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Analogy of Physical Performance Characteristics of Female and Male Ice Hockey Players

Parvaize Ahmad yarbash

Research Scholar Department of Physical Education University of Kashmir (J&K)

Email: yarbashparvaiz@gmail.com

Dr Rouf Ahmad Bhat

Research Scholar School of Studies in Political science Vikram University, Ujjain-M.P (India),

E.mail:roufbhat18@yahoo.com

Abstract

Females and males playing hockey together has caused great debate regarding the safety, ethics, and physiological differences of "girls" playing against "boys." However, there are no objective performance criteria that suggest female hockey players should not play with, or against, age-matched males. Research to compare the on-ice and off-ice physical performance characteristics of females and males will help answer questions regarding inter-gender hockey and further the understanding of female hockey players. The purpose of this study was to compare years of playing experience, off-ice fitness, on-ice performance skating, and on-ice anaerobic power of female and male ice hockey players between the ages of 10 and 15 years

Introduction

Fifty-four female and 77 male hockey players ranging in age from 10-15 years volunteered for this study. Demographic data included: age (AGE) and years of playing experience (YPE). Off-ice tests included: height (HGT), body mass (BM), lean body mass (LBM), predicted body fat % @AT%), 40-yard dash (40YD), vertical jump (VJ), push-upslmin (PUPS), sit-upslmin (SUPS), and sit-and-reach flexibility (S&R). On-ice performance skating tests included: acceleration (ACC), agility (AGL), and speed (SPD). On-ice anaerobic power (AnPow) was calculated using the formula of Watson and Sargeant (18). Generally speaking, the females and males in this study had similar results in office fitness. The males

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consistently out-performed the females in the on-ice tests. It would be difficult for females to compete with or against same-aged males based on the fact that males are superior skaters.

Although women have played hockey for many years, little research data exist regarding the physical performance characteristics of female hockey players.

Since its status as a full medal sport in the 1998 Olympic Winter Games, female hockey has taken a higher profile, and understanding the performance characteristics of these athletes has become increasingly important. Understanding the physical performance characteristics of female hockey players can help identify weaknesses in conditioning, improve performance, establish baseline performance data, and develop scientifically based training protocols. For many years, young female hockey players, wanting to play at a higher level of competition, have played on, or against, age-matched male teams. In some cases, females had to play incognito for fear of "getting caught" playing with or against males. In all these cases the female players were of exceptional ability and could compete against males of the same age.

Method

Subjects

Subjects were 54 female and 77 male hockey players from hockey teams in and around Calgary, AB, and participants in the American Hearing Impaired Hockey Association summer hockey camp in Chicago, IL (10-1 1 years: female, n = 19, male, n = 21; 12-13 years: female, n = 20, male, n = 31; 14-15 years: female, n =15, male, n = 25). Informed consent was obtained from a parent or legal guardian prior to testing. Each subject was informed of the objectives of the study, the testing protocol, the risks of participation, and the benefits of participation. The subjects were analyzed in the age groups they play in during the hockey season. Canadian and American youth hockey systems have age group categories as follows: 10 and 11 years ("Atom"), 12 and 13 years ("Pee Wee"), and 14 and 15 years ("Bantam").

Procedures

On-Ice Testing

Subjects wore full equipment and carried their stick during the testing. Prior to testing, players were lead through a 15-min on-ice warm-up consisting of skating, on-ice calisthenics (arm and shoulder circles, lateral torso bends, squats, push-ups, curl-ups, back extensions, and hip abductions and adductions) and static and dynamic stretching. The testing was done in the following order: (a) agility cornering S turn (AGL), (b) 6.10-m (20 feet) acceleration (ACC), and (c) 44.80-m (147 feet) speed (SPD). Two trials of each skating test were measured with a Brower Speed Trap 2 photo electric timing system. Timers were adjusted for the height of the subject and ranged from 0.61-m (2 feet) to 0.91-m **(3** feet) off the ice surface, which was approximately shoulder height when a subject was skating full speed. Subjects were tested in alphabetical order for both trials of all tests. After a subject finished the first trial (of each test), he or she continued to skate in the opposite end of the rink**.** After the first trial, the entire group came back to the start area for the second trial. the subjects keep moving while waiting for the next trial. Subjects received at least 7 min of recovery time between trials and 5 min between tests, while the timers were repositioned.

