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Contribution of playtime, sedentary behavior, and physical activity to body mass index of e-sports players

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ABSTRACT

Purpose of the study: to determine whether playtime, sedentary behavior, and physical activity contribute to the body mass index of e-sports players.

Methods. The sampling technique in this study used non-probability sampling with an accidental sampling method. The total sample in this study amounted to 386 people, who are e-sports players from Indonesia. The data analysis used Kolmogorov-Smirnov method to determine data normality, correlation test used Spearman's rho, and ordinal regression was used to determine the contribution of independent variables related to the dependent variable.

Results. The correlation test results indicate that playtime is not significantly associated with body mass index (BMI) among e-sports players (p = 0.062). However, sedentary behavior shows a significant correlation with BMI (p = 0.018), suggesting that sedentary behavior may contribute to BMI variations. Furthermore, sedentary behavior accounts for only a small proportion of the variance in BMI, with a contribution of R^2 = 0.009. In contrast, physical activity does not exhibit a significant relationship with BMI (p = 0.824).

Conclusion: based on the results, there is correlation between sedentary behavior and BMI, while playtime and physical activity have no correlation to the body mass index of e-sports players.

Keywords: playtime, sedentary behavior, physical activity, body mass index, e-sports

Влияние игрового времени, сидячего образа жизни и физической активности на индекс массы тела киберспортсменов

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АННОТАЦИЯ

Цель исследования: определить, влияют ли игровое время, малоподвижный образ жизни и физическая активность на индекс массы тела игроков в киберспорт.

Материалы и методы. В качестве метода отбора участников в данном исследовании использовалась невероятностная выборка со случайным методом отбора. Общая выборка в данном исследовании составила 386 человек, которые являются игроками киберспорта из Индонезии. При анализе данных использовался метод Колмогорова—Смирнова для определения нормальности данных, коэффициент ранговой корреляции Спирмена для определения корреляции и порядковая регрессия была использована для определения вклада независимых переменных в зависимую переменную.

Результаты корреляционного теста показывают, что время игры не имеет значительной связи с индексом массы тела (ИМТ) среди игроков в киберспорт ($p = 0,062$). При этом сидячий образ жизни демонстрирует значительную связь с ИМТ ($p = 0,018$), что позволяет предположить, что малоподвижный образ жизни может способствовать изменению ИМТ. Более того, малоподвижный образ жизни объясняет лишь небольшую часть дисперсии ИМТ ($R^2 = 0,009$). Было обнаружено, что наличие физической активности и ИМТ не связаны ($p = 0,824$).

Выводы: исходя из полученных результатов, существует взаимосвязь между малоподвижным образом жизни и ИМТ, в то время как время игровое время и уровень физической активности не имеют взаимосвязи с индексом массы тела игроков в киберспорт.

Ключевые слова: игровое время, сидячий образ жизни, физическая активность, индекс массы тела, киберспорт

1. INTRODUCTION

Most e-sports players spend considerable time being sedentary, primarily due to high screen time from playing. This is concerning as sedentary behavior, especially extended gaming duration is associated with increased morbidity and mortality. If left unchecked, such a lifestyle can lead to metabolic impairments, making it difficult to process fats and sugars, resulting in weight gain.

The rapid advancement of technology has also influenced the sports industry, thus creating many communities for individuals to participate in particular sports, such as recreational sports, professional interests, or a hobby [1]. Consequently, many game developers now organize national and international e-sports competitions. Another characteristic is that players tend to remain in a static position for extended periods, leading to a predominantly passive rather active lifestyle. As a result, e-sports players often engage in minimal physical activity, even outside of their gaming sessions [2]. Overweight and obesity, which are generally caused by abnormal fat accumulation, are commonly assessed by body mass index (BMI) [3]. Previous research has shown that increased gaming duration, particularly on weekends, correlates with a higher risk of obesity [4].

