Article
Changes in Physical Fitness among Elementary and Middle School Students in Korea before and after COVID-19

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Abstract: The present study aimed to analyze changes in health-related physical fitness among Korean elementary and middle school students before (2019) and after (2021) the COVID-19 pandemic. Data collection was completed by requesting the physical activity promotion system (PAPS) data from elementary and middle school students. This information is obtained annually by the Goyang Office of Education in Gyeonggi-do, Korea. The collected data were measured in 2019 and 2021. Data were collected from 17,000 children in the fifth and sixth grades of elementary school and about 24,000 boys and girls in the first, second, and third grades of middle school. Chi-square analyses were used to examine data from each school’s health-related physical fitness examinations. Our results indicated that physical fitness levels were significantly lower in 2021 than in 2019 across the following six areas: cardiorespiratory endurance, power, muscular strength, flexibility, obesity, and overall health-related physical fitness (p < 0.05). In addition, the ratio of students with excellent physical fitness (PAPS Grades 1 and 2) significantly decreased from 2019 to 2021, while the ratio of students with poor physical fitness (PAPS Grades 3, 4, and 5) increased (p < 0.05). In addition, there were some differences according to grade and gender. Discussions regarding the impact of decreases in physical activity on physical fitness, interpretations of physical fitness in the context of a pandemic, and practical measures that can be implemented to improve health and fitness among children and adolescents in such situations remain essential.

Keywords: COVID-19; elementary school students; middle school students; physical activity; physical activity promotion system

1. Introduction
The COVID-19 pandemic altered many aspects of daily life. In particular, decreases in physical activity during the pandemic exerted a significant impact on respiratory, cardiovascular, and musculoskeletal health [1]. While such changes critically impacted adults, they equally affected elementary and middle school students. Notably, face-to-face physical education classes were discontinued in favor of online classes to ensure adherence to social distancing measures and prevent the spread of COVID-19 [2,3].

Analyzing 29 studies related to various physical activities during the COVID-19 pandemic, Polero et al. [4] reported a lack of evidence upon which to base guidelines for exercise or adapt physical education within the context of COVID-19. The American College of Sports Medicine recommends at least 30 min of vigorous exercise at least five days a week [5]. This has been practically impossible during the COVID-19 pandemic, given the restrictions and prohibitions on outdoor activities in 2020 and 2021. Various studies conducted in Korea, Spain, and the United States have reported that both adults and adolescents have faced difficulty engaging in outdoor physical activities during the...
pandemic, and overall levels of physical activity have decreased given the difficulty of engaging in physical activity at home [4,6,7].

Physical activity during adolescence plays a key role in shaping a healthy lifestyle, thus providing important contributions to current and future mental and physical health [8–10]. Despite the importance of physical education in promoting health maintenance during adolescence, interruptions in physical education have been difficult to prevent during COVID-19. Research has demonstrated that students’ physical fitness levels decreased during the pandemic [11–14]. Specifically, a study on physical fitness changes in the midst of the COVID-19 situation was conducted on students in Japan, China, and Austria. Most students reported that their physical fitness levels were decreasing [15–18]. Moreover, various studies have examined educational, in addition to physical, aspects that have changed because of the COVID-19 situation. Kamila and Mróz [18] reported that Polish university students continued to feel anxiety and uncertainty and had difficulty learning at home through remote classes and organizing what they learned, as assessed by taking tests. Asanov et al. [19] surveyed 1500 high school students in Ecuador concerning how much they participated in distance learning during the COVID-19 pandemic. More than 74% of the students participated in distance learning, but students who faced social isolation experienced increased depression. Sait and Guveli [20] found that families receiving free meals, single-parent families, and homes with parents who had limited education in the UK spent much less time studying at home. Further, they reported that students should have time to study through offline and online remote classes. As such, many studies have examined how to operate students’ remote education in the context of COVID-19, in addition to assessing the severity of the current situation and how to return to more traditional forms of education after the COVID-19 situation is over [21–23].

Based on previous studies, various educational and psychological problems have been found, in addition to the loss of physical activity among elementary and middle school students in the COVID-19 situation. Studies [4,12] have shown that physical fitness levels have decreased, but how physical fitness levels have specifically changed has not been examined. Nor have there been any large-scale studies on elementary and middle school students. Considering this gap in the existing research, this study attempted to analyze changes in health-related physical fitness before and after the COVID-19 pandemic for elementary and middle school students in Korea using data obtained through the physical fitness promotion system (PAPS). Since 2010, all public and private schools in Korea have participated in the PAPS, which aims to evaluate physical fitness and provide exercise-related guidance to elementary, middle, and high school students based on assessments of physical factors such as power, flexibility, cardiorespiratory endurance, muscle endurance, and body composition [24,25]. The impact of PAPS has been assessed by various studies. For instance, Song et al. [25] examined the effect of providing students with various exercise programs on obesity and physical fitness. Lee et al. [24] reported improvements in physical fitness at a one-year follow-up assessment when high school students were provided morning exercise programs.

The present study aimed to investigate changes in health-related physical fitness levels among elementary and middle school students following the emergence of COVID-19 (from 2019 to 2021).

2. Materials and Methods

2.1. Participants

This study utilized 2019 and 2021 data obtained from elementary (5th and 6th grades; aged 12–13 years) and middle school students (1st, 2nd, and 3rd grades of middle school; aged 14–16 years) enrolled in Goyang, Gyeonggi-do, Korea.

Elementary and middle schools in Korea are required to participate in the PAPS every year and report their results to the Korea Office of Education. These data are used to investigate students’ health and physical conditions. In this study, data were collected by requesting the yearly PAPS data from the person in charge of the Office of Education. The
collected data were from 80 elementary and 38 middle schools. About 17,000 data sets were obtained from the 5th- and 6th-grade students in 2019 and 2021, and about 24,000 data sets were obtained from students in their 1st, 2nd, and 3rd years of middle school. The students who participated in the PAPS in 2019 and 2021 were selected as study participants because complete data did not exist for 2020. Because of the severity of COVID-19, not every school measured their students’ fitness with the PAPS. It is important to note that the data collected by the Korea Office of Education does not include personal information from the students, nor is the school’s name displayed.

We obtained the relevant data after receiving approval from the Gyeonggi-do Office of Education. This study was performed in accordance with the guidelines of the Declaration of Helsinki and was approved by the Gyeonggi Provincial Office of Education (2022-02). Since personal information such as name, telephone number, social security number, and address was not collected, ethical approval was not required. The number of study participants for each assessment in 2019 and 2021 are shown in Table 1.

