Impact of a frailty prevention package using esports on mental health of elderly individuals

Masashi Yoshitake (Faculty of Health Sciences, Kinjo University, yositake@kinjo.ac.jp, Japan)
Kaori Sato (Faculty of Health Sciences, Kinjo University, satokao@kinjo.ac.jp, Japan)
Naoki Sakano (Faculty of Health Sciences, Kinjo University, nsakano@kinjo.ac.jp, Japan)
Keisuke Machino (Faculty of Health Sciences, Kinjo University, machino@kinjo.ac.jp, Japan)
Aoi Hattori (Faculty of Health Sciences, Kinjo University, h2110018@g.kinjo.ac.jp, Japan)
Tsutomu Kibayashi (Faculty of Health Sciences, Kinjo University, kiba@kinjo.ac.jp, Japan)

e スポーツを使用した介護予防パッケージが高齢者のメンタルヘルスに与える影響

吉武 将司（金城大学 医療健康学部）
佐藤 香緒里（金城大学 医療健康学部）
酒野 直樹（金城大学 医療健康学部）
町野 圭亮（金城大学 医療健康学部）
服部 葵（金城大学 医療健康学部）
木林 勉（金城大学 医療健康学部）

要約

介護予防方法の１つとして、e スポーツが注目されている。e スポーツによる認知機能の改善効果が報告されてきているが、高齢者のメンタルヘルスに与える影響についての報告はない。また、e スポーツを介護予防として導入するにあたり、オーバーユースの問題や、やり方がわからない、継続できないなどの問題が生じている。そこで、本学では、e スポーツを使用した介護予防プログラムを作成し活動を行っている。このプログラムは、学生との交流を主体に行っているためメンタルヘルスに良い影響を与えることが予想される。本研究の目的は e スポーツを使用した介護予防プログラムが高齢者のメンタルヘルスに与える影響を検証することである。対象は地域在住高齢者 25 名。対象者に対し、e スポーツを含む介護予防プログラムを実施した。その前後で、唾液アミラーゼ濃度、アンケート調査を実施し高齢者のメンタルヘルスに与える影響を検証した。その結果、プログラムの前後で唾液アミラーゼ濃度が減少しており、本プログラムは高齢者に快刺激を与えストレスを軽減させている可能性を明らかにした。今回の結果はプログラム全体を通しての効果であり、e スポーツ体験のみの効果は検証できていない。しかし、e スポーツを使用することで高齢者と学生の交流を促進することができたのではないかと考えられた。

Key words
esports, mental health, elderly individuals, multi-generational exchange, nursing care prevention

1. Introduction

In Japan, population aging is progressing quickly, and according to a September 15, 2023 estimate, the elderly population aged 65 or above numbered 36.23 million (elderly proportion: 29.1 %) (Ministry of Internal Affairs and Communications, 2023). In the future, the proportion of elderly people is expected to continue rising until it reaches a peak in 2042.

With the increase in the number of the elderly, the number of patients suffering from geriatric syndromes specific to elderly individuals, such as dementia, frailty, and sarcopenia, is increasing too, and becoming a problem (Arai, 2021). To extend healthy life expectancy, prevention of these illnesses is needed.

Various methods have been reported for frailty prevention, and electronic sports (esports) have been gathering attention as one of them (Ikeda & Sonoda, 2022). Esports is a term used to denote competitive gaming involving computers and video games as a sporting activity (Japan Sports Agency, 2019). It has been developed since the late 1990s, and has a huge impact worldwide with currently more than 100 million players all over the world (Kakei, 2017). An increasing number of reports have stated that playing esports improves cognitive functions, such as attention function, response time, memory, and dual task performance ability (Green & Bavelier, 2012; Matsuno, 2021; Toril, Reales, & Ballesteros, 2014), however there are few reports on the impact of esports on the mental health of elderly individuals.