Excessive calorie intake during gaming combined with inadequate physical activity for energy expenditure will cause an increase in BMI. Research conducted by Subu et al. states that BMI index prevalence in adolescents who play video games has the following disctribution: underweight at 32.4 %, normal at 50.4 %, overweight at 10.4 %, and obese, which consists of 6.8 % [5].

Overweight and obesity in e-sports players are often linked to internal factors, including genetic predisposition and other habitual factors, such as an unhealthy diet, stress, and low physical activity. These factors lead to excessive accumulation of energy in the form of adipose tissue, leading to changes in the body mass index. Additionally, overweight and obesity are associated with significantly increased risk of cardiovascular disease (CVD) such as coronary artery disease and hypertension [6].

According to the "We Are Social" report, Indonesia ranks among the top three countries globally in terms of video game players, with an estimated 174.1 million active gamers. The report highlights that 94.5 % of internet users aged 16–64 in Indonesia played video games as of January 2022. Studies indicate that e-sports players exhibit sedentary behavior for an average of 4.2 hours per day during training [7–9].

In general, research related to contribution of long play time in online games, sedentary behavior, and the level of physical activity to the body mass index is still lacking, especially when looking at individuals of a young age. However,

research on the body mass index of e-sports players is very limited.

This study aims to examine the impact of online gaming duration, sedentary behavior, and physical activity levels on the body mass index (BMI) of e-sports players. The findings are expected to improve researchers' understanding and ability to develop high-quality and standardized research protocols.

2. METHODS

2.1. RESEARCH DESIGN

This study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [10]. It employs a quantitative approach using observational and cross-sectional study methods. In this design, data on the correlation between gaming duration, sedentary behavior, and physical activity with BMI in e-sports players were collected at a single time point [11].

2.2. RESEARCH VARIABLES

This study examines three independent variables: playtime, sedentary behavior, and physical activity, and one dependent variable, body mass index.

2.3. SAMPLING

Non-probability sampling was employed using an accidental sampling technique, in which e-sports players who fit the study criteria were included as participants [12].

2.4. SAMPLE CRITERIA

The inclusion criteria for this study were as follows: individuals aged 16–30 years, of any gender, classified as semi-professional, professional, or amateur players who engage in video gaming for ≥ 1 hour/day, have actively played video games for > 6 months, and are willing to participate in the study. The exclusion criteria included participants with a history of musculoskeletal injuries unrelated to gaming activities affecting the fingers, wrists, hands, elbows, shoulders, or back within < 6 months before data collection, as well as those with medical conditions that could influence the study results, such as neurological disorders (e.g., carpal tunnel syndrome, drop hand) and autoimmune diseases.

2.5. OPERATIONAL DEFINITION

Playtime refers to the length of time an individual plays video games in a single session. The variable uses the instrument Classification of gameplay duration, according to Manita et al. The instrument has the following interpretation: Low: < 3 hours/day; Medium: 3–7 hours/day; Long: > 7 hours/day [13].

Sedentary behavior is an activity that refers to any activity carried out outside of sleep time, with minimal calorie output characteristics, namely < 1.5 METs [14]. This study utilized the Sedentary Behavior Questionnaire (SBQ) to assess the time spent on nine sedentary activities, such as watching television, gaming, sitting while listening to music, talking on the phone, performing office work, reading, playing a musical instrument, engaging in crafts, and traveling by car, bus, or train. The SBQ categorizes sedentary behavior as low (< 16 hours) or high (> 16 hours) [15, 16].

Physical activity is any body movement produced by skeletal muscles that requires energy expenditure [7]. This variable was measured using the Godin Leisure Time Physical Activity Questionnaire.

Body Mass Index (BMI) is a standardized measure used to classify overweight and obesity based on the ratio of weight to height. To minimize bias, researchers assisted participants in completing the questionnaires and provided adapted versions for Indonesian respondents.

2.6. DATA ANALYSIS

The data was processed using the IBM SPSS 24 and analyzed through several stages, including univariate, bivariate, and ordinal regression analysis.