### Table 1. Number of study participants between 2019 and 2021.

| Grade             | Gender | Cardiorespiratory Endurance | Power | Muscular Strength | Flexibility | Obesity | Overall Health-Related Physical Fitness Score |
|-------------------|--------|------------------------------|-------|-------------------|-------------|---------|-----------------------------------------------|
| **Elementary school (5th grade)** | Boys   | 2019 4429                    | 4429  | 4429              | 4766        | 4321    | 4433                                          |
|                   |        | 2021 4716                    | 4754  | 4770              | 4429        | 4338    | 4774                                          |
|                   | Girls  | 2019 4248                    | 4250  | 4252              | 4542        | 4146    | 4257                                          |
|                   |        | 2021 4499                    | 4532  | 4543              | 4250        | 4147    | 4547                                          |
| **Elementary school (6th grade)** | Boys   | 2019 4589                    | 4569  | 4591              | 4632        | 4510    | 4601                                          |
|                   |        | 2021 4578                    | 4627  | 4635              | 4592        | 4470    | 4643                                          |
|                   | Girls  | 2019 4493                    | 4386  | 4396              | 4288        | 4335    | 4417                                          |
|                   |        | 2021 4251                    | 4289  | 4292              | 4408        | 4148    | 4299                                          |
| **Middle school (1st grade)** | Boys   | 2019 4264                    | 4200  | 4255              | 4769        | 4267    | 4277                                          |
|                   |        | 2021 4670                    | 4740  | 4721              | 4269        | 4737    | 4776                                          |
|                   | Girls  | 2019 4202                    | 4190  | 4182              | 4621        | 4199    | 4208                                          |
|                   |        | 2021 4486                    | 4589  | 4581              | 4201        | 4599    | 4634                                          |
| **Middle school (2nd grade)** | Boys   | 2019 4201                    | 4181  | 4198              | 4951        | 4165    | 4202                                          |
|                   |        | 2021 4958                    | 4942  | 4823              | 4200        | 4783    | 5066                                          |
|                   | Girls  | 2019 4085                    | 4069  | 4086              | 4755        | 4056    | 4092                                          |
|                   |        | 2021 4759                    | 4743  | 4631              | 4083        | 4587    | 4781                                          |
| **Middle school (3rd grade)** | Boys   | 2019 4671                    | 4669  | 4637              | 4509        | 4671    | 4685                                          |
|                   |        | 2021 4526                    | 4508  | 4491              | 4669        | 4519    | 4452                                          |
|                   | Girls  | 2019 4514                    | 4512  | 4481              | 4432        | 4509    | 4523                                          |
|                   |        | 2021 4447                    | 4427  | 4404              | 4509        | 4442    | 4452                                          |

#### 2.2. Assessment Variables

Five physical fitness variables were measured: cardiorespiratory endurance, power, muscular strength, flexibility, and obesity. Cardiorespiratory endurance was assessed via a shuttle run test. This test measures the number of times students make a round trip (15 m for elementary and 20 m for middle school) before the timed music runs out. Power was assessed via a standing long jump test. This test measures the distance jumped (in cm) from a standing position, without a starting run. Muscular strength was assessed based on the results of a grip strength test. Grip force is measured in kilograms for both the right and left hand using a grip machine. Level of flexibility was assessed using a sit-and-reach test. The curve was measured in cm by bending the upper body based on the baseline, which left a forward curve measured in a seated state [15]. Obesity status was determined based on body mass index, which was calculated using each participant’s height and weight [16].
Students' physical fitness levels were measured based on their overall health and physical fitness scores by adding scores in five areas. The rating criteria for each physical fitness factor were different for the young men and women in all grades, as shown in Table 2.

Table 2. Measurement standard table.

| Grade      | Gender | Shuttle Run Test (Repetitions) | Elementary School 15 m Middle School 20 m | Standing Long Jump (cm) | Hand Grip Strength (kg) | Sit and Reach (cm) | Body Mass Index (kg/m²) | Health-Related Physical Fitness (Total Score) |
|------------|--------|--------------------------------|------------------------------------------|-------------------------|------------------------|----------------------|------------------------|-----------------------------------------------|
|            |        | Grade 5                         | Grade 4                                  | Grade 3                 | Grade 2                 | Grade 1              | Grade 5                | Grade 4                          | Grade 3 | Grade 2 | Grade 1 |
| Elementary | Boys   | 28 under                        | 29–49                                    | 50–72                   | 73–99                   | 100 up               | 111 under              | 111.1–141                      | 141.1–159 | 159.1–180 | 180.1 up |
| school     | Girls  | 22 under                        | 23–44                                    | 45–62                   | 63–84                   | 85 up                | 100 under              | 100.1–123                      | 123.1–139 | 139.1–170 | 170.1 up |
| (5th grade)|        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Elementary | Boys   | 31 under                        | 32–53                                    | 54–77                   | 78–103                  | 104 up               | 122 under              | 122.1–148                      | 148.1–167 | 167.1–200 | 200.1 up |
| school     | Girls  | 24 under                        | 25–49                                    | 50–68                   | 69–92                   | 93 up                | 100 under              | 100.1–127                      | 127.1–144 | 144.1–175 | 175.1 up |
| (6th grade)|        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Middle     | Boys   | 19 under                        | 20–35                                    | 36–49                   | 50–63                   | 64 up                | 131 under              | 131.1–159                      | 159.1–177 | 177.1–211 | 211.1 up |
| school     | Girls  | 13 under                        | 14–18                                    | 19–24                   | 25–34                   | 35 up                | 100 under              | 100.1–127                      | 127.1–144 | 144.1–175 | 175.1 up |
| (1st grade)|        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Middle     | Boys   | 22 under                        | 23–37                                    | 38–51                   | 52–65                   | 66 up                | 136 under              | 136.1–169                      | 169.1–187 | 187.1–218 | 218.1 up |
| school     | Girls  | 14 under                        | 15–21                                    | 21–28                   | 29–39                   | 40 up                | 100 under              | 100.1–127                      | 127.1–145 | 145.1–183 | 183.1 up |
| (2nd grade)|        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Middle     | Boys   | 23 under                        | 24–39                                    | 40–53                   | 54–67                   | 68 up                | 145 under              | 145.1–180                      | 190.1–201 | 201.1–238 | 238.1 up |
| school     | Girls  | 15 under                        | 16–22                                    | 23–32                   | 33–44                   | 45 up                | 100 under              | 100.1–127                      | 127.1–145 | 145.1–183 | 183.1 up |
| (3rd grade)|        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Hand Grip  | Boys   | 12.4 under                      | 12.5–16.9                                | 17.0–22.9               | 23.0–30.9               | 31.0 up              | −4.1 under             | −4.0–9                         | 1.0–4.9    | 5.0–7.9   | 8.0 up   |
| Strength   | Girls  | 11.9 under                      | 12.0–15.4                                | 15.5–18.9               | 19.0–28.9               | 29.0 up              | 0 under                | 0.1–4.9                        | 5.0–9.9    | 10.0 up   | 12.0 up  |
| (kg)       |        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Sit and    | Boys   | 14.9 under                      | 15.0–18.9                                | 19.0–26.4               | 26.5–34.9               | 35.0 up              | −4.1 under             | −4.0–9                         | 1.0–4.9    | 5.0–7.9   | 8.0 up   |
| Reach (cm) | Girls  | 13.9 under                      | 14.0–18.9                                | 19.0–21.9               | 22.0–32.9               | 33.0 up              | 1.9 under              | 2.0–4.9                        | 5.0–9.9    | 10.0 up   | 12.0 up  |
| Body Mass  | Boys   | 16.4 under                      | 16.5–22.4                                | 22.5–29.9               | 30.0–41.9               | 42.0 up              | −4.1 under             | −4.0–1.9                       | 2.0–5.9    | 6.0–9.9   | 10.0 up  |
| Index (kg/ | Girls  | 13.9 under                      | 14.0–18.9                                | 19.0–22.9               | 23.0–35.9               | 36.0 up              | 1.9 under              | 2.0–7.9                        | 8.0–10.9   | 11.0–14.9 | 15.0 up  |
| m²)        |        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Health-     | Boys   | 21.9 under                      | 22.0–28.4                                | 28.5–36.9               | 37.0–44.4               | 44.5 up              | −4.1 under             | −4.0–1.9                       | 2.0–6.9    | 7.0–9.9   | 10.0 up  |
| Related    | Girls  | 13.9 under                      | 14.0–19.4                                | 19.5–25.4               | 25.5–35.9               | 36.0 up              | 1.9 under              | 2.0–7.9                        | 8.0–10.9   | 11.0–14.9 | 15.0 up  |
| Physical   |        |                                 |                                         |                        |                        |                      |                       |                                 |         |         |         |
| Fitness    | Boys   | 24.9 under                      | 25.0–32.9                                | 33.0–40.4               | 40.5–48.4               | 48.5 up              | −3.1 under             | −3.0–2.5                       | 2.6–6.9    | 7.0–9.9   | 10.0 up  |
| (Total Score) | Girls | 15.9 under                      | 16.0–19.4                                | 19.5–27.4               | 27.5–35.9               | 36.0 up              | 1.9 under              | 2.0–7.9                        | 8.0–10.9   | 11.0–15.9 | 16.0 up  |

