# The necessity of ‘Hifumi Gymnastics’ for Japanese children in physical education and recreation

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**Abstract**

The authors produced the ‘Hifumi Gymnastics’ programme, which included four representative movements based on Japanese traditional arts, to help Japanese children improve their physical strength and to address their lack of exercise. In addition, this exercise programme was designed to help children work on their educational subjects while enjoying local sports activities and educational scenes. The purpose of this study is to clarify the exercise intensity and the featured movements of Hifumi Gymnastics. Concretely, the program was measured by two methods: heart rate variability (HRV) and the body parts with the highest maximum temperature. Then, it was analysed by comparing its data to those of ‘Radio Exercise No. 1’, which is the representative exercise programme in Japan. The HRV for Hifumi Gymnastics increased gradually to approximately 75/min-100/min as the exercise load increased and ended. Thus, the intensity of the exercise proved to be slightly higher for Hifumi Gymnastics than for Radio Exercise No. 1. In terms of thermography, Hifumi Gymnastics constantly stimulated the back and lateral muscles of the lower extremities. This tendency was thought to be attributable to the selected four movements that the authors intentionally incorporated into the programme. From the above results, it is clarified that Hifumi Gymnastics is constructed of various movements and it uses many body parts from the comparison with Radio exercises. This results supports that it is valid as children's exercise for strengthening the lower extremities.

## 1. Introduction

There are many types of play in the daily life of Japanese children, such as ‘exercise play, expression play, traditional play, and play using playground equipment’[1],[2].The current circumstances for Japanese children have changed dramatically due to various educational reforms since World War Two, the sudden westernization of Japanese lifestyle, and the arrival of various mass media[3]. These changes are known as the three decreases of play space, playmates and play time for children in Japan. First, safe places for children to play have decreased because of the current traffic situation and residential environments in Japan. Second, Japanese children have fewer playmates, such as brothers, sisters and neighbourhood friends, because of the decline in the Japanese birth rate. Lastly, Ministry of Education, Culture, Sports, Science and Technology Japan, (hereafter referred to as MEXT) reported that they have no time to spend in play because the educational situation requires them to

study hard after school[4].

In this context, the arrival of video games has greatly influenced the lifestyle and approach to play of Japanese children since the 1980s. Children's leisure time after school has been occupied with electronic games and game equipment, such as PlayStation[5],[6].

Therefore, it is thought to be more difficult than before for Japanese children to grow up with a variety of free play in desirable situations. MEXT has sent 'Exercise Guidelines for Infants and Toddlers' to all kindergartens and nursery schools in Japan to address this situation[7]. through an educational policy for children's physical development in response to the decline of physical strength and health preservation.

MEXT has noticed Japanese children's lack of exercise and physical weakness caused by the various shifts of lifestyle. The authors suggest the following proposals to solve the physical problems of Japanese children: 1) the necessity of experiencing a low posture in their daily activities and 2) identifying a connection between colloquial words and their body image. These circumstances are considered to address the changes in the Japanese lifestyle. It was common for Japanese people in the old days to live with low posture, for example, by folding their legs (seiza) to sit on a mat on the floor (tatami) and sleeping on a thin mattress (futon) placed directly on the floor. Such lower postures unconsciously strengthened Japanese people's legs and loins. In earlier times, Japanese children could squat and stoop with ease because the lower parts of their body were trained on a daily basis in these forms of movement.

In contrast, present-day Japanese children tend to be brought up with no experience in low-posture movements because of the transformation of the Japanese lifestyle. As time passed, physical problems in children that were thought to be caused by this change in the Japanese lifestyle began to be noted. One such problem was that Japanese children could not sit down merely by folding their legs. Other problems were an insufficient flexibility of the ankle and lower extremity and poor flexibility of the whole body[8],[9].

In terms of disconnecting colloquial words and body image, the problem is considered to be caused by Japanese children's use of portable game machines and cellular phones as communication tools in their daily life[10]. As a result, substantial experiences in childhood seem to be completed not in real life but in the virtual world through the electronic devices. In other words, Japanese children's play has tended to shift from physical activities to games played using mobile equipment. This shift may have caused a situation in which children cannot be accurately conscious of the difference between the actual world and the virtual world.

MEXT and the Central Council for Education promote having Japanese children play outside and constantly use their bodies. They also promote play that uses direct communication among the children. For these reasons, the authors proposed stimulating the five senses by various methods that use children's play to assist their developmental process by considering the balance of body and mind. The children should be trained to build their body image through the exercise and through singing to identify the words with the behaviour[11],[12]. Based on this theory, Hifumi Gymnastics aims to achieve a body image by singing lyrics.

