Heart Rate Status of Players with Visual Impairment During a Newly Developed Blind Basketball Game

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Abstract: To make a clear exercise intensity as well as the features of the blind basketball, we measured the actual heart rate of the people with visual impairment during the blind basketball game. The heart rate of five people who are blind was measured by heartbeat meter. We adjusted a mock match in 10 minutes, the teams were set up by gender, and the performers were two on two. We measured the heart rates in three different situations, measuring in a whole game, only during the play, and only during the break, and analyzed those heart rate values in minimum, maximum, and mean to make a clear exercise intensity. The minimum value was 130.1 BPM, and the maximum value was 186.8 BPM, from the mean value of heart rating during the whole game. The minimum value was 148.8 BPM, the maximum value was 186.8 BPM, from the mean value of heart rating during only for the play. The mean value of heart rating of five participants during only the play was range between 150 to 180 BPM. This value is similar to that recorded from people with non-visual impairment during a typical basketball game playing. It means that the average heart rating of blind basketball player is much higher than the floor volleyball players which in range of 144.1 to 168.6 BPM, and the blind tennis players, between 145.8 to 153.8 BPM. Cleared featrues are: (1) the heart rate gently rose up, when the participant continued the defence, (2) the heart rate rapidly rose up, when the participant failed by dribble to defence, (3) the heart rate shown almost flat or decrease, unless the participant dribbled as top speed, and (4) the heart rate often rose rapidly, when the participant has dash, cut the pass, and pounce a loose ball.

Keywords: Visual Impairment; Basketball; Heart Rate; Exercise Intensity; Rating of Perceived Exertion

INTRODUCTION

In the community of people with visual impairment, the basketball is not yet distributed much nor included as the floor volleyball and the sound table tennis does. Because it is difficult for people with visual impairment to through and catch the aerial ball (Tsurui & Kobayashi, 2018), and it is imaginable of accidentally stumble and clash among players (Tsurui & Kobayashi, 2019). Meanwhile, the basketball has a lot of features that running in the coat, and various methods of shoot and dribble (Tsurui & Kobayashi, 2018), therefore, those features are different from the other visual impairment sports game such as blind tennis and floor volleyball. Therefore, the promotion of basketball game to be popular and included among community of people with visual impairment is a big step as it changing the sports style of them.

To measure the heart rate for clearly understanding heart rate status of people with visual impairments during exercise. According to past researches, during the basketball game of people with non-visual impairment the heart rate have been recorded between about 150 to 180 BPM (Yamaji, 1981). Furthermore, the BPM of floor volleyball (Kohda & Amano, 1999) and blind tennis (Sato, Sato, Sato, Matsui & Watanabe, 2017) were recorded during the game and also are clearly understanding. In this research, authors conducted research to measure the heart rate people with visual impairments during the mock match in basketball game for the members of basketball club, "BRAND NEW BASKET" in Japan. Collected data were analyzed to indicate the exercise intensity, in addition, the heart rate values in various features of blind basketball performances were compared to the heart rates of players in other sports.

METHOD

1. Participants:

We have invited five participants, who were agreed to participate in this research, people who are blind (2 males, 3 females) from "BRAND NEW BASKET". Before the main research, we made interviewing the participants about age, status of visual impairment, years of experiences in playing basketball, etc.

2. Procedure:

Adjusted a mock match as 10 minutes (one quarter), the teams set up by gender, and the performers were two on two:

(1) Measuring the Heart Rate:

We used heartbeat meter named A370, made by Polar Company, to measure heart rate of five participants. The participants were measured the heart rates in three different situations, namely the whole game, only during the play, and only during the break, in afterwards the collected data was analyzed to indicate the value of minimum, maximum, and mean.

(2) Calculated the Excise Intensity:

To clearly understanding the exercise intensity, we used the Karvonen Formula (Ogawa, Kitagaki, & Ono, 2010). In addition, Borg scale was used (Ogata & Aoki, 2008), when ?researched the rating of perceived exertion (RPE) and compared the heart rates.