Summary:
- Students’ physical fitness levels were measured based on their overall health and physical fitness scores by adding scores in five areas. The rating criteria for each physical fitness factor were different for the young men and women in all grades.
- Table 2 provides the measurement standard table for various fitness tests such as the Shuttle Run Test, Standing Long Jump, Hand Grip Strength, Sit and Reach, Body Mass Index, and Health-Related Physical Fitness.

Note: The table includes specific scores and measurements for shuttle run repetitions, standing long jump, hand grip strength, and sit and reach, categorized by grade and gender. The table also includes body mass index and health-related physical fitness scores.
Within each area of assessment, fitness levels were classified from Grade 1 (best) to 5 (worst). Body composition was divided into five categories: Grade 1 (normal), Grade 2 (underweight), Grade 3 (overweight), Grade 4 (mild obesity), and Grade 5 (severe obesity). An overall health-related physical fitness score was determined for each student based on the scores for each of the five assessments.

2.3. Data Processing

Data were analyzed using SPSS 18.0 (IBM Corp., Armonk, NY, USA). First, frequency analysis was conducted to examine differences according to gender, grade, and year. After classifying participants according to gender, grade, and year, chi-square analysis was performed to examine changes in cardiorespiratory endurance, power, muscular strength, flexibility, obesity, and overall health-related physical fitness from 2019 to 2021, thus representing the changes since the emergence of COVID-19. The level of statistical significance was set at 0.05.

3. Results

3.1. Cardiorespiratory Endurance

In Table 3, chi-square analysis revealed a significant difference in cardiorespiratory endurance scores between 2019 and 2021. Among elementary school students (in fifth and sixth grades) of both genders, we observed a significant reduction in the proportion of Grades 1 and 2 and a significant increase in the proportion of Grades 4 and 5. In addition, the proportion of Grades 1, 2, and 3 combined decreased among middle school students, while the proportion of Grades 3, 4, and 5 increased. In particular, rates of excellent endurance were lower among middle school boys compared with elementary school boys (middle school: first 9.1%, second 15.8%, third 19.9%) and among middle school girls compared with elementary school girls (middle school: first 14.2%, second 15.8%, third 12.3%).

Table 3. Comparison of cardiorespiratory endurance in 2019 and 2021.

| Grade        | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2$/$p$               |
|--------------|--------|---------|---------|---------|---------|---------|-------|---------------------------|
|              | Boys   | Frequency | 1190 | 1108 | 1413 | 555 | 163 | 4429 | $\chi^2 = 355.740$ |
| Elementary   | 1999   | Percentage | 26.9% | 25.0% | 31.9% | 12.5% | 3.7% | 100.0% | df = 4, p < 0.001 |
| school       | 2021   | Frequency | 775 | 980 | 1519 | 961 | 480 | 4715 | $\chi^2 = 302.505$ |
| (5th grade)  | Percentage | 16.4% | 20.8% | 32.2% | 20.4% | 10.2% | 100.0% | df = 4, p < 0.001 |

| Grade        | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2$/$p$               |
|--------------|--------|---------|---------|---------|---------|---------|-------|---------------------------|
|              | Girls  | Frequency | 1026 | 1217 | 1374 | 555 | 76 | 4248 | $\chi^2 = 254.372$ |
| Elementary   | 1999   | Percentage | 24.2% | 28.6% | 32.3% | 13.1% | 1.8% | 100.0% | df = 4, p < 0.001 |
| school       | 2021   | Frequency | 703 | 1046 | 1467 | 1047 | 236 | 4499 | $\chi^2 = 319.111$ |
| (5th grade)  | Percentage | 15.6% | 23.2% | 32.6% | 23.3% | 5.2% | 100.0% | df = 4, p < 0.001 |

| Grade        | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2$/$p$               |
|--------------|--------|---------|---------|---------|---------|---------|-------|---------------------------|
|              | Boys   | Frequency | 1209 | 1214 | 1355 | 642 | 169 | 4589 | $\chi^2 = 319.111$ |
| Elementary   | 1999   | Percentage | 26.3% | 26.5% | 29.5% | 14.0% | 3.7% | 100.0% | df = 4, p < 0.001 |
| school       | 2021   | Frequency | 814 | 952 | 1380 | 950 | 482 | 4578 | $\chi^2 = 254.372$ |
| (6th grade)  | Percentage | 17.8% | 20.8% | 30.1% | 20.8% | 10.5% | 100.0% | df = 4, p < 0.001 |

