



XV WORLD FORESTRY CONGRESS

Building a Green, Healthy and Resilient Future with Forests

2–6 May 2022 | Coex, Seoul, Republic of Korea

Exploratory data analysis on mountaineering patterns of 2030 generations in the Seoul metropolitan area before and after COVID-19

BoBae Lee¹, PongSik Yeon²

¹ Dept. of Forest Therapy, Chungbuk National University, Cheongju 28644, Korea - qhreo1469@gmail.com

² Dept. of Forestry, Chungbuk National University, Cheongju 28644, Korea

Abstract

The purpose of this study was to analyze the user comprehensively behavior to cope appropriately with the increasing demand for mountain usage from users in their 20s and 30s and to allocate resources efficiently. To analyze the behavior of hiking users, exploratory data analysis (EDA) was conducted on the data which has been collected in the Marketlink (online) trekking road user information and app Tranggle (offline). Online data is for residents of the metropolitan area, and offline data is for visitors in the mountains located in the metropolitan area. MarketLink provided user information for trekking road, and Tranggle provided user data for the top 13 mountains in the metropolitan area. After data pre-processing, mountain usage patterns were analyzed through statistical analysis and visualization. The number of online searching for trekking road increased in 2020 by 1.22 times compared to 2019. However, in the case of 2020, the search volume declined after June, so it did not recover to the level of 2019. Also, among men and women in their 20s and 30s, only women in their 30s saw a significant decline in search volume. The number of usages of offline data (Tranggle) increased 1.36 times in 2020 compared to 2019. The utilization rate of the well-established hiking trails has increased. The usage of mountain on weekends (Saturday > Sunday) was still the highest, and the difference in the usage on weekdays decreased. Outside of working hours, early morning usage has increased and night-time usage has decreased. There was no significant change in activity type, level (experience value) and exercise properties. Since COVID-19, the usage of mountains has been changing around low density and close range. After COVID-19, the function and role of forests in daily life are expected to increase. To cope with this, further research needs to be carried out with consideration of the wider demographic and social characteristics.

Keywords: Covid-19, Youth and young generation, Monitoring and data collection, Human health and well-being.

Introduction, scope and main objectives

In March 2020, the World Health Organization (WHO) declared a pandemic caused by the novel coronavirus, SARS-CoV-2 (hereinafter referred to as COVID-19) (WHO 2021). The behavior of participating in outdoor activities has changed since the COVID-19 pandemic (National Institute of Forest Science 2020). And also among these outdoor activities in 2020, a change in the hiking behavior of people in their 20s and 30s is remarkable. According to the 2018 Forest Leisure Activity Survey (National Institute of Forest Science 2019), people in their 20's had a very low frequency of participation in forest leisure activities as part of their lifestyle, such as only 1-2 times of mountain hikes per year (25.9%), and no mountain hikes at all (appr. 20%). However, referring to hiking experience rate by age in a "Factual Survey of Hiking in 2020" conducted by the Ministry of Culture, Sports and Tourism (MCST) and the Korea Tourism Organization (KTO), it decreased by 8.1% for those in their 40s and older compared to 2019, but increased by 3.0% for those in their 30s and below (Korea Tourism Organization 2021). One of the changes after the COVID-19 outbreak is that the number of hikers in

their 20s and 30s has significantly increased, which had not been noticeable before because they used hiking trails less frequently than the middle-aged, the main hiking age group.

In this regard, this study was conducted to analyze the usage behavior of forest space through EDA by selecting the data of a hiking app regarding users in their 20s and 30s visiting 13 mountains with the highest frequency of visits in the Seoul metropolitan area, as basic data.