Considering these proposals, the authors composed the Hifumi Gymnastics programme based on two concepts: (1) Japanese children will benefit from exercising with a lower centre of gravity that they do not experience in their daily life, and (2) they should build their body image by expressing the meaning of their body movements through song lyrics as they perform the movements. Specifically, four movements (three movements and one rhythm) were selected as the representative items of the Japanese traditional arts Nou and Kyogen (Nougaku). Each item was incorporated into the exercise as a gymnastics phase. The four items are 1) the ipsilateral movement: motion of the foot with the hand on the same side, moving at the same time; 2) the sliding walk: a type of walking with a sole landing on the ground; 3) the 'yatton' beat: the rhythm 'yatton, yatton, yatton ton' sounded by a leg; and 4) the 'hikyaku' run: the ancient running style of the Japanese traditional mailman with his leg extended back. Hifumi Gymnastics also incorporated the idea that children should exercise while singing lyrics to realize the meaning of certain

words and to identify the words with their body image through the five senses.

Basically, Japan had a historical style in which a Japanese dancer danced to songs sung by himself or herself. Many Japanese ancient plays and games were carried out by singing songs similar to current nursery rhymes. Therefore, it can be said that Hifumi Gymnastics follows the classical methods of Japan. Four occupational characters (1. sumo wrestler, 2. samurai, 3. kimono girl and 4. hikyaku) were incorporated into the exercise as teaching materials to help children understand their culture and history by combining the lyrics and exercise. Thus, Hifumi Gymnastics was created as a style of exercising with singing based on cultural history. The lyrics and the images of the characters are shown in Table 1.

The purpose of this study is to analyse the objective features of the exercise load and kinematic aspects of Hifumi Gymnastics before practising the programme in an educational setting. The data of heart rate variability (HRV) and the maximum temperature of each part of the body, measured with a thermography camera, were used as analytical indicators. HRV was used because it is a generally accepted method for calculating the intensity of an exercise in comparison to other gymnastics and daily-life motions. The detected numerical value was shown for every movement by a diagram. The reason to detect the skin maximum temperature by thermography is to avoid obstructing the subject's movement by attaching a direct measuring instrument to the skin.

Data obtained by searching for the highest temperature on the surface of the body are considered the best way to visualize the features of the body parts used during gymnastics. The results for which part of the skin temperature rises and which part of the blood flow volume increases for each movement of Hifumi Gymnastics were applied to the analysis for frequency in use. Our data analysis method is supported as an effective approach by previous reports on muscle temperatures[13],[14],[15].

The authors produced Hifumi Gymnastics by practising it in an educational setting from Sept. to Dec. 2016 and obtained significant results regarding its effects. The main aim of the study is to report the numerical trends of Hifumi Gymnastics by comparing it to other exercise as a preliminary step of determining a practical dimension for students.

| *1. Sumo wrestler* | *2. Samurai* | *3. Kimono girl* | *4. Hikyaku* |
|---|---|---|---|
| Sumo wrestler<br>huge body<br>push and shiko<br>'don don'<br>'hack yoi nokotta<br>dosukoi dosukoi'<br>push and push | Samurai<br>walks with a<br>sword 'katana'<br>he shows 'ojigi'<br>when he wants<br>respect<br>he lessons<br>katana 'ei! ya!' | A wonderful girl<br>with kimono<br>flare long<br>sleeves and<br>a beautiful belt<br>' yatton yatton<br>yatton ton' | Japanese<br>traditional<br>mailman is<br>'Hikyaku'<br>takes letters runs<br>to the destination<br>'essa hoisa hoisassa'<br>I give you a letter |
|  |  |  |  |

Table 1　Hifumi Gymnastics

## 2. Method

### *2.1. About Creating Hifumi Gymnastics*

This exercise was choreographed based on two purposes (1. enhancing the strength of Japanese children's lower extremities and 2. helping the children identify the meaning of colloquial words in relation to

their movement by expressing them through their own bodies).

### *2.2. Measurement of a Subject's Movements*

The recording of HRV and the visualization of the maximum temperature of different body parts by thermography were carried out simultaneously during the gymnastics, and the same measurements were conducted for Radio Exercise No. 1. The data for the two programmes were compared appropriately in the analysis.