| Grade        | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2$/$p$               |
|--------------|--------|---------|---------|---------|---------|---------|-------|---------------------------|
|              | Girls  | Frequency | 1877 | 1210 | 1503 | 693 | 120 | 4403 | $\chi^2 = 319.111$ |
| Elementary   | 1999   | Percentage | 19.9% | 27.5% | 34.1% | 15.7% | 2.7% | 100.0% | df = 4, p < 0.001 |
| school       | 2021   | Frequency | 559 | 956 | 1368 | 1093 | 275 | 4251 | $\chi^2 = 254.372$ |
| (6th grade)  | Percentage | 13.1% | 22.5% | 32.2% | 25.7% | 6.5% | 100.0% | df = 4, p < 0.001 |
Table 3. Cont.

| Grade          | Gender | 2019 Frequency | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | χ²/p |
|----------------|--------|----------------|---------|---------|---------|---------|---------|-------|------|
|                | Boys   | 1081           | 799     | 1013    | 1086    | 285     | 4264    |       |      |
|                |        | Percentage     | 25.4%   | 18.7%   | 23.8%   | 25.5%   | 6.7%    | 100.0%|      |
|                |        | Frequency      | 759     | 672     | 995     | 1575    | 669     | 4670  |      |
|                |        | Percentage     | 16.3%   | 14.4%   | 21.3%   | 33.7%   | 14.3%   | 100.0%|      |
| Middle school (1st grade) | Girls | 1805           | 1097    | 794     | 346     | 160     | 4202   |       |      |
|                |        | Percentage     | 43.0%   | 26.1%   | 18.9%   | 8.2%    | 3.8%    | 100.0%|      |
|                |        | Frequency      | 1309    | 1126    | 1062    | 626     | 363     | 4486  |      |
|                |        | Percentage     | 29.2%   | 25.1%   | 23.7%   | 14.0%   | 8.1%    | 100.0%|      |
| Middle school (2nd grade) | Boys  | 1481           | 734     | 937     | 726     | 323     | 4201   |       |      |
|                |        | Percentage     | 35.3%   | 17.5%   | 22.3%   | 17.3%   | 7.7%    | 100.0%|      |
|                |        | Frequency      | 969     | 664     | 1270    | 1380    | 675     | 4958  |      |
|                |        | Percentage     | 19.5%   | 13.4%   | 25.6%   | 27.8%   | 13.6%   | 100.0%|      |
|                | Girls  | 1478           | 925     | 947     | 480     | 255     | 4085   |       |      |
|                |        | Percentage     | 36.2%   | 22.6%   | 23.2%   | 11.8%   | 6.2%    | 100.0%|      |
|                |        | Frequency      | 969     | 941     | 1387    | 948     | 514     | 4759  |      |
|                |        | Percentage     | 20.4%   | 19.8%   | 29.1%   | 19.9%   | 10.8%   | 100.0%|      |
| Middle school (3rd grade) | Boys  | 1936           | 883     | 904     | 628     | 320     | 4671   |       |      |
|                |        | Percentage     | 41.4%   | 18.9%   | 19.4%   | 13.4%   | 6.9%    | 100.0%|      |
|                |        | Frequency      | 974     | 751     | 1248    | 1036    | 517     | 4526  |      |
|                |        | Percentage     | 21.5%   | 16.6%   | 27.6%   | 22.9%   | 11.4%   | 100.0%|      |
|                | Girls  | 1193           | 1133    | 1205    | 662     | 321     | 4514   |       |      |
|                |        | Percentage     | 26.4%   | 25.1%   | 26.7%   | 14.7%   | 7.1%    | 100.0%|      |
|                |        | Frequency      | 628     | 876     | 1403    | 866     | 674     | 4447  |      |
|                |        | Percentage     | 14.1%   | 19.7%   | 31.5%   | 19.5%   | 15.2%   | 100.0%|      |

3.2. Power

In Table 4, chi-square analysis also revealed significant differences in power before and after COVID-19 among fifth-grade girls and sixth-grade boys. In addition, significant differences in power were observed among both boys and girls at all middle school levels when comparing data between 2019 and 2021. In particular, compared with boys, fewer girls achieved grades of 1 and 2 in 2021 than in 2019. In the case of female students in their first year of middle school, such scores decreased by 11.3%. In the second grade, they decreased by 8.3%, and in the third grade, they decreased by 8.6%. Meanwhile, the frequency of Grades 3, 4, and 5 among girls significantly increased from 2019 to 2021 compared with boys.

3.3. Muscular Strength

In Table 5, chi-square analysis revealed significant differences in muscular strength between 2019 and 2021. Differences were observed between boys and girls in all grades except the last year of elementary and the first year of middle school. However, the frequencies of Grades 1 and 2 did not decrease by more than 10% for cardiorespiratory endurance or power, and there were no significant differences according to grade between 2019 and 2021.

3.4. Flexibility

In Table 6, chi-square analysis revealed significant differences in flexibility grades between 2019 and 2021. No significant differences were observed among fifth-grade girls, second-year middle school girls, or boys and girls in the third year of middle school. In addition, the χ² value was the highest for male students in the sixth grade, at 76.239; however, this difference was not significant when compared with those for other physical factors.
## Table 4. Comparison of power in 2019 and 2021.