Methodology/approach

1 -Target selection

To examine the forest usage patterns of MZers(born in the early 1980s to mid-2000s) who actively participated in exercise, such as the recent increase in the proportion of use of exercise platforms, the age range was set for those in their 20's and 30's, the age group corresponding to being the MZ generation. In addition, referring to the findings of Park and Kim (2001) that mountain forest type had a high usage rate of middle-aged people and suburban forest type had a high proportion of young people in their twenties, In the offline data (Tranngle), the region was set to 13 mountains with high frequency of visits in the metropolitan area, and in the online data (MarketLink), the region was set to 20-30 people living in the metropolitan area.

2 - Collecting data

1) Online data

MarketLink develops and sells data products on various topics by using the PC and mobile log data of 500,000 SurveyLink Panel users. We received data on the characteristics of the population interested in hiking trails from MarketLink. The data period was from March 2019 to November 2020, and there were 28,111 cases of hiking trail users in 2019 and 32,156 cases in 2020, totaling 60,267 cases.

2) Offline data

Beagle, the developer of the workout app "Tranngle," has collected big data specialized for outdoor activities and exercise, and has provided various services based on artificial intelligence (Beagle 2021). The data used in this study were provided on those in their 20's and 30's who visited the top 13 most frequently visited mountains in the Seoul metropolitan area. The period of data was from January 2019 to early December 2020, and the total number of data was 337,504, consisting of 142,806 in 2019 and 194,698 in 2020.

3 - Data Preprocessing

1) Online data

There were a total of 18 variables in the data provided from MarketLink, including user information ID, extracted word name, information acquisition date, user gender code, age group code, and occupation name, respectively. Derivative variables were created using these variables.

2) Offline data

The data provided had a total of 22 variables, such as classification, experience point, actual exercise distance, average speed, maximum speed, total time, travel time, maximum altitude, registration date and time, and region 2. We used these variables to create derived variables.

Thereafter, the missing and outlier values of the two data were identified and removed, and the data were processed as necessary.

4 - Data analysis

After statistical analysis and visualization using the completed data frame and each variable, online and offline forest use was analyzed by exploring statistics and visualized data.

Results

1 - Online data

1) Analysis of temporal factors

By year, the number of online searches for hiking trails in their 20's and 30's in the Seoul metropolitan area was 7,109 in 2019 and 8,198 in 2020, which is 1.22 times higher in 2020 than in 2019. In the case of monthly distribution, 2019 is relatively even, but in 2020, it decreased after a large increase from March to May (Fig 1).

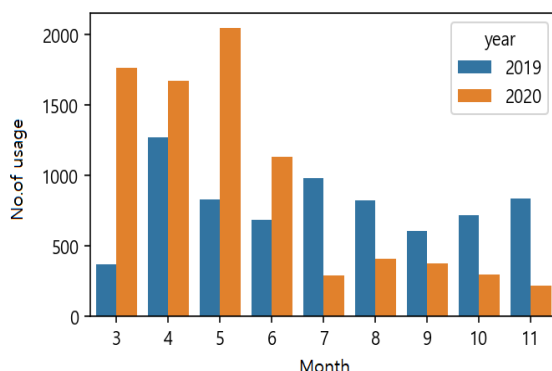


Fig 1. Monthly trend of online forest space-related search volume.

2) Gender and age analysis

Looking at the Table 1, in 2020, the number of hiking trail searches increased 2.19 times in their 20's compared to 2019, but decreased 0.89 times in their 30's. Compared to 2019, the overall number of searches for hiking trails in 2030 households increased, but the number for women in their 30's fell significantly.

Table 1. User characteristics for searching trekking road by year

2019				2020			
Gender	Age	N	%	Gender	Age	N	%
F	20	970	13.6	F	20	1,305	15.9
	30	4,291	60.4		30	2,186	26.7
M	20	430	6.0	M	20	1,770	21.6
	30	1,418	20.0		30	2,937	35.8
Total		7,109	100.0	Total		8,198	100.0

1 - Offline data

1) Analysis of temporal factors

The total number of accumulated data on mountain hikes by users in their 20's and 30's in the metropolitan area by year was a total of 337,504, which is 142,806 in 2019 and 194,698 in 2020, showing an increase of 1.36 times in 2020 compared to in 2019.