2.7. ETHICAL CLEARANCE

This research has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences, Muhammadiyah University of Surakarta, with No.644/KEPK-FIK/XI/2024.

3. RESULT

The descriptive characteristics of the respondents are summarized in Table 1. There is a significant age difference, most respondents are aged 16–20 years (46.9 %, $n = 284$). Regarding e-sport participation, the majority of respondents were amateurs (71.2 %, $n = 275$). There are reports related to the duration of professional engagement of respondents who play for ≥ 5 years with the number of respondents (52.1 %, $n = 201$). A notable proportion of players had been professionally engaged in e-sports for ≥ 5 years (52.1 %, $n = 201$). The most commonly used gaming device was mobile devices (84.7 %, $n = 327$). In terms of gender distribution, males (68.9 %, $n = 266$) outnumbered females (31.1 %, $n = 120$).

Playtime for most respondents was in the light category (1–3 hours) at 49.8 % ($n = 192$), with an average playtime of 2 hours/day. The majority had high physical activity levels (60.4 %, $n = 231$). However, sedentary behavior was notably high among respondents (79.2 %, $n = 300$), averaging 26 hours/week across weekdays and weekends. The Body Mass Index (BMI) of most respondents fell within the normal/ideal category (43.7 %, $n = 169$).

The Spearman's rho correlation test showed that sedentary behavior ($p < 0.05$) correlated with BMI, whereas game playtime and physical activity ($p > 0.05$) did not. The r-value analysis revealed that sedentary behavior (0.121) had a moderate correlation with BMI, while playtime (0.095) and physical activity (0.011) had weak or no correlation with BMI.

Ordinal regression analysis indicated that sedentary behavior contributed 0.9 % to BMI, with an insignificant effect ($p > 0.05$), suggesting that other unaccounted variables influence 99.1 % of BMI variations.

4. DISCUSSION

This study examined the correlation of video game playtime, physical activity and sedentary behavior to the body mass index of e-sports players. The findings confirm that sedentary behavior correlates with BMI, while gameplay duration and physical activity do not [17].

In this study, e-sports players often exhibit **sedentary behavior**, playing in seated or reclined positions for extended periods, which can adversely impact health. Low physical activity levels are associated with negative physiological effects, particularly on the sympathetic and parasympathetic nervous systems. This aligns with studies indicating that sedentary lifestyles are linked to a decreased quality of life due to adverse effects on physical and mental health [18]. In a study reporting e-sports physical activity, 90 % of e-sports game players only did physical activity for an average of one hour per day [19]. This is in line with research conducted by Goldfield et al. Games may have unique features that encourage gamers to continue playing for long periods, increasing the total time spent sedentary [20].

The study by Juhász et al. found that weight management through increased physical activity can prevent BMI elevation [21]. This aligns with the current study's findings, where overweight and obese e-sports players showed a low risk of BMI increase, as they reported high levels of physical activity

and an average playtime of 2.9 hours/day, which falls in the low category. Many e-sports players also engage in intense physical exercises, such as gym workouts. However, this study found no correlation between BMI and video game playtime, in contrast to other research suggesting that playing games for more than an hour daily is associated with higher rates of overweight and obesity [21, 22].

A key reason for BMI variance may be the lack of standardized gaming duration measures, as e-sports games vary in intensity. Some involve significant physical engagement, while others rely on cognitive or strategic play. Moreover, physical activity's effect on BMI may be influenced by factors such as exercise frequency and intensity. Other unexamined variables, including diet, sleep quality, and stress levels could also contribute to BMI fluctuations. This is consistent with Başoğlu et al, who found an inverse relationship between BMI and physical activity, with obese e-sports players exhibiting lower activity levels and longer sedentary periods [23].