### *2.3. Experimental Procedure*

1) The actor performed Hifumi Gymnastics from the first exercise to the fourth (1. sumo wrestler, 2. samurai, 3. kimono girl, and 4. hikyaku) at 'pace 110'. The reason to use BPM110 is that most Japanese songs for children apply to this pace
2) The performance of Hifumi Gymnastics of the performer was recorded by a video camera, the heart rate measurement, and the thermography camera. The performer is a woman who was 53 years old, height: 158 cm, weight 57 kg. The reason for using this data of the woman is that this female performer could accurately reproduce gymnastics about its time and movement no matter how many times the exercises are performed. (Child performers is less reliable in reproducibility)
3) The data for the maximum temperature of the physical parts (mainly the lower extremity recorded by the thermography camera were analysed from three directions (front, back, and side).
4) The same procedure was applied to Radio Exercise No. 1.
5) Experimental period: Sept. to Dec. 2016.
6) Experimental place: the shield room of the subject.
7) Experimental object: the adult actor of Hifumi Gymnastics. The authors obtained data from three experimental actors who performed during the experimental period. Then, the best actor was selected based on the stability of the movement speed and the accuracy of each motion.
8) Experimental machines: 1. NISSEI photoelectric expression pulse monitor PALNEO-HR70 and 2. IOS FLIR One infrared thermal imaging camera.
9) Analysis: The thermographic video camera was set to the function of indicating the maximum temperature of the body part by each movement. The measurements of the performer were come out during the exercise. Since the red part of the pictures on VTR shows the maximum temperature, diagrams showing the highest temperature interlocking with each movement are displayed as figures of results and used for analysis.
10) Hifumi Gymnastics and Radio exercises were repeated by the performer 10 times each. The time, motion, and the tendency of change about the HRV showed almost the same tendency. The reproducibility about both exercise was judged to be reliable.

## 3. Results

### *3.1. Heart Rate Variability of Hifumi Gymnastics*

The HRV of Hifumi Gymnastics started with a counting song of '1, 2, 3' that was inserted into each occupational verse. The HRV increased gradually as the movements were repeated and ranged between 61.7/min and 100.5/min from sumo wrestler to hikyaku (Figure A). The exercise started at the first step of singing the counting song '1, 2, 3' (78.2/min). The HRV decreased once during the first half of sumo wrestler (71.2/min), held steady, and then gradually increased again (80.1/min). The HRV for the second verse, samurai, rose to 90/min and then declined with the movement of sitting on the floor (80.1/min: seiza and ojigi). It increased when the counting and stepping began again during samurai and kimono girl (90.3/min). The HRV of the third verse, kimono girl, remained at approximately 90/min. The HRV of stepping and counting during kimono girl and hikyaku rose gradually (100.8/min). The HRV of the fourth verse, hikyaku, decreased (85.0/min) again with the movements of standing and low jumping. Then, it increased dramatically with the running part of hikyaku (103.2/min). The exercise ended with speaking 'I will give a letter' (90.3/min).

Hifumi Gymnastics takes a form like a series of counting songs that are repeated one verse by one verse. Therefore, the HRV also showed fluctuations (95.2/min).

Considering Hifumi Gymnastics overall, the HRV of stepping and counting before the next verse