To classify each month according to the time of sunset, it was divided into Winter season (November-March), Summer season (April-October), and All (12 months), and the high or low usage for each classified period was determined as the mean (Table 2).

The days of the week were classified by dividing into Weekdays (Monday-Friday), Weekends (Saturday-Sunday), and All (Monday-Sunday) and the means were calculated. Comparing the two years, in both years the mountain usage was highest on the weekends and higher on Saturdays than Sundays (Table 3).

Usage by time of day was divided into Work time (9-18 o'clock), Night time (19-23 o'clock), Early morning (0-8 o'clock), and All (24 hours). Comparing the two years, the time of day with above the mean of the early morning and Night advanced from 7 o'clock to 6 o'clock and from 21 o'clock to 19 o'clock, respectively (Table 4).

Table 2. Comparison of monthly, seasonal and yearly mountain usages.

Month	Number of usages	
	2019	2020
January	8,794	11,596
February	8,817	12,753
March	10,911	17,322
April	9,263	21,786
May	11,841	20,075
June	13,918	17,314
July	8,713	17,553
August	13,246	11,705
September	19,875	22,032
October	15,682	24,965
November	11,954	17,241
December	9,792	356
Mean (Winter season)*	10,054	11,854
Mean (Summer season)**	13,220	19,347
Mean (All)	11,901	16,225

Table 3. Comparison of day of week, weekday, and weekend mountain usages.

Day of week	Number of usages	
	2019	2020
Monday	10,629	14,697
Tuesday	14,035	15,833
Wednesday	15,490	16,966
Thursday	12,561	16,376
Friday	9,847	17,245
Saturday	40,798	57,008
Sunday	39,446	56,573
Mean (Weekday)	12,512	16,223
Mean (Weekend)	40,122	56,791
Mean (All)	20,401	27,814

Table 4. Comparison of time of day, working hours, dawn, and night mountain usages.

Time of day	Number of usages	
	2019	2020
0	719	619
1	525	338
2	719	188
3	809	250
4	421	286
5	434	571
6	933	1,334
7	1,743	2,594
8	3,060	3,461
9	3,756	4,589
10	4,497	6,414
11	6,636	9,881
12	10,454	14,475
13	13,680	19,281
14	16,712	23,867
15	19,006	27,197
16	18,547	26,115
17	14,302	20,241
18	8,358	12,340
19	4,851	7,120
20	4,061	4,512
21	4,365	5,019
22	2,229	2,630
Mean of Early (0-8)	1,040	1,071
Mean work (9-18)	11,954	16,896
Mean Night (19-23)	4,309	2,020

2) Analysis of mountain hiking regions

In 2020, the number of visits to mountains in the metropolitan area by those in their 20's and 30's using Trangle app increased 1.36 times compared to 2019. To examine the factors that increased mountain hikes in the metropolitan area, we analyzed the top 3 regions (si (city), gun (county) and gu (district)) with high frequency of usage by mountain (Table 5). For the mountains including Buk-han, Bul-am, Su-rak, and Cheonggye, the frequency of usage by region was evenly distributed in the past, or spread evenly in 2020; and for the other nine mountains, except for the three mountains, the frequency of usage in the regions, which showed the highest frequency of usage in 2019, got higher. This was related to the regional distribution of hiking trails by mountain. For mountains where the regions used by hikers were evenly distributed, hiking trails were evenly created in nearby areas, and for mountains with high frequency of use only in specific regions, hiking trails were built around specific areas only.

Table 5. proportion of the top 3 most used regions for each mountain.