Conversely, when playing esports for frailty prevention, factors that impair health, such as pain in the hands and back due to overuse, eye fatigue, and physiological stress factors, have been reported (Emara, Ng, Cruickshank, Kampert, Piuzzi, Schaffer, & King, 2020; Loh & Muraki, 2015). Therefore, care is needed when introducing esports to elderly individuals in a state of increased vulnerability. In addition, when introducing esports for

frailty prevention in elderly individuals, there may be problems such as not knowing how to play esports in the first place, and not being able to continue playing after they have started.

In order to eliminate these problems and use esports for frailty prevention, Kinjo University has been conducting K-CUBE (Kinjo-Cognitive Upkeep By Esports) activities since 2022. At K-CUBE, students aspiring to become future healthcare professionals collaborate with faculty possessing medical knowledge to implement a program incorporating warm-up exercises to prevent overuse injuries. Additionally, the program is designed to be experiential and easily sustainable by fostering interaction with students.

In the K-CUBE frailty prevention program, management and daily scheduling are mainly carried out by students. Care is taken to ensure that interaction between elderly individuals and students is always possible, and time for conversational exchanges is also set at the end of the program. For elderly individuals, the engagement with young people affects their sense of purpose (Choi, 2021), so it may have a good impact on their mental health, such as prevention and support for social withdrawal, as well as prevention of mental frailty. Therefore, this study was conducted to verify the impact of frailty prevention programs including esports on the mental health of elderly individuals.

2. Methods

2.1 Procedure

Salivary amylase and stress tolerance tests as well as a questionnaire survey on esports were conducted before and after the K-CUBE frailty prevention program, and the impact of frailty prevention programs using esports on stress was examined.

2.2 Participants

The recruitment of participants for the study involved distributing informational flyers about the K-CUBE frailty prevention program and the experimental research to elderly individuals residing in the community through organizations such as the social welfare council. Individuals who received the flyers and expressed interest became eligible candidates for inclusion in the study.

The purpose and methods of this research were explained to local elderly residents who expressed interest in participating, and written consent was obtained from 25 individuals who wished to participate in the study.

2.3 Details of K-CUBE frailty prevention program

An esports experience session lasting 90 minutes each time was conducted as a frailty prevention program for elderly individuals.

The program contents included: (1) vital signs measurement, (2) warm-up (10 minutes), (3) esports experience (50 minutes), (4) cooling down, (5) conversational exchange with students, and (6) vital signs measurement (Figure 1).

- Vital signs measurement ((1) and (6))
  To confirm physical condition, the blood pressure and pulse were measured before and after the program to confirm that there was no abnormality.
- Warming up and cooling down ((2) and (4))
  Exercises that take into consideration overuse, which tends to be caused by esports, were performed.
- Esports experience ((3))
  Nintendo Switch (Nintendo, Kyoto) was used. “Taiko Drum Master”, “Mario Kart 8 Deluxe” and “Nintendo Switch Sports” were played. All the games selected this time contained elements of multi-tasking, where players would not only operate the controller with fingers, but also hold drumsticks and hit the *taiko* drum to the rhythm using arms, or in golf, move the body as if swinging a real golf club.
- Conversational exchange with students ((5))
  Groups were formed with students of Kinjo University, and multi-generational exchanges were performed as they com-

