Self-tracking of Exercise and Sleep Quality

Jue Wang

Syracuse University   New York   Syracuse Postal Code: 13202

Abstract: In the fast-paced life era, managing personal health, especially sleep, is paramount. However, due to reasons like work stress and inadequate time management, individuals often experience poor sleep. Inspired by Gina Neff and Dawn Nafus' "Self-Tracking," I explored the potential of self-tracking in improving sleep quality. Self-tracking involves recording, monitoring, and analyzing data on life, health, and activities, enabling individuals to understand their behaviors and habits better, leading to positive changes and improved quality of life. I specifically investigated the effect of exercising before bedtime on sleep quality. Drawing from "Quantified Self" and "Biomedicalization," I recognized the potential of quantifying daily life for clearer self-understanding, leading to improved health and quality of life.

Keywords: Self-Tracking, Biomedicalization; Sleep Quality; Quantified Self; Data Visualization; Correlation Coefficient

Introduction:

In this age of fast pace, personal health management becomes more and more important, especially in ensuring sufficient and quality sleep. However, due to various reasons in daily life, it has become a common phenomenon for people to have less sleep time and low-quality sleep. For example, insomnia caused by work stress, students preparing for exams overnight, and teenagers overcompensating by staying up late during the day to fulfill their unmet need for time control. And it is even more important for me to have a good quality of sleep every day during my midterm period. In this context, I read Gina Neff and Dawn Nafus' book Self-Tracking and learned that self-tracking is the practice of individuals actively recording, monitoring, and analyzing data about their lives, health, and activities. (Neff & Nafus, 2016, p.2)This data covers a wide range of areas such as physical activity, sleep patterns, eating habits, emotional state, and productivity, and helps individuals to better understand their behaviors and habits so that they can make positive changes, achieve personal goals, or improve their quality of life. So, I decided to explore whether exercising before bedtime has a positive effect on improving sleep quality. According to "Quantified Self" and "Biomedicalization", all aspects of daily life can be medicalized and quantified through the intervention of technology. (Neff & Nafus, 2016, p.30) The quantification of daily life can help people understand themselves more clearly and improve their health and quality of life. Therefore, I tracked my sleep quality (dependent variable) and whether I exercised (independent variable) for 14 days using my iWatch as a device sensor. Preliminary results from this self-tracking activity suggest that performing relaxation exercises in the evening did have an impact on my sleep quality. By tracking sleep data, I expect to reveal the effects of daily habits on bio-medicalized parameters such as sleep depth and duration. As these are things I could not learn about when I was asleep before, there may be some correlation with mental health as well. It did give me a deeper understanding of my self-perception and lifestyle habits.

My self-experimental hypothesis was that exploring pre-bedtime exercise would improve sleep quality. This hypothesis is closely related to the category of "monitoring and evaluation" described in the Self-Tracking book. (Neff & Nafus, 2016, p.38) Monitoring and evaluation is a central purpose of self-tracking and is often used to evaluate the impact of specific health behaviors or lifestyle changes on an individual's well-being. In the category of "Monitoring and Evaluation," self-tracking behaviors help me get feedback on my status and make adjustments based on that information. (Neff & Nafus, 2016, p.71-73) I chose to focus on the relationship between sleep quality and evening exercise because sleep is the cornerstone of health and daily functioning. The book mentions that self-tracking is not only a process of data collection; it is also a process of personal exploration and self-discovery. By recording my bedtime exercise habits, I can observe how this variable affects the depth of my sleep and my sense of wakefulness the following day. And I can get a rough idea of whether or not I have any underlying health and psychological issues. To conduct this experiment, I will

exercise for a prescribed amount of time each night and use a smartwatch to monitor my sleep patterns for analysis and comparison. In this way, I hope to validate the actual impact of exercise habits on sleep quality and use it to improve my quality of life.

In the sleep quality self-tracking experiment, I used the sleep app of Apple Watch and the health app of Apple phones for data detection and collection. Then the data was organized and summarized through Excel, and finally, the data was presented more intuitively through Python's data visualization technique. First of all, the Sleep App of Apple Watch provides records about sleep patterns, duration, depth, and other indicators by monitoring my physiological signals such as heart rate, movement, and noise level. This data was the basis of my experiment. Second, the Apple Watch's synchronization with the health app allowed me to easily view, analyze, and share this sleep data on my phone. This seamless connection ensured real-time updates and integrity of the data, while Apple provided a user-friendly interface to help me view and understand it. This is something that no other testing bracelet can replace and is why I use the Apple Watch as a testing and information-gathering tool. (Apple Support, 2024) I further organized and structured the sleep data collected from the Apple Watch using Excel, a widely used data organizing tool with very easy-to-use and powerful data processing capabilities. By creating clear data tables in Excel, I was able to observe and analyze the daily changes in sleep patterns, including the percentage of time spent in different sleep stages and the trend of changes more intuitively. In addition, the flexibility of Excel greatly facilitates data conversion and processing, such as converting sleep time from a mixed format of hours and minutes to a uniform unit of minutes, thus simplifying the subsequent calculation and analysis process. This structured data recording not only improves the readability of the data but also provides a solid foundation for in-depth exploration of the relationship between sleep quality and daily activities. Finally, these Excel-organized data were transformed into intuitive, easy-to-understand charts and graphs using Python's data processing and visualization libraries (e.g., Pandas, Matplotlib, and Seaborn). These charts visualize trends and patterns in the data. With these charts, not only was I able to see more clearly how sleep quality changed over time, but I was also able to analyze in depth the potential connection between sleep quality and exercise.