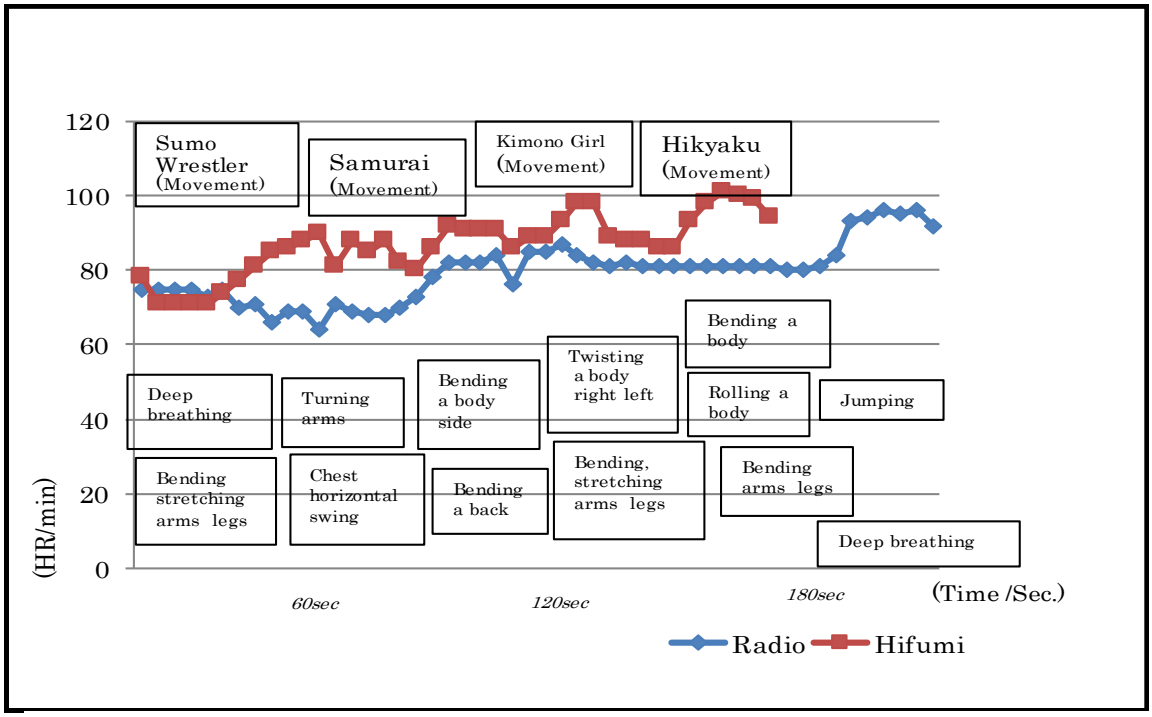


Figure A　The Comparison of HRV：‘Hifumi Gymnastics’ and ‘Radio Exercise No.1’

accompanying that repetitions.

In contrast, the HRV of Radio Exercise No. 1 was maintained at approximately 70/min at the start with the deep breathing exercise. Through the exercises of bending and straightening the arm and foot, turning an arm, and bending the chest backwards, the HRV score decreased to 64.0/min and then 66.0/min. Then, the HRV increased gradually (85.3/min) through the exercises of bending the body to the side, bending the body back and forth and twisting the body. Next, it decreased with the exercise of stretching an arm up and down. Then, it maintained the same level while bending the body at an angle and rolling the body. It increased dramatically with the jumping exercise tended to rise to 80.0/min. When the exercise started, it decreased and stayed at the same level and then increased with stepping and counting. A series of these changes was observed throughout the exercise. The HRV increased gradually, repeating the tendency to the end. The mean of the HRV for Hifumi Gymnastics was 86.1/min, and the mean of Radio Exercise No. 1 was 76.1/min. Therefore, Hifumi showed a higher total intensity than Radio Exercise.

### *3.2. The Body Parts with the Maximum Temperature (Hifumi Gymnastics)*

A sudden rapid rise of temperature was seen around both the shoulders and lower extremity at the

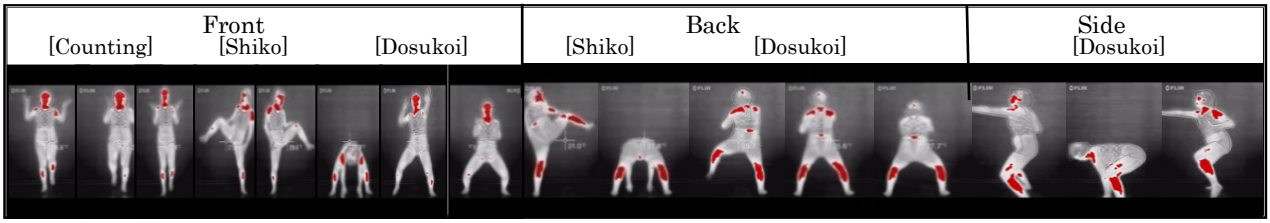


Figure 1　Sumo Wrestler

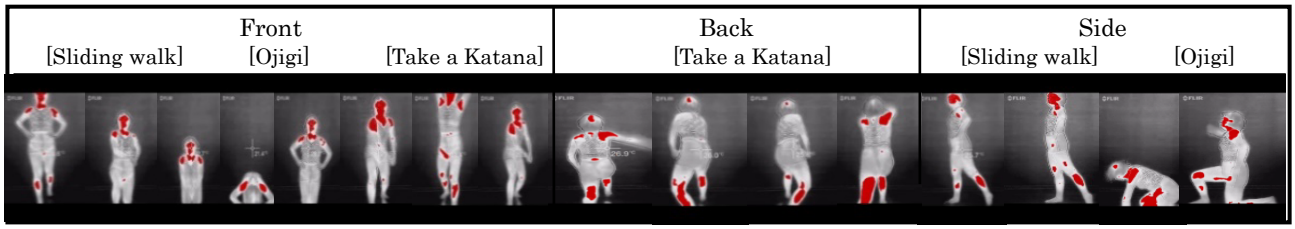


Figure 2　Samurai

beginning of sumo wrestler, which involved stepping while singing '1, 2, 3' (Figure 1). The boundaries of the lower and upper extremities showed the highest temperature during the shiko movement. When this movement was performed, a centroid position was shifted from one leg to the other with lower posture. Both legs were opened, and each leg was flung up in turn (Figure 1). During the 'hack yoi nokotta' motion, bending the body forward to prepare to dash, all dimensions (the front, back and side) of the lower extremities presented the maximum temperature. 'Dosukoi' was the sumo wrestler motion, in which the centre of gravity was low. During this motion, the lower extremity was raised to the highest point behind the body (Figure 1).