(3) Research Ethics: This research was agreed by research ethics committee of University of Tuskuba (No.2019-54A).

FINDING AND DISCUSSION

1. Profile of Participants:

The average age of five participants was 24.6±1.0 years old, none of congenital blind participants. The years of playing basketball were between 4 years 5 months to 5 years 2 months.

2. About the Mock Match

(1) Result of Male Team:

The total time of mock match was 1,200 seconds, which consisted 576 seconds of only during the play and 624 seconds of only during the break. In other words, it consisted 27 plays and 26 break times. The average time of only during the play was 21.4±14.6 seconds. The result of mock match was 2-0, the winner was Orange team, where participant no.5 included and the loser was Blue team, where participant no.1 included.

(2) Result of Female Team:

The total time of mock match was 3,270 seconds, which consisted 741 seconds of only during the play and 2,529 seconds of only during the break. In other words, it consisted 38 plays and 37 break times. The average time of only during the play was 19.5±10.3 seconds. The result of mock match was 8-0, the winner was Blue team, where participant no.3 included and the loser was Orange team, where participant no.2 and 4 included.

3. About the Measure Heart Rate

(1) Result of Male Team

①*Participant no.1:*

The result of measuring heart rate of participant no.1 from the whole game was shown on figure 1. The vertical axis describes the BPM and the horizontal axis describes the time in seconds during the game. About the heart rate of participant no.1 from the record was 124 BPM as minimum, 190 BPM as maximum and 168.6 BPM as mean. If the maximum BPM of participant no.1 (25 years old) that calculated based on Karvonen Formula (Ogawa, et al., 2010) is 195, the average exercise intensity would be 86.4%. Moreover, the mean BPM of participant no.1 from only during the play was 169.7 and from only during the break was 167.6. It was cleared that feature made a changing of heart rate that was repeated the gently rose up and down. Specifically, the heart rate shown almost flat or decrease, unless the participant dribbled as top speed. Especially, this player, participant no.1, often showed that the heart rate rose up in a moment about 3 to 4 BPM. However, the situation of it was happened that when he pounced a loose ball or cut the ball from dribbling.

②*Participant no.5:*

The result of measuring heart rate of participant no.5 from the whole game was shown on figure 2. About the heart rate of participant no.5 from the record was 151 BPM as minimum, 198 BPM as maximum

and 186.8 BPM as mean. If the maximum BPM of participant no.5 (26 years old) that calculated based on Karvonen Formula (Ogawa, et al., 2010) was 194, the average exercise intensity would be 96.3%. Moreover, the mean BPM of participant no.5 from only during the play was 186.8 and from only during the break was 186.5.It was cleared that feature made a changing of heart rate that this player often changed the heart rate gently rose up. It specifically often verified in the situations that block the dribbling or block the move of the other players.

(2) Result of Female Team
① Participant no.2:

The result of measuring heart rate of participant no.2 from the whole game is shown on figure 3.
 About the heart rate of participant no.2 from the record was 107 BPM as minimum, 189 BPM as maximum and 150 BPM as mean. If the maximum BPM of participant no.2 (23 years old) that calculated based on Karvonen Formula (Ogawa, et al., 2010) is 197, the average exercise intensity would be 76.2%. Moreover, the mean BPM of

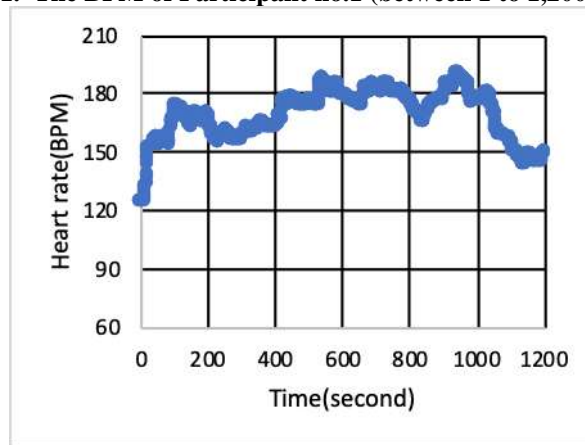**Figure 1. The BPM of Participant no.1 (between 1 to 1,200 seconds)**