Based on the results, there was no significant correlation between body mass index (BMI), video game playtime and physical activity due to the very small number of professional e-sports respondents and low average daily gaming duration [24]. Many e-sports players engage in high-intensity physical activities, such as gym workouts, soccer, and badminton, aligning with Giakoni–Ramírez et al. who reported that
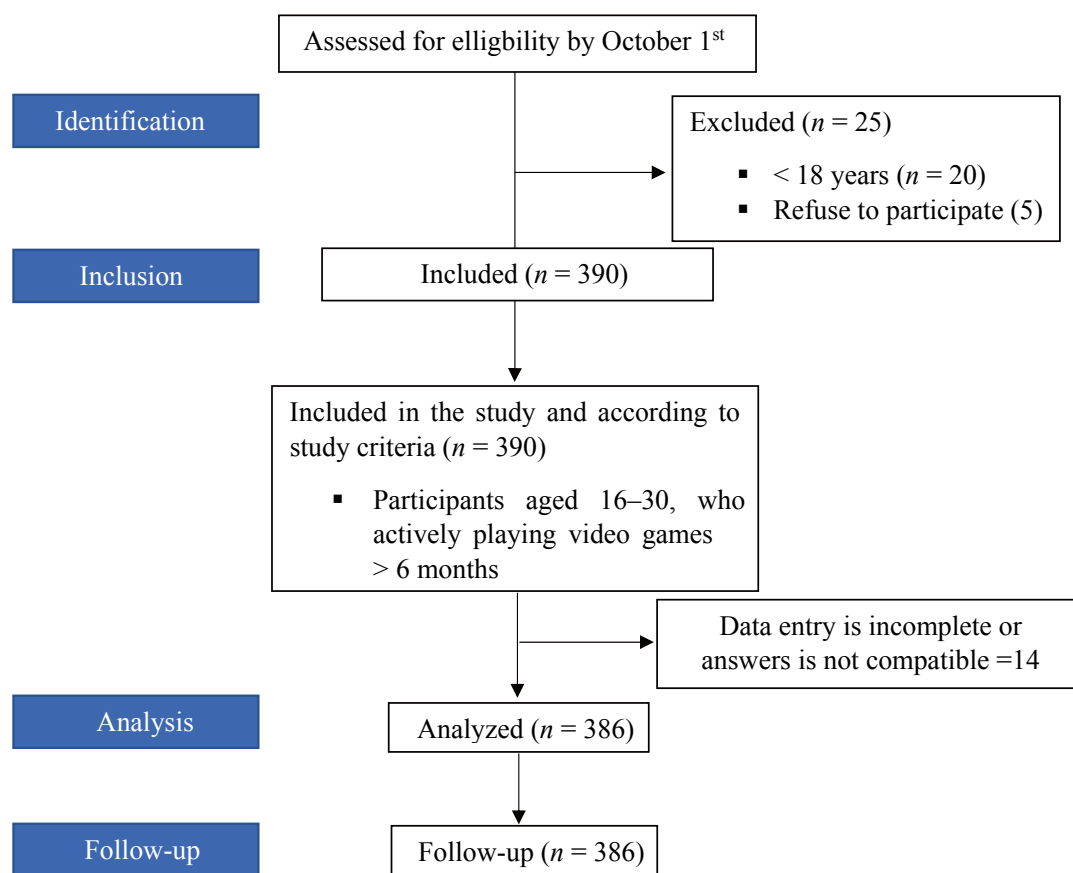

Fig. Flow Chart Diagram for research sampling.
Рис. Блок-схема выборки для исследования.