In the second verse, samurai, the highest temperature was recorded on the sides of the lower extremities during the sliding step and sitting on the floor with ojigi. During the motion of cutting down with a sword, the maximum temperature was recorded on the front and back of the lower extremities (Figure 2). In the third verse, kimono girl (Figure 3), most of the movements showed no rise in temperature except two movements (crossing both arms in front of the chest while bending and alternating sliding step) that showed a temperature increase in a small area of the front lower extremities.

The area around the boundary between the rear upper and lower extremities presented the maximum temperature while tapping the yatton rhythm and during the sliding walk. (Figure 3). The highest temperature was recorded on the sides of the lower extremities, especially around swollen ankles. It was also recorded during the yatton rhythm and sliding walk. (Figure 3). In the fourth verse, hikyaku, the verse consisted mainly jumping (a movement known as 'ken-ken' in Japan) repeatedly on one leg. The maximum temperature was observed only on some of the front lower extremity during hikyaku. The front parts of the lower extremities were not as heated except a small area (Figure 4).

In contrast, the back and sides of the lower extremities showed the maximum over a wide range of both areas. The maximum temperatures were also confirmed in both areas from the jumping and moving movement to swinging from left to right. Then, it was maintained until the motion of handing a letter to someone at the end (Figure 4).

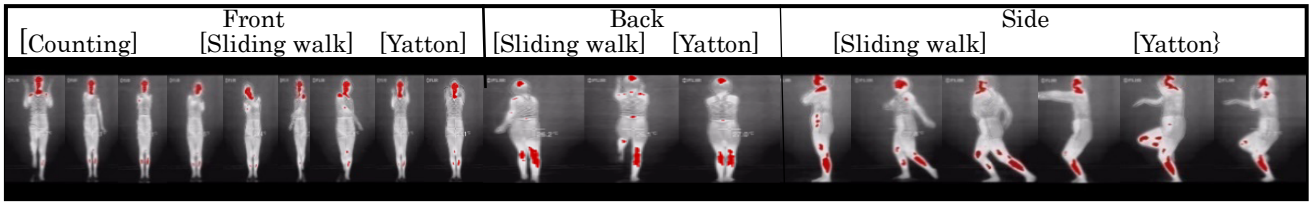


Figure3　Kimono Girl

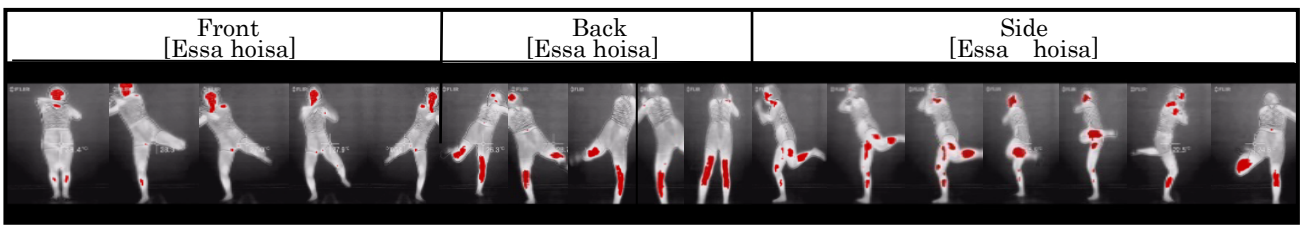


Figure 4　Hikyaku

### *3.3. The Body Parts with the Maximum Temperature (Radio Exercise)*

Radio Exercise No. 1 was selected for comparison with Hifumi Gymnastics because Radio Exercise No. 1 is the most representative exercise programme in Japan. It features facing forward from the beginning with deep breathing to the end with deep breathing through a fixed pace, counted, for example, as 'one, two, one, two'. The front parts of the shoulders and a part of lower extremities showed the maximum temperature during the total exercise (Figure 5). The back and sides of the lower extremities revealed the highest temperature during the exercises of bending the body to the side, bending the body back and forth and bending and stretching both legs repeatedly. In particular, the boundaries of the upper part of the thigh and lower extremity constantly showed the maximum (Figure 6). Both sides of the calves indicated the maximum during the exercise of bending the body to the side, bending the body back and forth and bending and stretching both legs repeatedly with swinging arms, and the same observation was made for the lower back record (Figure 7). In total, in Radio Exercise No. 1, parts of the front lower extremities, the boundary of the upper and lower extremity, and the sides of the lower extremity (the sides of the calves) showed the maximum temperature throughout the exercises.