| Grade            | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2/p$            |
|------------------|--------|---------|---------|---------|---------|---------|-------|----------------------|
|                  |        | Frequency | 462     | 1212    | 1347    | 1262    | 146   | 4429 $\chi^2 = 22.939$ df = 4 $p = 0.011$ |
| Elementary school (5th grade) |        | Percentage | 10.4%   | 27.4%   | 30.4%   | 28.5%   | 3.3%  | 100.0% |
| Boys             | 2019   | Frequency | 487     | 1239    | 1459    | 1318    | 251   | 4754 $\chi^2 = 13.090$ df = 4 $p < 0.001$ |
| Girls            | 2019   | Percentage | 10.2%   | 26.1%   | 30.7%   | 27.7%   | 5.3%  | 100.0% |
|                  | 2021   | Frequency | 330     | 1637    | 1286    | 1062    | 217   | 4532 |
|                  | 2021   | Percentage | 7.3%    | 36.1%   | 28.4%   | 23.4%   | 4.8%  | 100.0% |
| Elementary school (6th grade) |        | Frequency | 403     | 1537    | 1406    | 1044    | 179   | 4569 $\chi^2 = 29.143$ df = 4 $p < 0.001$ |
| Boys             | 2019   | Percentage | 8.8%    | 33.6%   | 30.8%   | 22.8%   | 3.9%  | 100.0% |
| Girls            | 2019   | Frequency | 385     | 1452    | 1416    | 1085    | 289   | 4627 |
|                  | 2019   | Percentage | 8.3%    | 31.4%   | 30.6%   | 23.4%   | 6.2%  | 100.0% |
|                  | 2021   | Frequency | 506     | 1498    | 1313    | 932     | 137   | 4386 |
|                  | 2021   | Percentage | 11.5%   | 34.2%   | 29.9%   | 21.2%   | 3.1%  | 100.0% |
| Middle school (1st grade) |        | Frequency | 583     | 1550    | 1182    | 832     | 53    | 4200 $\chi^2 = 292.876$ df = 4 $p < 0.001$ |
| Boys             | 2019   | Percentage | 13.9%   | 36.9%   | 28.1%   | 19.8%   | 1.3%  | 100.0% |
| Girls            | 2019   | Frequency | 861     | 1748    | 882     | 586     | 113   | 4190 |
|                  | 2019   | Percentage | 20.5%   | 41.7%   | 21.1%   | 14.0%   | 2.7%  | 100.0% |
|                  | 2021   | Frequency | 421     | 1785    | 1164    | 1042    | 177   | 4589 |
|                  | 2021   | Percentage | 9.2%    | 38.9%   | 25.4%   | 22.7%   | 3.9%  | 100.0% |
| Middle school (2nd grade) |        | Frequency | 760     | 1562    | 956     | 781     | 122   | 4181 $\chi^2 = 72.385$ df = 4 $p < 0.001$ |
| Boys             | 2019   | Percentage | 18.2%   | 37.4%   | 22.9%   | 18.7%   | 2.9%  | 100.0% |
| Girls            | 2019   | Frequency | 740     | 1687    | 1122    | 1124    | 269   | 4942 |
|                  | 2019   | Percentage | 15.0%   | 34.1%   | 22.7%   | 22.7%   | 5.4%  | 100.0% |
|                  | 2021   | Frequency | 700     | 1592    | 880     | 708     | 189   | 4069 |
|                  | 2021   | Percentage | 17.2%   | 39.1%   | 21.6%   | 17.4%   | 4.6%  | 100.0% |
| Middle school (3rd grade) |        | Frequency | 727     | 1850    | 1092    | 851     | 149   | 4669 $\chi^2 = 176.032$ df = 4 $p < 0.001$ |
| Boys             | 2019   | Percentage | 15.6%   | 39.6%   | 23.4%   | 18.2%   | 3.2%  | 100.0% |
| Girls            | 2019   | Frequency | 351     | 1487    | 1243    | 1205    | 222   | 4508 |
|                  | 2019   | Percentage | 7.8%    | 33.0%   | 27.6%   | 26.7%   | 4.9%  | 100.0% |
|                  | 2021   | Frequency | 770     | 1749    | 934     | 879     | 180   | 4512 |
|                  | 2021   | Percentage | 17.1%   | 38.8%   | 20.7%   | 19.5%   | 4.0%  | 100.0% |
|                  | 2021   | Frequency | 419     | 1608    | 1221    | 932     | 247   | 4427 |
|                  | 2021   | Percentage | 9.5%    | 36.3%   | 27.6%   | 21.1%   | 5.6%  | 100.0% |
Table 5. Comparison of muscular strength in 2019 and 2021.

| Grade | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | \( \chi^2/p \) |
|-------|--------|---------|---------|---------|---------|---------|-------|-----------|
| Boys  | Elementary school (5th grade) | Frequency | 400 | 687 | 1996 | 1160 | 186 | 4429 | \( \chi^2 = 20.223 \) df = 4 \( p = 0.011 \) |
|       |        | Percentage | 9.0% | 15.5% | 45.1% | 26.2% | 4.2% | 100.0% |
|       | 2019   | Frequency | 393 | 843 | 2181 | 1110 | 243 | 4770 |
|       |        | Percentage | 8.2% | 17.7% | 45.7% | 23.3% | 5.1% | 100.0% |
| Girls | Elementary school (5th grade) | Frequency | 360 | 1198 | 1416 | 1026 | 252 | 4252 |
|       |        | Percentage | 7.9% | 34.3% | 33.8% | 18.7% | 5.3% | 100.0% |
| Boys  | Elementary school (6th grade) | Frequency | 550 | 842 | 1252 | 1020 | 219 | 4363 |
|       |        | Percentage | 12.0% | 18.3% | 46.3% | 18.2% | 5.2% | 100.0% |
| Girls | Elementary school (6th grade) | Frequency | 444 | 1278 | 1520 | 1120 | 201 | 4290 |
|       |        | Percentage | 10.1% | 29.1% | 35.1% | 18.3% | 3.6% | 100.0% |
| Boys  | Middle school (1st grade) | Frequency | 540 | 1289 | 1495 | 777 | 154 | 4255 |
|       |        | Percentage | 12.7% | 30.3% | 35.1% | 18.3% | 3.6% | 100.0% |
| Girls | Middle school (1st grade) | Frequency | 761 | 1440 | 1611 | 725 | 184 | 4721 |
|       |        | Percentage | 16.1% | 30.5% | 34.1% | 15.4% | 3.9% | 100.0% |
| Boys  | Middle school (2nd grade) | Frequency | 844 | 875 | 1430 | 791 | 258 | 4198 |
|       |        | Percentage | 20.1% | 20.8% | 34.1% | 18.8% | 6.1% | 100.0% |
| Girls | Middle school (2nd grade) | Frequency | 888 | 978 | 1875 | 802 | 280 | 4823 |
|       |        | Percentage | 18.4% | 20.3% | 38.9% | 16.6% | 5.8% | 100.0% |
| Boys  | Middle school (3rd grade) | Frequency | 687 | 1288 | 1582 | 481 | 48 | 4086 |
|       |        | Percentage | 16.8% | 31.5% | 38.7% | 11.8% | 1.2% | 100.0% |
| Girls | Middle school (3rd grade) | Frequency | 755 | 1407 | 1733 | 582 | 154 | 4631 |
|       |        | Percentage | 16.3% | 30.4% | 37.4% | 12.6% | 3.3% | 100.0% |

\( \chi^2 = 8.638 \) df = 4 \( p = 0.071 \)

\( \chi^2 = 24.552 \) df = 4 \( p < 0.001 \)

\( \chi^2 = 46.668 \) df = 4 \( p < 0.001 \)