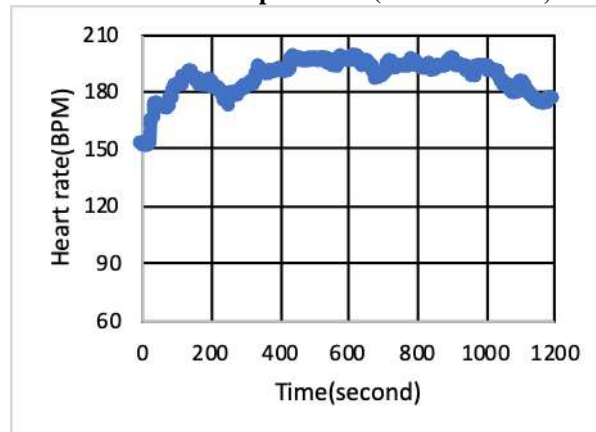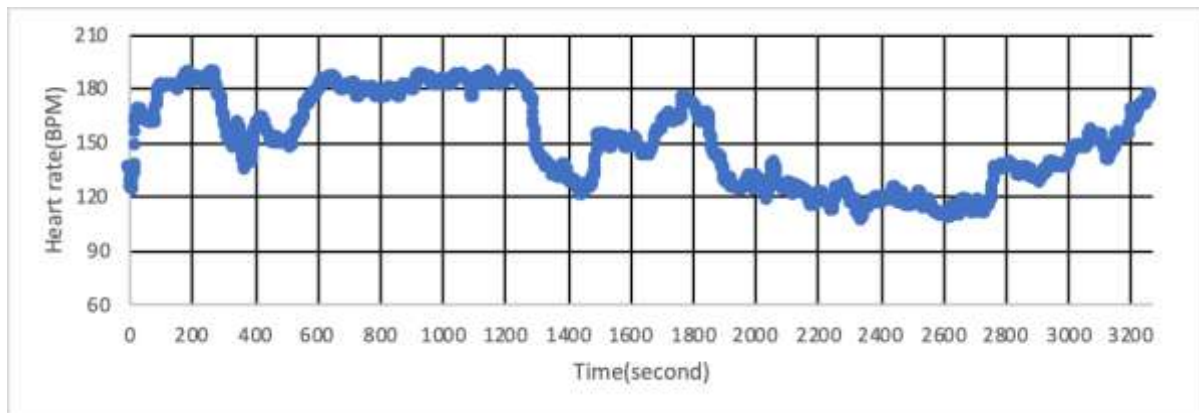**Figure 2. The BPM of Participant no.5 (between 1 to 1,200 seconds)**

Figure 3. The BPM of Participant no.2 (between 1 to 3,270 seconds)

participant no.2 from only during the play was 172.5 and from only during the break was 143.5.It was cleared that feature made a changing of heart rate, this player often changed the heart rate gently rose up during the play. As the same as participant no.5, it specifically often verified in the situations that block the dribbling or block the move of the other players. Also, this player often showed the over 180 BPM, and it was especially often verified when the Blue team got the points.