## 4. Discussion

### *4.1. Hifumi Gymnastics in Terms of HRV*

The HRV of Hifumi Gymnastics increased to approximately 80/min with sumo wrestler sung at a moderate pace. It decreased slightly and then maintained the same level with each movement. It increased with the samurai song; then, it decreased slightly and maintained the same level again. Comprehensively, the HRV of Hifumi Gymnastics increased to over 100/min, repeating the pattern of this trend, and culminated with the increase of exercise load. In comparison, the HRV of Radio Exercise No. 1 showed fluctuations in the first half and then gradually increased to over 80/min with the movements of

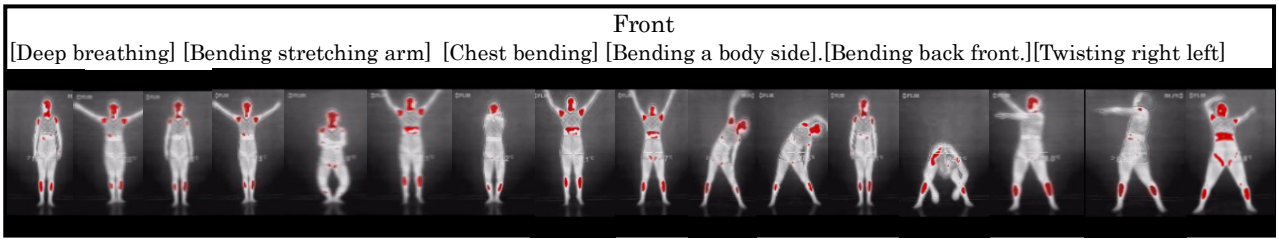


Figure 5　Radio Exercise No.1

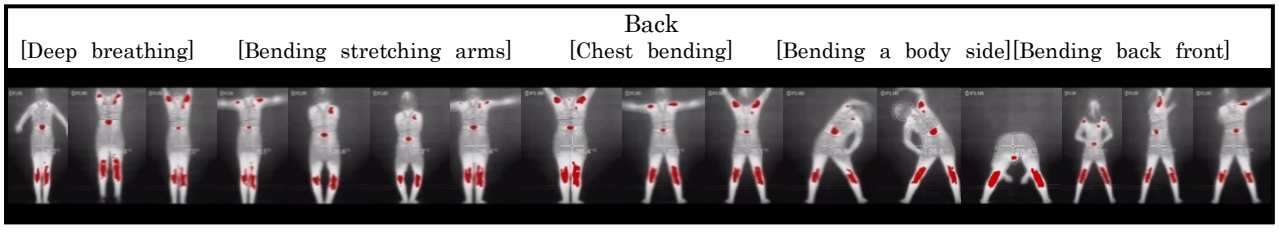


Figure 6　Radio Exercise No.1

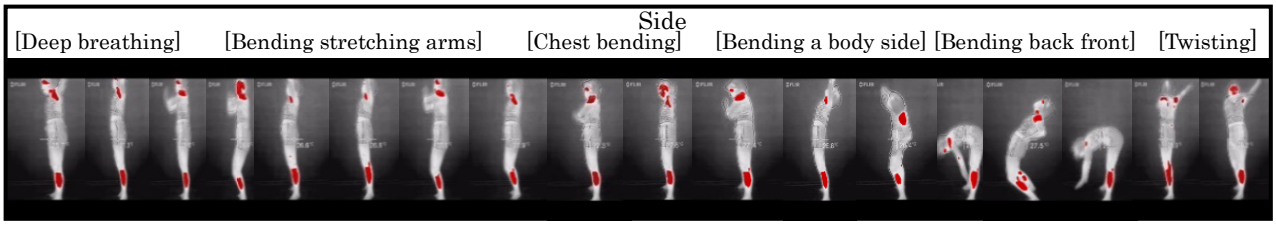


Figure 7　Radio Exercise No.1

bending the body to the side and bending the body back and forth. It maintained the same level until it increased to over 90/min with jumping.