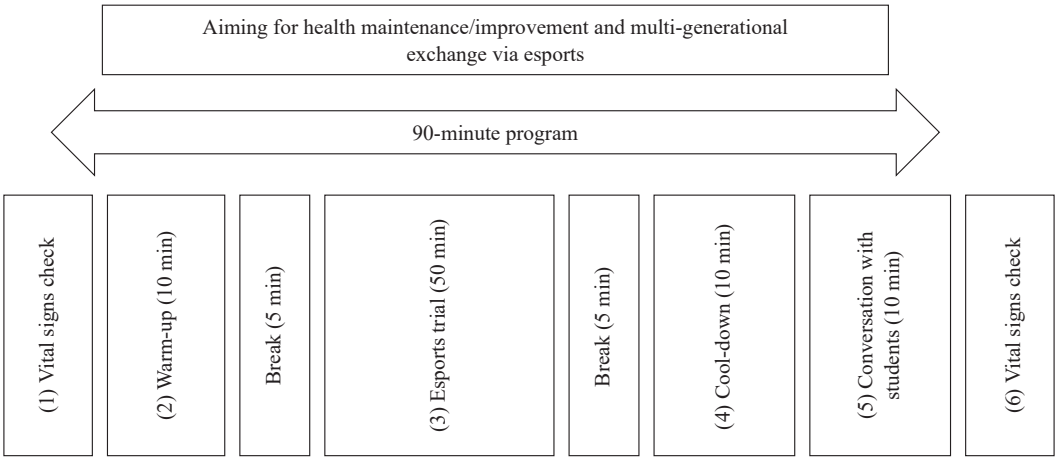

Figure 1: Program contents

municated thoughts about the esports experience.

2.4 Evaluation

Assessments were conducted before and after the K-CUBE frailty prevention program. The assessments were carried out in the following order: salivary amylase measurement, stress resilience test, and questionnaire survey. The post-program evaluation took place after completing the final vital signs measurement, following a few minutes of rest.

2.4.1 Salivary amylase

Salivary amylase concentration was measured using a salivary amylase monitor (Nipro, Osaka), and changes in stress levels before and after the implementation of the K-CUBE program were investigated.

Measurement was conducted by leaving a saliva collection sheet under the subjects' tongue for saliva collection. Originally, the saliva collection sheet is to be left for 30 seconds, but because the saliva secretion amount decreases in elderly individuals (Hasegawa, Tokudome, Susaki, Ito, Yasutomo, Fujiki, & Yuda, 2022), it was left for two minutes to collect sufficient saliva. To minimize influences other than the program, it was confirmed that participants had not consumed food or beverages within 60 minutes before the program. To eliminate physical stress, participants sat in a chair with a backrest, and measurements were taken in a resting state. Salivary amylase increases with the increase in stress. It is highly sensitive, making it possible to distinguish between pleasure and displeasure, and it is said to be particularly effective for acute stress evaluation (Nakano & Yamaguchi, 2011).

2.4.2 Stress tolerance test

The stress tolerance levels of the participants were measured using a stress tolerance test, conducted via a questionnaire. The subjects were required to answer "rarely," "sometimes," "often," or "always" to 20 questions. In the stress tolerance test, the highest score is 80 points, and 50 points or above is determined as high stress tolerance, 40–49 points indicate neutrality, and less than 40 points is determined as low stress tolerance (Oritsu, Murakami, Katsura, & Nozaki, 1996).

2.4.3 Questionnaire survey on esports

A questionnaire was created and the participants were asked on three aspects: their experience with esports, their impressions of today's program, and their desire to play esports again in the future. For impressions, participants were requested to choose from the following options: "very enjoyable," "quite enjoyable," "average," "not very enjoyable," or "not enjoyable at all." Regarding the desire to participate in future esports activities, responses were collected on a scale of "very much want to," "somewhat want to," "neutral," "not very interested," and "not interested at all."

2.4.4 Statistical processing

JMP14 (SAS Institute Inc, Cary, NC) was used for statistical processing. The Wilcoxon rank-sum test was performed for a before and after comparison of salivary amylase.

In addition, this study was conducted with the approval of the Research Ethics Committee of Kinjo University (No. 2023-04).

3. Results

3.1 Changes in salivary amylase level

Figure 2 shows the changes in the salivary amylase levels before and after the program. When salivary amylase levels before and after the program were compared, it was found that they significantly decreased after the program ($p < 0.05$).