Mountain	City name with high frequency of usage (%)					
	2019			2020		
Gwan-ak	Gwanak-gu (49.6)	Gwacheon-si (27.0)	Etc (10.5)	Gwanak-gu (55.9)	Gwacheon-si (27.5)	Etc (9.7)
Gwang-gyo	Suwon-si (51.8)	Yongin-si (16.7)	Etc (20.1)	Suwon-si (60.3)	Yongin-si (5.6)	Etc (21.3)
Namhan-sanseong	Gwangju-si (46.2)	Seongnam-si (23.2)	Hanam-si (16.5)	Gwangju-si (51.0)	Seongnam-si (19.8)	Hanam-si (15.2)
Dae-mo	Gangnam-gu (68.8)	Seocho-gu (24.2)	Etc (2.5)	Gangnam-gu (74.5)	Seocho-gu (19.5)	Songpa-gu (2.2)
Do-bong	Dobong-gu	Yangju-si (13.4)	Uijeongbu-si	Dobong-gu	Yangju-si (14.3)	Uijeongbu-si

	(59.9)		(11.3)	(63.8)		(12.6)
Buk-han	Eunpyeong-gu (24.7)	Gangbuk-gu (23.5)	Etc (19.8)	Gangbuk-gu (28.7)	Eunpyeong-gu (27.4)	Goyang-si (19.3)
Bul-am	Nowon-gu (69.7)	Namyangju-si (14.4)	Uijeongbu-si (4.4)	Nowon-gu (44.8)	Uijeongbu-si (31.1)	Namyangju-si (16.2)
Sa-pae	Uijeongbu-si (59.6)	Yangju-si (18.1)	Dobong-gu (6.7)	Uijeongbu-si (60.8)	Yangju-si (21.0)	Dobong-gu (6.0)
Sam-sung	Anyang-si (45.5)	Gwanak-gu (23.3)	Etc (8.2)	Anyang-si (50.3)	Gwanak-gu (23.6)	Geumcheon-gu (7.8)
Su-rak		Etc (100.0)		Nowon-gu (44.8)	Uijeongbu-si (31.1)	Namyangju-si (16.2)
A-cha	Gwangjin-gu (70.5)	Jungnang-gu (10.5)	Guri-si (7.1)	Gwangjin-gu (70.7)	Jungnang-gu (10.3)	Guri-si (9.0)
In-wang	Jongno-gu (67.9)	Seodaemun-gu (21.9)	Etc (3.0)	Jongno-gu (70.9)	Seodaemun-gu (20.8)	Etc (2.7)
Cheong-gye	Seocho-gu (28.4)	Seongnam-si (22.6)	Etc (17.7)	Seocho-gu (30.3)	Seongnam-si (23.4)	Etc (10.8)

3) Analysis of activity types

Looking at the top 3 activities of users in their 20's and 30's, the rate of use for Hiking and Walking was still high, and Cycling increased (Table 6).

Table 6. Frequency of mountain usage by activity type

Mountain	City name with high frequency of usage (%)					
	Hiking (%)	Walking (%)	Cycling (%)	Jogging (%)	Inline skating(%)	Etc (%)
2019	133,763 (93.7)	4,780 (3.3)	1,519 (1.1)	271 (0.2)	3 (0.0)	2,470 (1.7)
2020	182,992 (94.0)	6,514 (3.3)	2,453 (1.3)	462 (0.2)	4 (0.0)	2,273 (1.2)

4) (Level-based) analysis of experience point

When converting the yearly experience points of users in their 20's and 30's who visited the mountains in the metropolitan area according to Tranggle level standard table, about 90% of them were distributed in the lower six Levels in both years (Table 7).