No exercise before bedtime (min)

date	awake_time	rem_time	core_time	deep_time	total_time
2024-02-04	36	69	307	62	474
2024-02-05	32	64	181	65	342
2024-02-06	1	74	198	68	341
2024-02-07	27	99	288	24	438
2024-02-08	31	113	250	58	452
2024-02-09	1	70	204	82	357
2024-02-10	3	141	218	61	423

exercise before bedtime (min)

date	awake_time	rem_time	core_time	deep_time	total_time
2024-02-11	7	87	215	78	387
2024-02-12	4	90	228	51	373
2024-02-13	2	70	108	68	248
2024-02-14	5	80	261	77	423
2024-02-15	7	102	212	73	394
2024-02-16	7	110	228	81	426
2024-02-17	12	102	275	75	464

These two tables are a collection of data on sleep quality without stretching exercises before bedtime and sleep quality with stretching exercises before bedtime, respectively. In it, it can be found that the awake time without exercise before bedtime is longer than the awake time with exercise before bedtime. This indicates that the time between wakefulness and falling asleep became shorter after exercise. As well as the number and length of waking up during sleep were significantly reduced. Secondly, the duration of deep sleep with exercise before bed was generally slightly higher than the duration of deep sleep without exercise before bed. The depth and duration of my sleep generally improved, so I think exercise helps with sleep quality to some degree.

In conducting a 14-day self-tracking experiment, my self-perception was reinforced by monitoring the effects of evening exercise on sleep quality. By keeping a daily log of sleep quality and whether I exercised in the evening, I noticed a positive correlation between exercise and sleep quality. I found that my sleep depth and duration generally improved after engaging in relaxed evening exercise. This confirms the concept of the "quantified self" mentioned in Self-Tracking, that by tracking and quantifying aspects of my daily life, I can gain a clearer understanding of myself, thereby improving my health and quality of life. (Neff & Nafus, 2016, p.31-32) I also learned about the limitations of the self-tracking activity. Since the experiment mainly focuses on sleep quality and evening exercise, other factors that may affect sleep, such as eating habits, work stress, and emotional state, are not fully considered. For example, during last week's test, I had three exams in one day during the midterm, and I slept very little the day before to study for them. In the middle of the week, I had my period, which caused my mood to be extremely bad. These factors caused fluctuations in the sleep quality test and affected the accuracy of the experimental results. The missing and disturbed data also served to make me reflect. In the course of the experiment, there were a few nights when the data could not be recorded because the watch ran out of power. Unexpected interruptions in this daily life and how they affect the continuity of the experiment. These situations reminded me of the need to consider the reliability of equipment and the consistency of data collection when conducting self-tracking. The experimental process revealed a trend towards the "biomedicalization" of self-tracking activities. By continuously monitoring physiological data through technological means, my life was medicalized, transforming the subjective feeling of sleep into quantifiable data. (Neff & Nafus, 2016, p19) However, this transformation may cause me to lose sight of the subjective perception of sleep and individual differences, leading to an over-reliance on data rather than a comprehensive understanding of my health.

Through a self-tracking experiment on sleep quality, I explored the far-reaching effects of integrating technology with personal health management. This experiment not only validated the positive effects of evening exercise on improving sleep depth and duration but also deepened my understanding of the concepts of quantified self and biomedicalization. (Neff & Nafus, 2016, p.31) Although I encountered missing and interfering data during the tracking process, these helped me to reflect. Through the accurate monitoring of the Apple Watch, data organization in Excel, and visual analysis in Python, I learned how to decipher the quality of life from numbers, while also recognizing the importance of maintaining a personal subjective perception during digital lifestyle trends. This journey of discovery highlights self-tracking as a powerful tool for self-awareness and lifestyle improvement and serves as a reminder that we should not lose sight of the diversity and complexity of life in our quest for health optimization.

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About the author:

Jue Wang (Aug,2000), Female, Han nationality, Jiangyin, Jiangsu, China, Education: bachelor of science, SUID:909125539, Unit: Syracuse University, Research Direction: Applied Data Analysis, E-mail: jwang144@outlook.com, Postal Code of the USA: 13202