②Participant no.4:

Measured heart rate of participant no.4 from the whole game is shown on figure 4.About the heart rate of participant no.4 from the record was 105 BPM as minimum, 178 BPM as maximum and 136.2 BPM as mean. If the maximum BPM of participant no.4 (24 years old) that calculated based on Karvonen Formula (Ogawa, et al., 2010) is 196, the average exercise intensity would be 69.5%. Moreover, the mean BPM of participant no.4 from only during the play was 148.8 and from only during the break was 132.6.It was cleared that feature made a changing of heart rate, this player repeatedly changed the heart rate rose up and down. As the same as the participant no.3, this player showed a quick decreased of heart rate while the break. On the other hand, her heart rate didn't much show the changing, although she did a lot of shoots, and dribbles. Therefore, the result was lower than the participant no.2, who is the team-mate.

③Participant no.3:

Result of measuring the heart rate of participant no.3 from the whole game is shown on figure 5. About the heart rate of participant no.3 from the record was 81 BPM as minimum, 173 BPM as maximum and 130.1 BPM as mean. If the maximum BPM of participant no.3 (25 years old) that calculated based on Karvonen Formula (Ogawa, et al., 2010) is 195, the average exercise intensity would be 66.7%. Moreover, the mean BPM of participant no.3 from only during the play was 149.4 and from only during the break was 124.5. The main skill of this player was dribble and shoot, therefore, it seemed that she could hold back the heart rate. Showed a quick decreased of heart rate while the break too. However, when her heart rate was over 170 BPM, it showed flatness for a while.

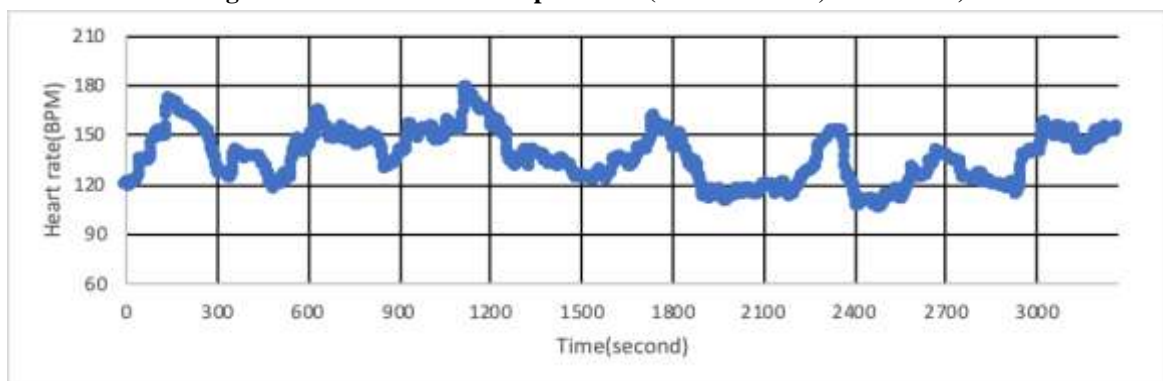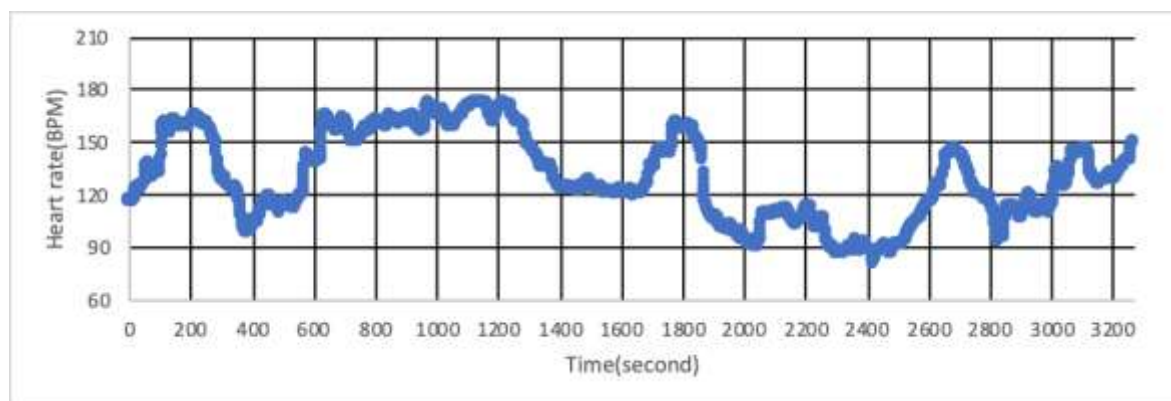**Figure 4. The BPM of Participant no.4 (between 1 to 3,270 seconds)**