Table 7. Mountain usage frequency by altitude level

Level	No. of usages														Mean	Ratio (%)
	Buk-han	Do-bong	Su-rak	Gwan-ak	Cheong-gye	Gwang-gyo	Sa-pae	Bul-am	Namhan-sansung	Sam-sung	In-wang	Dae-mo	A-cha			
Altitude (m)	836	740	638	620	620	582	552	507	498	480	338	293	287	538		
2019	Lev 0	2,415	1,201	509	1,275	652	730	234	528	237	530	231	253	989	753	7
	Lev1	3,655	545	388	1,438	1,102	1,844	171	1,208	514	759	1,117	1,098	2,237	1,237	11.3
	Lev 2	1,999	362	332	1,486	452	872	124	2,089	790	738	1,419	2,203	5,211	1,391	12.7
	Lev3	2,294	603	881	1,707	888	1,139	536	1,913	541	1,443	887	1,014	3,072	1,301	11.9
	Lev 4	4,093	5,073	4,121	7,059	2,341	3,060	1,223	1,621	519	1,914	453	435	1,606	2,578	23.6
	Lev 5	7,001	5,752	2,702	4,670	2,589	3,226	1,882	1,463	557	1,816	187	157	460	2,497	22.8
	Others	1,980	1,332	1,720	1,152	1,963	2,112	1,015	1,732	329	1,313	139	315	179	1,175	10.7
Total	23,437	14,868	10,653	18,787	9,987	12,983	5,185	10,554	3,487	8,513	4,433	5,475	13,754	10,932	100	
2020	Lev 0	1,083	573	520	731	367	631	339	520	364	519	338	255	1,139	568	3.8
	Leve1	1,420	180	183	578	236	343	117	183	802	600	2,971	1,573	3,123	947	6.4
	Lev 2	2,602	439	411	2,324	409	1,141	364	411	1,060	1,005	3,049	3,699	8,050	1,920	12.9
	Lev 3	3,543	566	1,246	2,192	861	1,637	855	1,246	762	1,928	1,550	2,106	5,111	1,816	12.2
	Lev 4	4,733	5,881	5,936	9,491	2,829	4,670	2,233	5,936	850	2,726	864	809	2,552	3,808	25.5
	Lev 5	9,333	9,651	4,365	7,961	4,121	5,919	3,234	4,365	833	1,966	283	262	679	4,075	27.2
	Others	2,533	2,044	2,611	1,803	3,191	3,726	1,660	2,611	413	1,821	249	327	356	1,796	12
Total	25,247	19,334	15,272	25,080	12,014	18,067	8,802	15,272	5,084	10,565	9,304	9,031	21,010	14,930	100	

5) Comparison of representative values for each characteristic of mountain hikes

Since the median is appropriate as a representative value of the data with singular values, the characteristic of each mountain hike in both years was compared based on the median (Kim, 2009). Excluding speed, the medians of all characteristics increased compared to in 2019 (Table 8).

Table 8. Comparison of representative values for each characteristic

Mountaineering characteristics	Year	Mean	Std*	25%	50%	75%	Max
Experience value (M)	2019	907	714	454	834	1,140	23,343
	2020	999	698	579	916	1,193	15,418
Actual exercise distance (m)	2019	10,048	6,676	6,354	8,698	11,775	264,490
	2020	10,727	6,915	6,944	9,180	12,407	152,846
Average speed (km/h)	2019	3	1	2	3	3	25
	2020	3	1	2	3	3	63
Top speed (km/h)	2019	11	16	5	7	9	200
	2020	11	14	6	7	10	200
Whole time (m)	2019	667	63,114	168	247	340	10,322,240
	2020	355	16,042	180	257	348	4,759,198
Transit time (m)	2019	617	63,108	149	208	274	10,322,200
	2020	299	15,978	155	213	280	4,759,198
Rest time (m)	2019	49	860	5	28	64	270,522
	2020	56	1,426	11	33	67	457,179
Highest altitude (m)	2019	587	179	496	610	693	9,592
	2020	590	170	496	628	676	8,000

* std: standard deviation

Discussion

Considering the increase in data before and after the outbreak of COVID-19 (2019-2020) of users in their 20's and 30's using mountains in the Seoul metropolitan area, it shows that short-range hiking has increased compared to the previous year. In addition, considering that the five most visited mountains in 2020 are highly accessible and convenient to forests, it is thought that forest use in people in their 20's and 30's is more suitable for daily life, not for a clear hiking purpose. However, there is a significant decrease in hiking in certain age groups and genders, so detailed observation and further study is required.