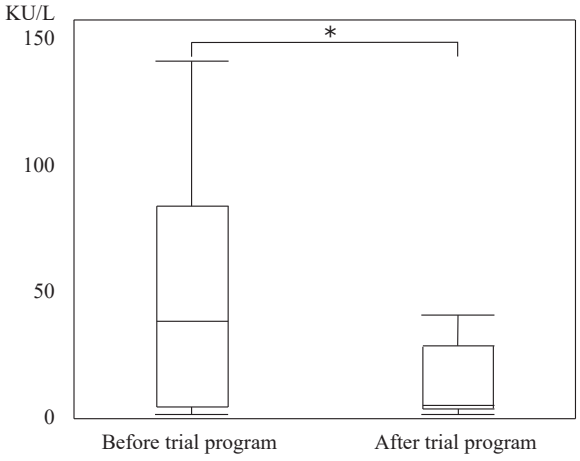

Figure 2: Changes in salivary amylase levels
Note: $N = 25$, * $p < 0.05$.

3.2 Stress tolerance test

The median total score of the stress tolerance test was 63 points (minimum score: 38 points, maximum score: 75 points). Out of the participants, 22 were determined as having high stress tolerance, 2 were determined to be in neither category, and 1 was determined as having low stress tolerance.

3.3 Results of the questionnaire on esports

Out of the 25 participants, while 6 (24 %) had prior experience of playing esports, it was the first esports experience for many. In addition, in this session, 24 (96 %) answered that it was "very enjoyable," or it was "quite enjoyable," and 23 (92 %) answered that they "very much want to" play esports again if they had an opportunity in the future.

4. Discussion

It was thought that the participants in this study were relatively stress tolerant, with only one participant scoring less than 40 points and therefore determined as having low stress tolerance, as shown in the results of the stress tolerance test. As an

indicator of stress, salivary amylase was measured before and after the esports frailty prevention program, and it was found to have significantly decreased. As salivary amylase decreases with pleasant stimulation, and increases with unpleasant stimulation, it can be used to distinguish between pleasure and displeasure, and is used in the evaluation of stress (Yamaguchi, Kanamori, Kanamaru, Mizuno, & Yoshida, 2001). In this study, it was clarified that the activities of K-CUBE, a frailty prevention program using esports, may be able to provide pleasant stimulation to participating elderly individuals, and relieve their stress.

It is said that elderly individuals generally have a strong tendency to be conservative and have difficulty learning new things, and thus feel anxious when experiencing something for the first time, or doing something they are not used to, which increases their stress. This time, out of the elderly individuals who experienced esports, while 24 % of all participants had experienced esports before, it was the first esports experience for many. However, in this program, trying esports while interacting with students may have effectively provided pleasant stimulation without stress.

Even though some elderly individuals who have never experienced esports before may have a negative impression towards esports (Ando, 2003), in the program, almost all participants felt that it was fun, and thought that they would like to play it again if they had the opportunity in the future. Therefore, it was thought that this program may be able to provide pleasant stimulation to elderly individuals from a subjective point of view.

This esports frailty prevention program may be able to relieve stress in elderly individuals, and exert a positive impact on their mental health. It is said that when stress increases due to continuous unpleasant stimulation, people are susceptible to depression (Hammen, 2005). In addition, developing depression in old age is a risk factor for Alzheimer's disease or dementia (Takeda, 2010). It has been reported that esports experience increases blood flow in the brain, and it is expected to prevent cognitive decline (Green & Bavelier, 2012; Matsuno, 2021; Toril et al., 2014). Since it can provide pleasant stimulation to elderly individuals, it may be able to promote mental health as well.

In recent years, it has been verified that esports have various effects for frailty prevention. However, there are problems such as difficulties in introduction, continuation, and overuse. Therefore, playing esports, as a frailty prevention package program focusing on interactions with students, resolves these problems, and it is possible to implement frailty prevention using esports more effectively.