Table 1

Statistics on Demographic Characteristics of Respondents

Таблица 1

Статистика по демографическим характеристикам респондентов

Variable	Category	*n*	(%)	Minimum	Maximum	Median	Mean	SD
Age	16–20	284	46.9	16	27	20.00	19.38	2.292
	21–23	95	24.6					
	24–27	7	10					
e-sport participation	Amateur	275	71.2	NA	NA	NA	NA	NA
	Semi-professional	87	22.5					
	Professional	24	6.2					
Duration of professional engagement	≥ 6 months	79	20.5	NA	NA	NA	NA	NA
	≥ 2 years	106	27.5					
	≥ 5 years	201	52.1					
Devices	Mobile	327	84.7	NA	NA	NA	NA	NA
	Computer	56	14.5					
	Console	3	0.8					
Gender	Male	266	68.9	NA	NA	NA	NA	NA
	Female	120	31.1					
Playtime video games (hours/day)	Low	192	49.8	1.0	15.0	3.000	2.955	1.927
	Medium	175	45.3					
	High	19	5					
PA	Less active	26	6.8	0	119	27.00	34.08	21.663
	Moderately active	129	66.8					
	Active	231	60.4					
Sedentary	Low	86	22.6	2.75	79.00	23.75	26.32	13.412
	High	300	79.2					
BMI	< 18.49	83	21.7	14.6	44.5	21.30	22.22	4.613
	18.5–22.9	169	43.7					
	23–24.9	38	9.8					
	25–29.9	76	20					
	≥ 30	20	5.8					

Note: playtime (low: < 3 hours, medium: 3–7 hours, long: > 7 hours), sedentary behavior (low: ≤ 16 hours on weekdays and weekends, high: > 16 hours on weekdays and weekends), physical activity (low: < 14, moderate: 14–24, high: > 24), BMI: Body Mass Index (underweight: < 18.49, normal or ideal: 18.5–22.9, overweight: 23–24.9, obesity I: 25–29.9, obesity II: ≥ 30), *n*: sample size, NA: not applicable SD: standard deviation.

Примечание: игровое время (низкое: < 3 часов, среднее: 3–7 часов, длительное: > 7 часов), сидячий образ жизни (низкий: ≤ 16 часов в будни и выходные, высокий: > 16 часов в будни и выходные), физическая активность (низкая: < 14, умеренная: 14–24, высокая: > 24), BMI — индекс массы тела (недостаточный вес: < 18,49, нормальный или идеальный: 18,5–22,9, избыточный вес: 23–24,9, ожирение I: 25–29,9, ожирение II: ≥ 30), *n*: размер выборки, NA — не применимо, SD — стандартное отклонение.

Table 2

Bivariate and Regression Analysis

Таблица 2

Бивариационный и регрессионный анализ

Variable independent	Spearman correlation		Ordinal regression	
	Sig (p)	*R*	Sig (*p*)	*R²*
Playtime (hours/day)	0.062	0.095		
PA	0.824	0.011		
Sedentary behavior	0.018	0.121	0.067	0.9 %

* Statistically significant at p < 0.005.
Note: *r*: correlation coefficient, PA: physical activity, *R²*: coefficient of determination.
* Статистически значимо при p < 0.005.
Примечание: *r* — коэффициент корреляции, PA — физическая активность, *R²* — коэффициент детерминации.

professional e-sports players meet or exceed international physical activity recommendations for performance enhancing. In contrast, amateur players often game for leisure or stress relief, leading to lower total gaming hours. Given these two aspects, BMI management in e-sports players remains feasible [25].

According to research conducted by Luciano et al. more than 90 % of students from first year to sixth year during the lockdown period spent more than 6 hours per day in a sitting position. Additionally, most students (52 %) fell into the 'high sitting — high active' category, which is defined as individuals who sit more than 6 hours per day and engage in physical activity with an intensity of more than 16 MET-hours per week [26]. These findings suggest that high physical activity levels are not always directly proportional to low sedentary behavior. Similarly, van der Ploeg and Hillsdon differentiated sedentary behavior from physical inactivity, noting that individuals can be both highly sedentary and moderately active. On any given day, an individual is going about their day; the individual drives to work in the morning then sits behind a computer and attends meetings all day at work. After work, however, the evening was classified into the moderately active category, as the individual ran for 30 minutes, meeting the physical activity target recommended by the World Health Organization (WHO) [27].