\( \chi^2 = 21.510 \) df = 4 \( p < 0.001 \)

\( \chi^2 = 87.872 \) df = 4 \( p < 0.001 \)
### Table 6. Comparison of flexibility in 2019 and 2021.

| Grade | Gender | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Total | $\chi^2/p$ |
|-------|--------|---------|---------|---------|---------|---------|-------|-----------|
|       |        | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
|       | Boys   | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2463     | 51.7%   | 826      | 17.3%   | 931      | 19.5%   | 325      | 6.8%     | 221      | 4.6%     | 4766     | $\chi^2 = 32.469$ | df = 4 | $p = 0.011$ |
|       | Girls  | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2126     | 68.8%   | 3589     | 13.0%   | 321      | 7.1%    | 328      | 7.2%     | 178      | 3.9%     | 4542     | $\chi^2 = 4.584$ | df = 4 | $p = 0.333$ |
|       |       |          |         |          |         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|       | Boys   | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2445     | 52.8%   | 738      | 15.9%   | 816      | 17.6%   | 405      | 8.7%     | 228      | 4.9%     | 4632     | $\chi^2 = 76.239$ | df = 4 | $p < 0.001$ |
|       | Girls  | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2377     | 55.4%   | 800      | 18.7%   | 703      | 16.4%   | 199      | 10.2%    | 209      | 6.7%     | 4288     | $\chi^2 = 35.113$ | df = 4 | $p < 0.001$ |
|       |       |          |         |          |         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|       | Boys   | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2101     | 44.1%   | 917      | 19.2%   | 866      | 18.2%   | 627      | 13.1%    | 258      | 5.4%     | 4769     | $\chi^2 = 39.023$ | df = 4 | $p < 0.001$ |
|       | Girls  | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 1649     | 38.6%   | 867      | 20.3%   | 896      | 21.0%   | 561      | 13.1%    | 296      | 6.9%     | 4269     | $\chi^2 = 22.407$ | df = 4 | $p < 0.001$ |
|       |       |          |         |          |         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|       | Boys   | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2340     | 47.3%   | 672      | 13.6%   | 993      | 20.1%   | 589      | 11.9%    | 357      | 5.4%     | 4951     | $\chi^2 = 20.160$ | df = 4 | $p < 0.001$ |
|       | Girls  | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2242     | 51.1%   | 716      | 18.3%   | 435      | 11.7%   | 563      | 13.4%    | 310      | 6.9%     | 4755     | $\chi^2 = 6.7895$ | df = 4 | $p = 0.148$ |
|       |       |          |         |          |         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|       | Boys   | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2205     | 49.7%   | 686      | 15.1%   | 398      | 9.1%    | 478      | 11.8%    | 257      | 6.5%     | 4083     | $\chi^2 = 7.042$ | df = 4 | $p = 0.134$ |
|       | Girls  | 2019     |         | 2021     |         |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         | 2021     |         |
|       |        | 2431     | 54.9%   | 715      | 16.8%   | 435      | 9.7%    | 642      | 11.7%    | 385      | 6.3%     | 4509     | $\chi^2 = 3.981$ | df = 4 | $p = 0.409$ |
3.5. Obesity Status

In Table 7, chi-square analysis revealed significant differences in obesity grades between 2019 and 2021, except among girls in the third year of middle school. In particular, obesity frequency increased among elementary and middle school students due to a decrease in the frequency of normal-weight/thin grades and an increase in the ratio of overweight, mild obesity, and severe obesity grades.

Table 7. Comparison of obesity status in 2019 and 2021.

| Grade Group       | Gender | Grade 1 (Normal) | Grade 2 (Thin) | Grade 3 (Overweight) | Grade 4 (Mild Obesity) | Grade 5 (Severe Obesity) | Total | \( \chi^2 \), df, p |
|-------------------|--------|------------------|----------------|----------------------|------------------------|--------------------------|-------|---------------------|
| Elementary school (5th grade) | Boys    | Frequency 2019 2829 | Percentage 65.5% | 19.0% | 11.8% | 1.0% | 100.0% | 4321 | \( \chi^2 = 137.579 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2379 | Percentage 54.8% | 22.4% | 18.4% | 2.2% | 100.0% | 4338 | \( \chi^2 = 43.152 \), df = 4, p < 0.001 |
|                   | Girls   | Frequency 2019 3061 | Percentage 73.8% | 13.5% | 8.4% | 0.3% | 100.0% | 4146 | \( \chi^2 = 93.752 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2738 | Percentage 66.0% | 16.8% | 13.5% | 0.7% | 100.0% | 4147 | \( \chi^2 = 34.378 \), df = 4, p < 0.001 |
| Elementary school (6th grades) | Boys    | Frequency 2019 3000 | Percentage 66.5% | 15.5% | 13.6% | 2.1% | 100.0% | 4510 | \( \chi^2 = 105.354 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2537 | Percentage 56.8% | 18.7% | 18.3% | 3.9% | 100.0% | 4470 | \( \chi^2 = 84.236 \), df = 4, p < 0.001 |
|                   | Girls   | Frequency 2019 3193 | Percentage 73.7% | 13.5% | 9.0% | 0.8% | 100.0% | 4335 | \( \chi^2 = 29.283 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2927 | Percentage 70.6% | 15.6% | 10.7% | 0.9% | 100.0% | 4148 | \( \chi^2 = 29.283 \), df = 4, p < 0.001 |
| Middle school (1st grade)    | Boys    | Frequency 2019 2996 | Percentage 70.2% | 10.8% | 13.9% | 2.3% | 100.0% | 4267 | \( \chi^2 = 84.236 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2524 | Percentage 58.1% | 12.9% | 21.0% | 5.3% | 100.0% | 4733 | \( \chi^2 = 29.283 \), df = 4, p < 0.001 |
|                   | Girls   | Frequency 2019 3223 | Percentage 76.8% | 12.6% | 6.6% | 1.2% | 100.0% | 4199 | \( \chi^2 = 29.283 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 3319 | Percentage 72.2% | 14.6% | 8.6% | 1.8% | 100.0% | 4999 | \( \chi^2 = 49.999 \), df = 4, p < 0.001 |
| Middle school (2nd grade)    | Boys    | Frequency 2019 2924 | Percentage 70.2% | 2.5% | 6.6% | 16.0% | 4.7% | 100.0% | 4165 | \( \chi^2 = 177.183 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2889 | Percentage 60.4% | 2.7% | 8.0% | 21.7% | 7.2% | 100.0% | 4783 | \( \chi^2 = 12.399 \), df = 4, p < 0.001 |
|                   | Girls   | Frequency 2019 3106 | Percentage 76.6% | 2.2% | 10.8% | 8.9% | 1.5% | 100.0% | 4056 | \( \chi^2 = 23.399 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 3383 | Percentage 72.2% | 3.4% | 10.8% | 9.5% | 2.5% | 100.0% | 4587 | \( \chi^2 = 84.236 \), df = 4, p < 0.001 |
| Middle school (3rd grade)   | Boys    | Frequency 2019 3339 | Percentage 71.5% | 3.3% | 3.3% | 16.3% | 5.6% | 100.0% | 4671 | \( \chi^2 = 23.399 \), df = 4, p < 0.001 |
|                   |         | Frequency 2021 2835 | Percentage 62.7% | 3.5% | 4.2% | 21.9% | 7.7% | 100.0% | 4519 | \( \chi^2 = 6.013 \), df = 4, p = 0.198 |
|                   | Girls   | Frequency 2019 3470 | Percentage 77.0% | 3.2% | 8.1% | 9.4% | 2.4% | 100.0% | 4509 | \( \chi^2 = 6.013 \), df = 4, p = 0.198 |
|                   |         | Frequency 2021 3395 | Percentage 76.4% | 3.8% | 7.6% | 9.2% | 2.9% | 100.0% | 4442 | \( \chi^2 = 6.013 \), df = 4, p = 0.198 |
3.6. Overall Health-Related Physical Fitness Scores