Overall, the HRV of Hifumi Gymnastics is higher than that of Radio Exercise No. 1. The HRV of Hifumi Gymnastics increased gradually, repeating the fluctuations with each verse. The HRV of Radio Exercise No. 1 did not show the fluctuations of each movement throughout the exercises. Thus, the heart rate intensity of Hifumi Gymnastics is slightly higher than that of Radio Exercise No. 1. Examination showed that the HRV of Hifumi Gymnastics undergoes many changes in accordance with each motion in each verse because each verse includes a variety of movements (for example, jumping or more limited motions). In Radio Exercise No. 1, an increase in HRV was observed that was influenced not by the influence of each motion but by the passing of time. It is presumed that the pace of the exercise is monotonous because the motion pattern is fixed. Therefore, it is considered that the increase in HRV during Radio Exercise No. 1 is influenced only by time.

Several exercises have been created in Japan to maintain senior citizens' physical strength, and 'Shan Shan Gymnastics' is one of them. This programme was compared to Radio Exercise No. 1 in terms of the exercise intensity; the results indicated that the exercise was at the same level as Radio and that it had become familiar to elderly people in local communities. [16] These data cannot be compared to those for Hifumi Gymnastics simply because of the differences in the targeted ages. The tendency of Hifumi Gymnastics is to increase HRV gradually as each verse of traditional characters is practised, and it ultimately showed a higher HRV than Radio Exercise. The Hifumi Gymnastics programme may be repeated because of some requests from the children to memorize the lyrics and the movements after the practice in an educational setting. Then, this point will be reported after the next iteration.

### *4.2. Hifumi Gymnastics in Terms of Thermographic Data*

'Hifumi Gymnastics uses four specific factors (①the ipsilateral movements, ② the sliding walk, ③ the practice of the yatton rhythm and ④ the running method of the Japanese traditional mailman) as the exercises that are required for Japanese children. In the first verse, sumo wrestler, a wide range of the back and sides of the lower extremities (the back and sides of the calves) shows the maximum temperature mainly because of the motions to gain a lower centre of gravity, such as the shiko and dosukoi movements. Changes in the front lower extremities are not seen as much as those in the back and sides. As comparative data, Radio Exercise No. 1 keeps the maximum temperature on the front of the lower extremities throughout the exercise.

During the second verse, samurai, the front of the lower extremities shows the maximum during the movement of cutting down with a sword. However, the front part does not always indicate the highest temperature in the samurai. The wider parts of the back and sides of the lower extremities indicate the highest temperature during the movements of sliding one leg back and sitting, such as seiza, and cutting down with a sword. During the third verse, kimono girl, the front of the lower extremities around the knee shows the highest temperature in the first half. The maximum temperature is not seen with any movements except that one, however the back and sides of the lower extremities present the highest temperature during the motion of the sliding walk and the yatton rhythm.

During the fourth verse, hikyaku, the highest temperature is not found in the front of the legs. The wide boundary of the upper and lower extremities (inner calf) shows the maximum whenever running and jumping (that is, when the centre gravity is placed on one leg) is performed. An overview of the total Hifumi Gymnastics programme indicates that the front area of the extremity shows the maximum temperature only during the motion of cutting down with a sword in samurai. Conversely, it is observed that the back and sides of the lower extremities constantly maintain the maximum. In particular, the wide boundaries of the upper legs and lower extremities show the maximum temperature during the motions of shiko, dosukoi and hikyaku running. This tendency is particularly notable in sumo wrestler and hikyaku.

Meanwhile, Radio Exercise No. 1 proves that the

limited front muscles of the legs and the boundaries of the determinate upper limbs and lower extremities are used regularly throughout the exercise. In contrast, Hifumi Gymnastics continually uses the back and lateral muscles of the lower extremities.

The maximum temperature is also recorded on the back and sides of the lower extremities during the two movements of the sliding walk and sitting, such as seiza, including samurai and the movement and rhythm of yatton as well as kimono girl.

Additionally, the parts of the legs that show the maximum temperature in Radio Exercise are limited to a small area. Thus, the Radio Exercise programme does not use a variety of leg muscle areas.

### *4.3. Relation Between the Motions and the Experimental Results*

The results clearly indicate that Hifumi Gymnastics is a type of exercise that constantly stimulates the back muscles and the lateral muscles of the lower extremities. In particular, this tendency is conspicuous during the selected movements (①, ②, ③ and ④) designed to strengthen Japanese children's legs and loins (the first purpose). These results show that Hifumi Gymnastics is suitable for Japanese children in terms of enhancing the muscular power of the lower half of their body. It is also expected to have a kinematical effect. Additionally, the results prove that the muscles used in Hifumi Gymnastics shift within the areas of the back and lateral lower extremities according to each movement, the rhythm, and the pace, unlike Radio Exercise No. 1, which uses limited muscles of the legs and follows a monotonous rhythm.