This study examined the correlation between body mass index (BMI), video game playtime, physical activity, and sedentary behavior in e-sports players. The results indicated that e-sports players' BMI significantly differed from the Noncommunicable diseases Risk Factor Collaboration BMI population reference data, with more players categorized as having normal weight or being overweight. A healthier BMI was associated with higher perceived physical activity (PA) levels and general health. Players ranked in the top 10 % were significantly more physically active than the other 90 % [2]. The study emphasizes the importance of exercise for obese individuals, recommending at least 150 to 300 minutes of moderate-intensity exercise per week. While there was no significant correlation between video game playtime and

physical activity with BMI, sedentary behavior was found to be correlated with BMI. Given the rapid growth of e-sports, the study suggests that the government could create policies to encourage physical activity in the e-sports community. In line with this, the establishment of Pendidikan Bakat E-Sports Indonesia (PERENASI) aims to foster e-sports athletes, providing programs that enhance both technical and physical skills while promoting a healthy, active lifestyle to combat sedentary behavior [28].

The results of this study may guide physiotherapists in treating obese patients by emphasizing lifestyle changes, such as a healthy diet and physical exercise, over medication alone.

A limitation of this study is that all variables relied on self-report. For example, it was found that individuals under-reported their weight and over-reported their height and activity levels, making the research data difficult to read. Research on the body mass index of e-sports players is still very limited. Only one study showed that the average player's body mass index (BMI) could be classified as normal [29]. In contrast, research examining the correlation between video game use and BMI status remains unclear. For example, video game players' BMI was higher than non-players [2].

For future research direction, it is recommended to use more objective and gold standard measurements so that the data received is more valid and reliable, such as for the duration of playing games can use Screen Time Tracker, for physical activity can use ActiGraph accelerometer, and for sedentary behavior can use BodyMedia FIT or can also use ActiGraph accelerometer. Additionally, stratified random sampling and studies incorporating dietary habits, stress, and sleep quality are recommended for comprehensive BMI analysis in e-sports players [30].

5. CONCLUSIONS

Based on the results, there is correlation between sedentary behavior and BMI. No significant correlation was found between video game playtime, PA, and BMI. E-sports players were suggested to benefit from shorter play durations, balancing gaming and physical activity. further research with more diverse data is needed for clearer results.

Authors' contribution:
Annya Shakty Indraprastha — conceptualization, methodology, investigation, data collection and interpretation, writing — original draft, writing — editing, visualization, project administration, and formal analysis.

Farid Rahman — conceptualization, methodology, writing — original draft, writing — editing, visualization, and project administration.

Вклад авторов:
Анния Шакти Индрапрастха — концептуализация, методология, исследование, сбор и интерпретация данных, написание — первоначальный проект, написание — редактирование, визуализация, администрирование проекта и формальный анализ.

Фарид Рахман — концептуализация, методология, написание — первоначальный проект, написание — редактирование, визуализация и администрирование проекта.

References / Литература

1. **Fahrizqi E.B., Agus R.M., Yuliandra R., Gumantan A.** The Learning Motivation and Physical Fitness of University Students During the Implementation of the New Normal COVID-19 Pandemic. JUARA: Jurnal Olahraga. 2021;6(1):88–100. https://doi.org/10.33222/juara.v6i1.1184

2. **Trotter M.G., Coulter T.J., Davis P.A., Poulus D.R., Polman R.** The association between E-sports participation, health and physical activity behavior. *Int. J. Environ. Res. Public Health.* 2020;17(19):1–14. https://doi.org/10.3390/ijerph17197329

3. **Ghosh S., Paul M., Mondal K.K., Bhattacharjee S., Bhattacharjee P.** Sedentary lifestyle with increased risk of obesity in urban adult academic professionals: an epidemiological study in West Bengal, India. *Sci. Rep.* 2023;13(1): 4895. https://doi.org/10.1038/s41598-023-31977-y

4. **Arnaez J., Frey G., Cothran D., Lion M., Chomistek A.** Physical wellness among gaming adults: Cross-Sectional study. *JMIR Serious Games.* 2018;20(6):e12. https://doi.org/10.2196/games.9571