Before each test, the researcher demonstrated the movement. The AGL followed the protocol of Greer et al. (1 1). The length from goal line to finish line was 18.90-m (62 feet), and the width was 22.55-m (74 feet). The ACC (15, 16) and the SPD were measured in one continuous skating movement, with the first 6.10-m being measured as an acceleration split time, and the entire 44.80-m being measured as the speed performance. Subjects faced forward behind a start-line at the first timing device. When the clock was reset from the previous test, a researcher would tell the next subject to go. The SPD test was used with body mass to establish anaerobic power (AnPow) using the formula of Watson and Sargeant (18): AnPow = Body Mass (kg.) X 44.80-m /Time. The average of two trials was calculated and used in the data analysis.

Off-Ice Testing

The testing was completed in the following order: (a) skinfold measurements, (b) height and body mass, (c) vertical jump, (d) push-upslmin, (e) sit-and-reach flexibility, **(f)** sit-upslmin, (g) 40-yard dash, and (h) playing experience questionnaire. **A** 15-min warm-up, consisting of low intensity push-ups and abdominal crunches, running, and static and dynamic stretching exercises, was performed after the skinfolds, height, and body mass were measured. The female subjects had triceps, supra-iliac, and thigh skinfolds measured, and the male subjects had chest, abdominal, and thigh skinfolds measured for predicted body fat percentage. The sum of the three skinfolds was calculated, and an estimate of fat percentage was calculated from Baurngartner and Jackson's (2) tables for estimates of percentage for fat. Each skinfold was measured three times, using a measurement occurring more than once, or the average of two or three measurements if they were close together, as the skinfold measurement for data analysis. Reliability skinfolds measurements were performed on every other subject and calculated as r = 39. Height was measured by having the subjects stand against a tape measure taped to a wall and measuring the height with a ruler. Body mass was measured with a standard weigh scale calibrated after each subject was weighed.

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Body mass was measured three times, with the same measurement occurring more than once, or the average of two or three close measurements, used in the data analysis. Reliability measures were conducted with every other subject for height and body mass. The r values were .92 and .90 for height and body mass, respectively. Vertical jump was measured using the protocol of Baumgartner and Jackson

(2), with the average of the highest two of three jumps being recorded. Subjects were instructed to use a countermovement with their arms and legs to jump as high as possible, making a mark with their "chalked" fingers on the wall. Subjects were allowed one practice jump prior to data collection. Although comparing boys to girls with push-ups has limitations, with bichromium (bi-scapular) breadth being wider in males than in females, push-ups were used as a measure of relative upper body strength/endurance. Push-ups were counted by a researcher, while a subject started flat on an exercise mat and pushed up on his or her toes until the elbows were straight and went down until the elbows were at 90'. Each time a subject went up and down, a push-up was counted. When a subject's technique deviated from the protocol, he or she was instructed to take a rest but was encouraged to do more when able. Sit-and-reach flexibility was measured with a meter stick placed between the subject's bare feet, whereupon the subject reached as far down the stick as possible while keeping the heels on a line on the ground, the knees straight, and one hand over the other with fingers parallel. Sit-ups were performed with a researcher holding the feet of subject, the knees at a 90' angle, arms crossed over the body with hands touching the opposite shoulder. **A** subject started in the down position and proceeded to sit-up **until** the arms touched the thighs and back down until the lower back touched the exercise mat. When a subject's hips started to come off the ground, or the arms were not touching the body, or the hands were not touching the shoulders, he or she was instructed to rest but encouraged to attempt more sit-ups when able. Forty-yard dash was measured with photoelectric timing cells. Subjects ran on grass and were instructed to go on the command of the researcher. The average of two trials was calculated and used in the data analysis. Subjects ran the opposite direction on the second **CraiI.** Two trials were used because there was a slight wind and an average time was desired to theoretically illuminate a "wind aided" 40-yard dash. The number of years a subject played hockey was recorded based on verbal questioning which, in most cases, was in the presence of the subject's mother or father. The number of years a female subject participated in a game called ringette, which is very similar to ice hockey, was also recorded and added to the years of playing experience.

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Statistical Analysis of Data

Means and standard deviations were calculated for descriptive data (Tables 1-3). Data were analysed with separate one-way **ANOVA** for each variable to determine significant differences between the two groups (17). Experiment-wise error was adjusted using the Bonferroni technique (17). Alpha level for Bonferroni correction for 14 variables wasp < .00357.

Table 1 ANOVA (Bonferroni Corrected): Off-Ice and On-Ice Testing: Physical Performance

Characteristics of Female and Male Hockey Players: 10-11 Years Old.