In Nou and Kyogen (Nougaku), representative Japanese traditional performing arts, the basic posture is based on a low centre of gravity. [17] Additionally, it was clear that the muscles of the back and sides of the lower extremities are used in the exercises of the sliding walk and hikyaku running when the authors analysed these motions after designing them. This finding suggests that walking and other movements in Japanese traditional arts may consist of motions that tend to use the back and sides of the legs. No walking movement and no motion with a lower centre of gravity are found in Radio Exercise. Thus, it can be said that Radio Exercise uses a quality of movement that is completely different from that of Japanese traditional entertainment. The authors therefore gained the knowledge that the area of the leg used is limited and the pace of the exercise is fixed and regular in Radio Exercise. In future research, the authors plan to pursue the second purpose of investigating the effect on Japanese children of identifying the meaning of the lyrics with their body image in an educational setting.

## 5. Conclusion

This study explains that the exercise load of Hifumi Gymnastics increased with repetitions of the fluctuation of HRV in accordance with a variety of motions and rhythms. In contrast, the HRV of Radio Exercise rose due not to the fluctuation of the movements but to time passing.

In addition, this study proves that Hifumi Gymnastics is an exercise in which the back and sides of the lower extremities are trained. This tendency is observed especially conspicuously during the four movements that the authors inserted into Hifumi Gymnastics so that Japanese children could experience activities with a low centre of gravity. Furthermore, it is apparent that the back and lateral muscles of the lower extremities are trained harder than they are in Radio Exercise No. 1, possibly because Hifumi Gymnastics includes some movements and rhythms related to Japanese traditional entertainment.

This study of Hifumi Gymnastics was approached from not detailed descriptions of the HRV and measurement about the movements but an approximate trend. However, with regard to the purpose of grasping the exercise load and exercise tendency for children, Hifumi Gymnastics was clarified to be constructed of various movements and it proved to use many body parts from the comparison with Radio exercises. It shows it is valid as children's exercise for strengthening the lower extremities and loins of Japanese children.

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**Abstract（Japanese）**

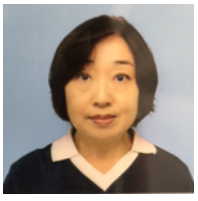
筆者らは，運動不足と体力向上の維持および自分文化理解の目的のために，現代の幼児・児童に有効な活動として，“低重心の動き”と“言葉と身体の協応”の動きが組み込まれている伝統芸能の動きに着目した．筆者らが作成した”ひふみ体操”は，日本の伝統的芸能の中で行われる特徴的動きを幼児の遊びの中に取り入れることで，現代の幼児期に実施されなくなりがちな下方重心型の活動と“多様な動き”の経験を補うことを目的とする．具体的には，能・狂言，日本舞踊に出てくる，日本古来の動き（例　同側動作，片足で踏ん張る，片足で跳ぶ，ヤットン拍子）を体操の中に設定した．

次に，身体と精神活動が分離しがちな現代の子どもの傾向を回避するためと，幼児期に必要とされる五感刺激によるボディイメージの獲得をさらに強化するため“ひふみ体操”は歌や言葉に出してその意味や意図を身体で体現する」遊びを組み込んだ．もともと日本の古来の芸能は，舞踊者が歌に合わせて自ら舞うという形式があり，また日本の伝承遊びには，わらべうた，お遊戯など，歌唱とともに身体で表現する遊びが多く見られることから“ひふみ体操”もそこに着目し作成した．

今回の報告は，あとで報告する“ひふみ体操”の教育実践効果報告の前段階として，“ひふみ体操”実践時の心拍数とサーモグラフィーの皮膚最高温部位の検出より，体操の運動負荷的特徴と動作特徴を他の体操と比較を用いながら分析することで，“ひふみ体操”自体の客観的特徴を明らかにすることを目的とした．

心拍の変動は，“ひふみ体操”は開始後 1 番から 4 番までの時間経過に伴い徐々に 75-80-100 越えまで緩やかに上昇してゆく傾向になった．ラジオ体操は，後半 80 過ぎを横ばいで維持する傾向が見られた．また“ひふみ体操”は，下肢部下部の側面と後面が（太ももからふくらはぎにかけての側面と後ろ側，足首にかけて側面と後ろ側）各動きを通じてしっかりと使われる運動であった．一方，下肢の前面部（ひざ下の前面部分）は側面部や後ろ側の部位と比較すると高温度を示さなかったことから，“ひふみ体操”は全体的に下肢の前側よりも側面部や下肢の下部後ろ側をよく使う体操であることが明らかにされた．

総合すると，ひふみ体操はラジオ体操との比較から身体の多様な部位と動きを用いる体操であることが明示され，子ども向け体操として妥当であるとの判断に至った．



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