Figure 5. The BPM of Participant no.3 (between 1 to 3,270 seconds)

4. About the Rating of Percived Exertion (RPE)

Participant no.1 was chose 15 from Borg scale, when he felt most hard. Then he was chose 10 from Borg scale, when he felt most right. These chosen points were lower than the heart rate of mock match (maximum 190 BPM and minimum 124 BPM). Participant no.5 was chose 17 from Borg scale, when he felt most hard. Then he was chose 11 from Borg scale, when he felt most right. These chosen points were lower than the heart rate of mock match (maximum 198 BPM and minimum 151 BPM). It means that these two participants, no.1 and 5, shown that the RPE is lower than their heart rates from mock match. Therefore, we presumed that these two participants could continue the play easily.

Meanwhile, participant no.2 was chose 19 from Borg scale, when she felt most hard. Then she was chose from 11 Borg scale, when she felt most right. These chosen points were mostly equal to the heart rate of mock match (maximum 189 BPM and minimum 107 BPM). Participant no.4 was chose 17 from Borg scale, when she felt most hard. Then she was chose 11 from Borg scale, when felt most right. These chosen points were also mostly equal to the heart rate of mock match (maximum 178 BPM and minimum 107 BPM). It means that these two participants, no.2 and 4, shown that the RPE is mostly equal to the heart rates from mock match, consequently, it showed a strong reliability.

As the last, participant no.3 was chose 19 from Borg scale, when she felt most hard. Then she was chose 10 from Borg scale, when she felt most right. These chosen points were higher than the heart rate of mock match (maximum 173 BPM and minimum 81 BPM).

5. Compare with the Other Sports

The mean value of heart rates from the male team, during for the whole game, was mostly equal or higher than the record, that from people with non-visual impairment during for a typical basketball game, between 150 to 180 BPM (Yamaji, 1981). Meanwhile, the mean value of heart rates from the female team, during for the whole game, was lower than people with non-visual impairment during for a typical basketball game. However, we could presume that the heart rate would rising up, when the break time got shorter. The mean value of heart rates from the female team, during only for the play was a similar value that recorded from people with non-visual impairment during for a typical basketball game.

To compare with the other blind sports, the average heart rate was between 145.8 to 153.8 BPM, during for the play of the blind tennis game, recorded from two males, in 40s (Sato, et al., 2017). Then, the average heart rate was between 144.1 to 168.6 BPM, during for the play of the floor volleyball game, recorded from blind junior college students (Kohda & Amano, 1999). These results clearly showed that the mean value of heart rates of the blind basketball is much higher BPM.

Nevertheless, according to Kanno (1986), the heart rate would be decreasing when the number of team members got increased. Therefore, we presumed that the heart rates of blind would be decreasing, if they playing the basketball 5 on 5. Then we also presumed that even if the blind playing the basketball 2 on 2, they could not be moved as quickly as may people with non-visual impairment do.

CONCLUSSION

From the two mock matches, cleared features are: (1) the heart rate gently rose up, when the participant continued the defense, (2) the heart rate rapidly rose up, when the participant failed by dribble to defense, (3) the heart rate shown almost flat or decrease, unless the participant dribbled as top speed, and (4) the heart rate often rose rapidly, when the participant has dash, cut the pass, and pounce a loose ball. Also, it considered as to be effective for improving the endurance and cardiorespiratory function of people with visual impairment because it loads more than the other blind sports.

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