved from http://eprints.leedsbeckett.ac.uk/77/

Nuti, S. V., Wayda, B., Ranasinghe, I., Wang, S., Dreyer, R. P., Chen, S. I., & Murugiah, K. (2014). The use of google trends in health care research: a systematic review. *PloS One, 9*(10), e109583. doi:10.1371/journal.pone.0109583

Pajek, M. B., Cuk, I., Pajek, J., Kovac, M., & Leskosek, B. (2013). Is the quality of judging in women artistic gymnastics equivalent at major competitions of different levels? *J Hum Kinet, 37*, 173-181. doi:10.2478/hukin-2013-0038

Petlichkoff, L. M. (1992). Youth sport participation and withdrawal: Is it simply a

matter of FUN? *Pediatric Exercise Science, 4*, 105-110.

Porter, M. L. (1993). Exploratory data analysis uncovers unexpected relationships. *Personal Engineering and Instrumentation News, 10(12)*, 21-28.

Ryan, M., Harrison, S., & Ismael, S. T. (2017). Forecasting Sports Popularity: Application of Time Series Analysis. *Academic Journal of Interdisciplinary Studies, 6*(2). Retrieved from http://www.richtmann.org/journal/index.php/ajis/article/view/9982

Ryan, T. J. (2012). SGMA: Olympics do impact sports participation.

Rynecki, N. D., Siracuse, B. L., Ippolito, J. A., & Beebe, K. S. (2019). Injuries sustained during high intensity interval training: are modern fitness trends contributing to increased injury rates? *Journal of Sports Medicine and Physical Finess, 59*(7), 1206-1212. doi:10.23736/s0022-4707.19.09407-6

Sagiroglu, S., & Sinanc, D. (2013). *Big data: A review.* Paper presented at the 2013 International Conference on Collaboration Technologies and Systems (CTS), San Diego, CA.

Schneier, B. (2015). *Data and Goliath*: W.W. Norton & Company.

Shenk, D. (1997). *Data smog*. San Francisco, CA: HarperEdge.

Siegel, E. (2016). *Predictive Analytics*. Hoboken, NJ: Wiley and Sons.

Stein, M., Janetzko, H., Seebacher, D., Jäger, A., Nagel, M., Hölsch, J., . . . Grossniklaus, M. (2017). How to make sense of team sport data: from acquisition to data modeling and research aspects. *Data, 2*(1), 2. Retrieved from http://www.mdpi.com/2306-5729/2/1/2

Stoll, C. (1995). *Silicon snake oil*. New York, NY: Doubleday.

Tay Wee Teck, J., & McCann, M. (2018). Tracking internet interest in anabolic-androgenic steroids using Google Trends. *The International journal on drug policy, 51*, 52-55. doi:10.1016/j.drugpo.2017.11.001

Tran, U. S., Andel, R., Niederkrotenthaler, T., Till, B., Ajdacic-Gross, V., & Voracek, M. (2017). Low validity of Google Trends for behavioral forecasting of national suicide rates. *PloS One, 12*(8), e0183149. doi:10.1371/journal.pone.0183149

Trends, G. (2013). Understanding Google Trends Retrieved from https://searchanalysisguide.blogspot.com/2013/04/understanding-google-trends.html

Wiley, K. E., Steffens, M., Berry, N., & Leask, J. (2017). An audit of the quality of online immunisation information available to Australian parents. *BMC Public Health, 17*(1), 76. doi:10.1186/s12889-016-3933-9

Zhou, X., Ye, J., & Feng, Y. (2011). Tuberculosis surveillance by analyzing Google trends. *IEEE Transactions on Biomedical Engineering, 58*(8). doi:10.1109/tbme.2011.2132132

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