In Table 8, among both elementary and middle school students, significant differences in the overall health-related physical fitness scores were observed for both boys and girls between 2019 and 2021. Our analysis indicated that the frequency of Grades 1 and 2 decreased, while the frequency of Grades 3 and 4 increased. In particular, there was a greater difference among middle school than elementary school students. The \( x^2 \) values for boys and girls in the second year of middle school and for boys in the third year were 344.394, 226.981, and 251.844, respectively, indicating large differences in overall health and fitness scores between 2019 and 2021.

Table 8. Comparison of overall health-related physical fitness in 2019 and 2021.

| Grade        | Sex     | 2019                      | 2021                      | \( \chi^2 \)/\( p \)  |
|--------------|---------|---------------------------|---------------------------|-------------------------|
| Elementary   | Boys    | Frequency 207             | Frequency 156             | 125.701, 0.001          |
| School       |         | %207                      | %156                      |                         |
| (5th grade)  | Girls   | %4.7%                     | %3.3%                     |                         |
|              |         | Frequency 1468            | Frequency 1261            | 86.797, 0.001           |
|              |         | %48.8%                    | %49.2%                    |                         |
|              |         | Frequency 2165            | Frequency 2349            | 226.981, 0.001          |
|              |         | %12.3%                    | %19.3%                    |                         |
|              |         | Frequency 546             | Frequency 923             | 251.844, 0.001          |
|              |         | %1.1%                     | %1.8%                     |                         |
|              |         | Frequency 11712           | Total 4433                |                         |
|              |         | %100.0%                   |                           |                         |
| Middle       | Boys    | Frequency 267             | Frequency 197             | 141.978, 0.001          |
| School       |         | %5.8%                     | %4.5%                     |                         |
| (1st grade)  | Girls   | Frequency 1565            | Frequency 197             | 25.069, 0.001           |
|              |         | %34.0%                    | %37.4%                    |                         |
|              |         | Frequency 2114            | Frequency 2118            | 144.489, 0.001          |
|              |         | %61%                      | %60%                      |                         |
|              |         | Frequency 618             | Frequency 406             | 228.981, 0.001          |
|              |         | %37%                      | %21%                      |                         |
|              |         | Frequency 3437            | Total 4610                |                         |
|              |         | %100.0%                   |                           |                         |
| Middle       | Boys    | Frequency 325             | Frequency 197             | 154.321, 0.001          |
| School       |         | %7.6%                     | %4.5%                     |                         |
| (2nd grade)  | Girls   | Frequency 1471            | Frequency 197             | 178.181, 0.001          |
|              |         | %34.4%                    | %37%                      |                         |
|              |         | Frequency 1770            | Frequency 2118            | 344.394, 0.001          |
|              |         | %41.4%                    | %48.0%                    |                         |
|              |         | Frequency 646             | Frequency 406             | 226.981, 0.001          |
|              |         | %15.1%                    | %9.2%                     |                         |
|              |         | Frequency 618             | Total 4277                |                         |
|              |         | %1.5%                     |                           |                         |
| Middle       | Boys    | Frequency 197             | Frequency 174             | 344.394, 0.001          |
| School       |         | %5.8%                     | %4.0%                     |                         |
| (3rd grade)  | Girls   | Frequency 1463            | Frequency 2144            | 28.669, 0.001           |
|              |         | %49.9%                    | %49.9%                    |                         |
|              |         | Frequency 481             | Total 4634                |                         |
|              |         | %11.2%                    |                           |                         |

\( x^2 = \) chi-squared statistic, \( df = \) degrees of freedom, \( p < 0.001 \) indicates statistical significance.
4. Discussion

The present study aimed to analyze changes in health-related physical fitness among elementary and middle school students in Korea before (2019) and after (2021) the COVID-19 pandemic. Our results indicated that physical fitness levels were lower among both elementary and middle school students after the COVID-19 pandemic.

4.1. Interpretation of Findings

Looking at the results for the changes in cardiorespiratory endurance, both elementary and middle school students saw a decrease in Grades 1 and 2 and an increase in Grades 3, 4, and 5. In particular, in the case of male students in the third year of middle school, the change in physical fitness was the largest. The first grade was 41.4% in 2019, but it decreased by about 20% to 21.5% in 2021. In addition, in the case of female students, the ratio of the first grade decreased the most, from 36.2% to 20.4%. Due to COVID-19, both elementary and middle school students were unable to go to school and learned through online education. Consequently, external activities were cut off and physical activity opportunities were reduced, as the results of previous studies [14,26] showed. After the WHO’s pandemic declaration, the scope of life for students was very narrow. In particular, the amount of physical activity students participated in decreased when school was restricted. The decrease in students’ cardiorespiratory endurance can be attributed to this decrease in activity.

Next, looking at the results for the change in power, elementary school students did not show as much difference as they did for other physical fitness factors, but power decreased for both men and women in all three grades of middle school. On the other hand, it increased for both genders in the third, fourth, and fifth grades of elementary school. In particular, compared with males, females in their first year of middle school had a higher rate of decrease. In a study by Pinho et al. [27], male students’ power rapidly decreased due to COVID-19. Moreover, the power of elementary and middle school students in Korea continuously decreased compared with 2019. These results can also be interpreted as a decrease in students’ physical activity due to the pandemic situation. Since power is a combination of innate motor sense and planned training, planned physical activities are necessary to improve it. In particular, it is worth noting that female students’ power decreased when regular physical activities were not provided in physical education classes at school. Because male students are relatively interested in sports events and have a strong desire to move, their access to and participation in various physical activities is higher than that of female students [24]. The results derived from this study confirmed that the physical activity program provided by the school was essential to maintain and improve the balanced power among female students.