5. **Subu M.A., Rahmawati P., Waluyo I., Agustino R.** Kecanduan Internet Gaming dan Status Body Mass Index (BMI) Pada Remaja Tingkat Sekolah Menengah Pertama Tahun 2018. *Jurnal Ilmu dan Teknologi Kesehatan.* 2019;6(2):167–174. https://doi.org/10.32668/jitek.v6i2.182

6. **Khan S.S., Ning H., Wilkins J.T., Allen N., Carnethon M., Berry J.D., et al.** Association of body mass index with lifetime risk of cardiovascular disease and compression of morbidity. *JAMA Cardiol.* 2018;3(4):280–287. https://doi.org/10.1001/jamacardio.2018.0022

7. World Health Organization (WHO). Physical Activity [internet]; 2024. Available at: https://www.who.int/news-room/fact-sheets/detail/physical-activity (accessed 18 July 2024).

8. **Lam W.K., Chen B., Liu R.T., Cheung J.C.**W., **Wong D.W.C.** Spine Posture, Mobility, and Stability of Top Mobile E-sports Athletes: A Case Series. *Biology (Basel).* 2022;11(5):737. https://doi.org/10.3390/biology11050737

9. CNBS Indonesia. Legenda e-Sports China Ini Pensiun di Usia 23 Tahun, Kenapa? [internet]; 2020 June 5. Available at: https://www.cnbcindonesia.com/tech/20200605103319-37-163269/legenda-e-sports-china-ini-pensiun-di-usia-23-tahun-kenapa#:~:text=Alasannya%20mengundurkan%20diri%20karena%20masalah,5%2F6%2F2020) (accessed 19 December 2024).

10. **Cuschieri S.** The STROBE guidelines. *Saudi J. Anaesth.* 2019;13(5):S31–S34. https://doi.org/10.4103/sja.SJA_543_18

11. **Abduh M., Alawiyah T., Apriansyah G., Sirodj R.A., Afgani M.W.** Survey Design: Cross Sectional dalam Penelitian Kualitatif. Jurnal Pendidikan Sains dan Komputer. 2022;3(01):31–39. https://doi.org/10.47709/jpsk.v3i01.1955

12. **Jalil A., Hamzah S.A.** Pengaruh Bagi Hasil Dan Kebutuhan Modal Terhadap Minat Umkm Mengajukan Pembiayaan Pada Lembaga Keuangan Syariah Di Kota Palu. *Jurnal Ilmu Perbankan dan Keuangan Syariah.* 2020;2(2):178–198. https://doi.org/10.24239/jipsya.v2i2.31.177-197

13. **Manita Y.A., Rahayu C.D., Setyawati A., Alviana F., Purnamasari I.** Hubungan Durasi Bermain Game Online Dengan Kualitas Tidur Pada Remaja Dalam Tinjauan Qs Arrum: 23. *Jurnal Ilmiah Kesehatan.* 2023;13(2). https://doi.org/10.32699/jik.v13i2.5897

14. P2PTM Kemenkes RI. Yuk, mengenal apa itu Kegiatan Sedentari? [internet]; 2019. Available at: https://p2ptm.kemkes.go.id/infographic-p2ptm/obesitas/yuk-mengenal-apa-itu-kegiatan-sedentari (accessed 25 July 2024).

15. **Rahma Wijaya N., Irawati D.** Hubungan Self Care Dan Sedentary Lifestyle Dengan Kejadian Hipertensi Di Wilayah Puskesmas Kecamatan Cakung Jakarta Timur Tahun 2021; Universitas Muhammadiyah Jakarta. Ссылка: https://lib.fikumj.ac.id/index.php?p=fstream-pdf&fid=23137&bid=6065

16. **Rosenberg D.E., Norman G.J., Wagner N., Patrick K., Calfas K.J., Sallis J.F.** Reliability and Validity of the Sedentary Behavior Questionnaire (SBQ) for Adults. *J. Phys. Act Health.* 2010;7(6):697–705. https://doi.org/10.1123/jpah.7.6.697

17. **Shafa F.S.** Hubungan Tingkat Aktivitas Fisik dan Perilaku Sedenter terhadap Indeks Massa Tubuh, Persentase Lemak Tubuh, dan Level Lemak Viseral Pada Mahasiswa yang Mengikuti Perkuliahan Sistem Blok [Skripsi thesis]. Universitas Hasanuddin; 2021.