Variable	Female (n = 19)	Male (n = 21)
		10.75 + 0.65 years
Off-ice	10.95 f 0.55 years	5.00 **f** 0.89 years
Age	3.80 f 1.74 years	140.92 f 4.1 1 cm
Playing exp	143.43 f 8.30 cm	35.66 + 4.32 kg
Height	36.44 ?I 7.13 kg	30.58 + 5.32 kg
	29.39 + 6.65 kg	"7.58 + 2.24%
Body mass	19.00 + 7.41%	9.44 + 0.52
Lean mass	7.45 f 0.61	33.46 **f** 7.48 cm
Body fat %	29.67 f 6.63 cm	22.21 **f** 10.96 p-ups
40-yard Dash	28.94 f 12.62 p-ups	30.78 + 1 1.94 S-ups
Vertical jump	*32.50 + 8.00 S-ups	33.77 + 7.56 cm
Push-upslmin	39.60 + 7.82 cm	
Sit-upslmin		
Sit & reach		

On-ice	*1.64 **f** 0.10	1.78 + 0.11
Acceleration (6.1 **m)**	7.73 **f** 0.46	*6.97 + 0.56
Speed (44.80 m)	11.74 f 0.75	11.695 1.04
Agility	5.81 f 0.33 w . kg-'	*6.52 **f** 0.18 w . kg-'
Anaerobic power		
Bonferroni correction ***p*** <		

.00357		

Table 2 ANOVA (Bonferroni Corrected): Off-Ice and On-Ice Testing: Physical Performance

Characteristics of Female and Male Hockey Players: 12-13 Years Old.

Variable Male (n = 31)	Female (n = 20)	Male (n = 31)
Off-ice		
Age		
Playing exp	12.75 +_ 0.54 years	12.25 +- 0.52 years
Height	4.25 + 2.27 years	*6.68 +_ 1.06 years
Body mass	158.60 + 1.07 cm	159.17 + 8.68 cm
Lean mass	46.97 f 7.95 kg	48.28 + 8.54 kg
Body fat %	38.59 f 5.46 kg	36.23 + 6.42 kg
40-yard dash	17.43 **f** 3.71%	"6.80 f 3.41%
Vertical jump	7.01 **f** 0.50	6.58 **f** 0.49
Push-upslmin	31.00 **f** 7.20 cm	*37.93 f 7.50 cm
Sit-upslmin	31.95 + 10.65 p-UPS	29.60 + 10.13 p-ups
Sit & reach	35.15 + 7.50 S-UPS	38.23 + 8.41 s-ups
On-ice	37.39 + 9.99 cm	36.24 + 7.71 cm
Acceleration (6.10 m)	1.63 + 0.14	1.67 + 0.09
Speed (44.80 m)	7.54 f 0.38	*6.48 + 0.41
Agility	11.10 **f** 0.48	*10.10 **f** 0.52
Anaerobic power	5.44 +_ 0.31 w . kg-'	*6.93 +- 0.46 w . kg-'
Bonferroni correction ***p** < .00357		

Results

ANOVA with the Bonferroni correction ***0*** < .00357) determined significant differences between the female and male hockey players. The data for off-ice and on ice testing are presented in Tables 1, 2, and 3. The 12-13-year and 14-15-year male players had significantly more YPE. There were no differences in the HGT, BM, or LBM. The males consistently had lower predicted FAT%. No differences existed in the 40YD. The 12-13-year males had a significantly higher VJ. The 14- 15-year males performed more PUPS. The 10-1 1-year females performed more SUPS. There were no differences in **S&R** flexibility in any of the groups. The 10-1 1 females accelerated quicker over 6.1 m. In every age group, the males were faster on the SPD test. On AGL, the 12-13-year males performed better. In every age group, the males produced more skating AnPow,

Discussion

There were few differences in the components of off-ice fitness between the females and males. The 12-13-year males had a 6.93-cm higher VJ than the females,

Table 3 ANOVA (Bonferroni Corrected): Off-Ice and On-Ice Testing: Physical Performance Characteristics of Female and Male Hockey Players: 14-15 Years Old