As a limitation of this study, it should be noted that we are verifying the effects of the packaged program, and thus, we have not examined the effects solely attributable to the experience of esports. Therefore, it is not possible to conclusively determine whether the results obtained in this study are specifically due to the use of esports. However, as esports is a tool that promotes multi-generational exchange (Ikeda & Sonoda, 2022), using esports could at least have promoted exchanges between elderly individuals and students. In addition, as this package program contained elements of exercise, multi-tasking and social exchange, it is considered necessary to perform multi-faceted evaluations on physical function and sociality, and examine the effects on frailty prevention in the future.

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References

Ando, R. (2003). Book review "The fear of game brain." *Simulation & Gaming*, 13 (1), 70-71. (in Japanese)

Arai, H. (2021). Frailty and sarcopenia. *The Japanese Journal of Clinical and Experimental Medicine*, 98 (4), 464-470. (in Japanese)

Choi, E. (2021). A study on the impact of community activities involving engagement with children and young people on older individuals' sense of purpose, and support for them: from a generativity perspective. *Thesis for Nihon Fukushi University Graduate School of Social Well-Being and Development (Doctorate Program)*. (in Japanese)

Emara, A. K., Ng, M. K., Cruickshank, J. A., Kampert, M. W., Piuzzi, N. S., Schaffer, J. L., & King, D. (2020). Gamer's health guide: Optimizing performance, recognizing hazards, and promoting wellness in esports. *Current Sports Medicine Reports*, 19 (12), 537-545.

Green, C. S. & Bavelier, D. (2012). Learning, attentional control, and action video games. *Current Biology*, 22 (6), 197-206.

Hammen, C. (2005). Stress and depression. *Annual Review of Clinical Psychology*, 1, 293-319.

Hasegawa, S., Tokudome, Y., Susaki, H., Ito, Y., Yasutomo, Y., Fujiki, R., & Yuda K. (2022). Relationship between saliva secretion volume and oral function, psychological status and eating habits in community elderly. *Tokai Journal of Public Health*, 10 (1), 126-135. (in Japanese)

Ikeda, R. & Sonoda, D. (2022). Frailty prevention in the new era utilizing esports. *Physical Therapy Toyama*, 34, 15-20. (in Japanese)

Japan Sports Agency (2019). About esports (Retrieved December 1, 2023 from https://www.mext.go.jp/sports/content/1412226_010.pdf). (in Japanese)

Kakei, S. (2017). Potentials of esports. *CUC View & Vision*, 43, 16-20.

Loh, P. Y. & Muraki, S. (2015). Effect of wrist angle on median nerve appearance at the proximal carpal tunnel. *PLoS One*, 10 (2), e0117930.

Matsuno, S. (2021). Questionnaire survey on brain training using game consoles in older individuals requiring long-term

care. *Physical Therapy Science*, 36 (4), 521-525. (in Japanese)

Ministry of Internal Affairs and Communications (2023). Elderly individuals in Japan viewed through statistics (Retrieved October 1, 2023 from https://www.stat.go.jp/data/topics/pdf/topics138.pdf). (in Japanese)

Nakano, A. & Yamaguchi, M. (2011). Evaluation of stress by salivary amylase. *Japanese Journal of Biofeedback Research*, 38 (1), 3-9. (in Japanese)

Oritsu, M., Murakami, M., Katsura, D., & Nozaki S. (1996). Examination of stress tolerance level checklist (1st report). *Japanese Journal of Psychosomatic Medicine*, 36 (6), 490-496. (in Japanese)

Takeda, M. (2010). Perspectives on geriatric syndromes. Depression in elderly individuals. *Japanese Journal of Geriatrics*, 47 (5), 399-402. (in Japanese)

Toril, P., Reales, J. M., & Ballesteros, S. (2014). Video game training enhances cognition of older adults: A meta-analytic study. *Psychology and Aging*, 29 (3), 706-716.

Yamaguchi, M., Kanamori, T., Kanamaru, M., Mizuno, Y., & Yoshida, H. (2001). Can salivary amylase activity be an indicator in stress estimation? *Journal of Japanese Society for Medical and Biological Engineering*, 15 (9), 234-239. (in Japanese)

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