Conclusions/ wider implications of findings

In this study, we looked at how the hiking patterns of people in their 20s and 30s who use the Trangle app or forest search in crisis situations caused by infectious diseases such as COVID-19 are changing. As the COVID-19 pandemic situation has been prolonged, the epidemic disaster has adversely affected the mental health of the people (Lee 2020). However, it will be a long time before the COVID-19 situation is over, so unless quarantine guidelines and social distancing are lifted, climbing is likely to at least maintain the current level or increase it. In order to actively cope with the increase in demand for mountaineering due to the prolonged COVID-19, additional research that considers sociodemographic characteristics more broadly is needed.

References

Beagle. 2021. Available at: <https://www.beaglepeople.com/>. [accessed 20.01.21]

Cha MY. 2020. Line of amusement park above Gwanak mountain...2030 outdoor boom in Corona. 2020.12.26. Available at: <https://www.asiae.co.kr/article/2020070708514094317>. [accessed 21.12.20]

Kim N.D, Zeon MY, Choi JH, Lee HE, Lee JY, Lee SJ, Seo YH, Kwon JY, Han DH. 2020. Trend korea 2021. Seoul, Korea: Window of the Future. pp.40-250.

Kim NH. 2020. November 30. Beagle Co., Ltd. "Trangle GPS, the growth rate of members in the 2030 age group increases". Available at: <https://www.futurekorea.co.kr/news/articleView.html?idxno=143858>. [accessed 21.11.20]

Kim MJ. 2009. On Relevance of Mean as a Representative value of Data shown in Secondary Math Textbooks. MA diss., Dept. of education, Kon-Kuk Univ. seoul, Korea.

Korea Forest Service. 2014. Designation of national hiking trails and management plan. Available at: <http://know.nifos.go.kr/book/search/DetailView.ax?sid=1&cid=162269>. [accessed 28.05.21]

Korea Tourism Organization. 2020. S.A.F.E.T.Y.'s Travel trend changed by safety awareness Available at: <http://kto.visitkorea.or.kr/kor/notice/news/press/board/view.kto?id=441712&instanceId=42>. [accessed 21.02.21]

Korea Tourism Organization. 2021. March. 11. How did walking travel change during the Corona era?. Available at: <http://kto.visitkorea.or.kr/kor/notice/news/press/board/view.kto?id=443047&isNotice=false&instanceId=42&rnum=3>. [accessed 21.05.21]

Lee EH. 2020. Corona 19 generation, good mental health. Gyeonggi Res. Institute(GRI), Issue & Diagnosis, 2020(5), 1-25.

Maketlink. Available at: <https://ww.marketlink.co.kr>. [accessed 24.05.21]

Ministry of Culture, Sports and Tourism. 2020, November13. During the Corona 19, cultural life inside the house, outdoor activities near the house, Available at: https://www.mcst.go.kr/kor/s_notice/press/pressView.jsp?pSeq=18455&pMenuCD=0302000000&pCurrentPage=3&p

National Institute of Forest Science. 2019. 2018 Survey report on national forest leisure activities. Available at: <http://know.nifos.go.kr/book/search/DetailView.ax?sid=10&cid=173554>.

National Institute of Forest Science. 2020. The effect of Corona 19 on forests, forestry, and mountain villages in Korea. Available at: <http://know.nifos.go.kr/book/search/DetailView.ax?sid=4&cid=174770>.

Park JS and Kim YI. 2001. Satisfaction by type of natural recreation forest based on user evaluation. Proc. Korean Inst. Landsc. Archit. Conference, pp.103-107.

TypeDept=&pSearchType=01&pSearchWord=%EC%BD%94%EB%A1%9C%EB%82%9819. [accessed 21.04.21]

Univtomorrow20slab. 2019. Millennial-Z generation trend 2020. Goyang, Korea:Wisdom House. pp.20-100.

WHO. 2021. Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. [accessed 16.01.21]