18. **Setyoadi S., Rini I.S., Novitasari T.** Hubungan penggunaan waktu perilaku kurang gerak (sedentary behaviour) dengan obesitas pada anak usia 9-11 tahun di sd negeri beji 02 kabupaten tulungagung. Journal of Nursing Science Update (JNSU). 2015;3(2):155–167.

19. **Lam W.K., Liu R.T., Chen B., Huang X.Z., Yi J., Wong D.W.C.** Health Risks and Musculoskeletal Problems of Elite Mobile E-sports Players: a Cross-Sectional Descriptive Study. *Sports Med. Open.* 2022;8(1):65. https://doi.org/10.1186/s40798-022-00458-3

20. **Goldfield G.S., Kenny G.P., Hadjiyannakis S., Phillips P., Alberga A.S., Saunders T.J., et al.** Video game playing is independently associated with blood pressure and lipids in overweight and obese adolescents. *PLoS One.* 2011;6(11):e26643. https://doi.org/10.1371/journal.pone.0026643

21. **Juhász M., Paulik E., Horváth E.** Sedentary lifestyle, concomitant with video game playing, is reflected in the gamers' body weights: A study from Hungary. *J. Gambl. Issues* [internet]. 2023. https://doi.org/10.4309/JVER2753

22. **Apor P., Babai L.** A fizikai aktivitás lassítja az öregedéssel járó teljesítőképesség-romlást. *Orv. Hetil.* 2014;155(21):817–821. https://doi.org/10.1556/OH.2014.29838

23. **Başoğlu B.** Comparison of body mass index and physical activity levels of e-sportsmen. *Front. Public Health.* 2025;13. https://doi.org/10.3389/fpubh.2025.1557022

24. **Canale N., Marino C., Griffiths M.D., Scacchi L., Monaci M.G., Vieno A.** The association between problematic online gaming and perceived stress: The moderating effect of psychological resilience. *J. Behav. Addict.* 2019;8(1):174–180. https://doi.org/10.1556/2006.8.2019.01

25. **Giakoni-Ramírez F., Merellano-Navarro E., Duclos-Bastías D.** Professional E-sports Players: Motivation and Physical Activity Levels. *Int. J. Environ. Re.s Public Health.* 2022;19(4):2256. https://doi.org/10.3390/ijerph19042256

26. **Luciano F., Cenacchi V., Vegro V., Pavei G.** COVID-19 lockdown: Physical activity, sedentary behavior and sleep in Italian medicine students. *Eur. J. Sport Sci.* 2021;21(10):1459–1468. https://doi.org/10.1080/17461391.2020.1842910

27. **van der Ploeg H.P., Hillsdon M.** Is sedentary behavior just physical inactivity by another name? *Int. J. Behav. Nutr. Phys. Act.* 2017;14(1):142. https://doi.org/10.1186/s12966-017-0601-0

28. Persatuan E-sports Nasional Indonesia (PERENASI) [internet]. Available at: https://perenasi.id/

29. **Rudolf K., Bickmann P., Froböse I., Tholl C., Wechsler K., Grieben C.** Demographics and Health Behavior of Video Game and E-sports Players in Germany: The E-sports Study 2019. *Int. J. Environ. Res. Public Health.* 2020;17(6):1870. https://doi.org/10.3390/ijerph17061870

30. **Hope B.** How often should you practice games? [internet]; 2022 January 10. Available at: https://britishE-sports.org/the-hub/advice/how-often-should-you-practice-games/ (accessed 17 December 2024).

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