Third, compared with other physical factors, there was no significant change in muscular strength for either elementary or middle school students. The chi-square values for 2019 and 2021 were not significant, nor did they show a sharp decrease in muscular strength. A study by Sagarrá-Romero and Viñas-Barros [28] found that physical activity decreased rapidly for the elderly during the COVID-19 pandemic, and the decrease in muscular strength was significant. In addition, in a study by Young et al. [29], similar results to ours were found, in that a decrease in physical activity among the elderly and other adults did not lead to significant changes in muscular strength. Muscular strength is developed, in part, through basic movements and exercises that can be done at home during the course of our daily lives. Therefore, outside physical activity changes may not have much effect. Online learning due to the pandemic restricted physical education classes. However, Korean physical education teachers have made great efforts to increase students’ physical activity in online-based classes. In particular, the expansion of home training centered on muscular strength and muscle endurance has become popular nationwide. These findings on muscular strength indicate maintained muscular strength, of course. Alternatively, they demonstrate the persistence of its power, and they may be interpreted
to show how home training during online class periods as a result of the pandemic did not reduce students’ muscular strength, as derived in this study.

Fourth, overall changes in flexibility decreased in Grades 1 and 2 in 2021. Especially noticeable were the changes seen in both male and female students in the final year of elementary school and the first year in middle school. A previous study by Song et al. [25] reported significant improvement in flexibility (pre = 2.64 ± 3.49, post = 5.98 ± 2.78) through a 16-week health exercise program geared toward adolescents. Lee et al. [24] also reported improved flexibility after a one-year physical activity program. Bartolo et al.’s [30] study reported that trunk-specific rehabilitation treatment for 4 weeks improves the lateral trunk flexion of Parkinson’s patients, showing that there was no decrease in flexibility due to reduced physical activity. Flexibility can be improved through static and dynamic stretching. Health management is an important content element in the Korean physical education curriculum. In particular, stretching before and after class plays a major role in improving students’ flexibility. This stretching was inevitably limited in the pandemic situation. The decrease in flexibility after the pandemic can be interpreted as a reflection of these limitations. For adolescents whose physical activity has been reduced due to COVID-19, specific measures are needed to improve youth flexibility by providing them with a suitable exercise program [14,27].

Finally, the results for changes in obesity were very different from those for other physical factors. In particular, obesity increased mainly among male students in the fifth and sixth years of elementary school and the first, second, and third years of middle school. This is consistent with the results of previous studies showing that obesity naturally increased due to decreased physical activity [31,32]. In addition, Lange et al. [33] investigated the obesity levels of adolescents in the U.S. during the COVID-19 situation, and the number of obese adolescents increased during the COVID-19 period. As discussed above, there were changes in cardiorespiratory endurance, power, muscular strength, and flexibility before and after the pandemic declaration, but the decreased obesity rate was more dramatic than any other observed change. In general, in addition to the basal metabolic rate, people use energy when participating in physical activity. If the nutrients they consume are constant and physical activity decreases, the obesity rate increases. These results highlight the changes that much of our society have experienced because of the physical restrictions imposed by government-controlled “social distancing” aimed at preventing the spread of an infectious disease, as was the case in the unprecedented special situation of COVID-19. Schools, places of education where many people come in contact daily, were not untouched by the pandemic situation. In particular, physical education, which is centered on physical activity, was inevitably hit hard. In the end, it can be interpreted that students’ decreased physical activity naturally resulted in an increase in obesity.

Several studies have highlighted the need to address decreased physical activity since the outbreak of COVID-19 in 2020, especially among children, as this decrease has persisted following the pandemic situation [33]. In particular, researchers have stressed the importance of high-intensity, rather than general low-intensity, physical activity [34,35].

4.2. Practical Implications of the Study

Recently reclassified as endemic, COVID-19 has become a part of daily life. As such, there is a great need for discussion regarding the types of physical education offered to elementary and middle school students in this context. Normal school operations were significantly inhibited by COVID-19, and teachers experienced numerous difficulties due to a lack of familiarity with implementing online physical education classes [3,34]. In particular, given limitations in terms of space and the availability of sports equipment, online physical education classes consisted mainly of training exercises that could be performed at home [36]. Several reports have suggested that online physical education classes have been relatively ineffective for children [37–39]. Although face-to-face physical education classes have mostly resumed, physical education teachers must play a key role in promoting and advancing basic physical education classes at the elementary and
middle school levels. Kim et al. [38] reported several technical difficulties related to the implementation of online classes, citing that physical education during the COVID-19 pandemic was most effective when offered face-to-face rather than online. As such, the role of physical education teachers is considered important in an endemic situation [38–40].

In addition to ensuring regular implementation of physical education classes, expanding opportunities to participate in various sports activities beyond those associated with regular classes may help to improve physical fitness levels among elementary and middle school students. School sports clubs are common in Korea [41–43], allowing students to select a preferred activity in which to engage during lunch and before/after school. However, participation in such clubs was largely restricted during the COVID-19 pandemic [44], with even the Olympic Games being postponed by a year. Nevertheless, some physical education teachers in Korea attempted to operate school sports club events online [44,45]. Although participation in ball sports such as soccer and basketball was not possible, these teachers have been able to provide limited physical activity despite social distancing measures. While most Korean schools are now able to conduct classes as usual, additional efforts are required to ensure that sports activities and competitions are reintroduced along with physical education classes.

One major limitation of the current study is that it remains difficult to generalize our findings, given that the results were derived from assessments conducted among elementary and middle school students in Korea. That is, changes in physical activity levels may have differed across countries due to differences in the effects of COVID-19 and the different preventive measures utilized. Therefore, further studies are required to examine how the COVID-19 pandemic has impacted health and fitness levels in each country. Another limitation is that participation in other activities could not be controlled. Moreover, this study used chi-square and frequency analysis for the sake of reliability. Further well-designed statistical methods, such as linear regression analysis, are necessary to provide an even more detailed analytical explanation of these and similar data so that a broader understanding of adolescent physical fitness can be achieved.

5. Conclusions

Our results demonstrated that physical fitness levels decreased among both elementary and middle school students in Korea from 2019 to 2021. Further research is required to identify the most effective strategies for improving physical fitness among these students, given that COVID-19 has become endemic in Korea.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon request from the authors. The data are not publicly available owing to privacy and ethical restrictions.

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