Variable	Female (***n*** = 15)	Male (n = 25)
Off-ice		
Age	14.55 f 0.46 years	14.65 f 0.26 years
Playing exp	5.96 + 3.03 years	"9.00 f 1.63 years
Height	64.85 f 5.94 cm	166.69 f 9.99 cm
Body mass	58.83 f 5.92 kg	56.92f 9.61 kg
Lean mass	47.69 f 3.65 kg	
Body fat %	19.88 + 4.85%	43.81 f 6.71 kg
40-yard dash	6.74 f 0.42	*13.80 f 2.96%
Vertical jump	38.13 _+ 5.74 cm	6.40 f 0.42
Push-upslmin	27.17 f 11.07 p-ups	44.43 f 8.14 cm
Sit-upslmin	35.17 f 8.97 s-ups	*37.44 + 11.55 p-ups
Sit & reach	39.39 + 12.02 cm	42.72 f 7.1 1 s-ups
On-ice		
Acceleration (6.10 m)	1.602 0.11	36.28 f 8.75 cm
Speed (44.80 m)	7.19 f 0.29	1.62f 0.14
Agility	10.68 + 0.71	
Anaerobic power	6.12 + 0.24 w kg-'	*6.23 f 0.40
Bonfenoni correction		10.13 f 1.08
p<.00357		*7.09 f 0.45 w . kg-'

which probably explains their 1.06-s superior performance on the SPD as vertical jump has consistently been found to be a reliable predictor of skating speed (3,5, 7, and 14). The 14-15-year males performed 10.5 more push-ups than the females. This may be a result of the bichromium (bi-scapular) breadth being wider in males than in females. The 10-1 1-year females showed superior performance in sit-ups. There were no differences in the flexibility of the players.

The only difference between any of the groups in acceleration was the 10- 1 1-year females' superior performance; all other groups had similar acceleration. These results concur with Bracko (4), who found that elite and non-elite female hockey players were also similar in their ability to accelerate over 6.1 m. Bracko et al. (6 also found that non aged matched male high school players were similar in acceleration time. It appears that acceleration does not differ significantly for younger and older elite and non-elite females, and young non-elite male hockey players. The male hockey players were 0.76-1.06 s faster than the females on the speed test. The increased length of the SPD requires a higher level of skill coordination in order to produce a faster time. The superior speed of the 12-13-year and 14-15-year male groups may also be attributable to their increased years of playing experience. The AGL test is the most representative of game-performance skating (8). The 12-13-year male hockey players were 1.00 s faster on the AGL than the female players. The 12-13-year males had more playing experience, which can explain their performance on AGL. There were no differences in AGL for the 10-1 1- year and 14-15-year groups. All the males in this study produced 0.71-1.49 w - kg-' more on-ice AnPow than females. The males higher AnPow output was in spite of the fact that there were no differences in HGT, BM, and LBM. However, the males were consistently lower in FAT%. Therefore, the increased production of on-ice AnPow in the male hockey players may be due to several factors: (a) The 12-13 and the 14-15-year male groups had more playing experience, which can translate into a higher level of skating skill; (b) the 12-13-year males had higher VJ, which is a measure of power and may translate into power production on the ice; and (c) although this was not quantified, the males may have had more specialized training in hockey in the form of skating and hockey camps. Anaerobic fitness is an important performance variable for hockey players (13), and information about on-ice fitness can be an important criteria for a coach to understand about a player. Bar-Or (1) suggests the accuracy of "field tests" may be questioned because of the skill level required to perform well. Nevertheless, skating ability (12), and testing skating ability, are important aspects of hockey performance. Sport scientists are concerned with eliminating the skill factor in exercise testing to produce objective results, whereas coaches are interested in a player's sport-specific fitness and game-performance skating ability. With the use of Watson and Sargeant's (18) formula, on-ice testing provides the opportunity to analyse both. On-ice testing for anaerobic fitness may be more appropriate than using a Wingate cycle ergometer test (10). Skating is different from cycling because the external power is used to overcome air and ice resistance, and to support body weight (9). During cycling, weight is supported, and the requirements of external power are reduced. Another difference between skating and cycling is that during skating the arms are used to maintain balance and aid in forward momentum, whereas in cycling, the arms are stationary. Greer et al. (1 1) cited a test-retest r value of 0.96 for the AGL test on 14- and 15-year male players. Bracko (4) calculated Pearson product moment correlations when he performed a test-retest on elite and non-elite female hockey players for

ACC ($r = .80$, $p < .001$), SPD ($r = .76$, $p < .01$), and AGL ($r = .64$, $p < .02$). Watson and Sargeant (18) developed formulas to determine anaerobic capacity and anaerobic power from skating tests. When comparing values from on ice scores and Wingate test scores, they found that the values calculated from the on-ice data overestimated off-ice AnPow and AnCap by an average of 1.5 w . kg-'. They also showed significant correlations (***p*** < .05) between 40-s skate and a repeat skate test and AnCap (Wingate), $r = .73$ and $r = .69$, respectively. Blatherwick (3) found that skating endurance correlated significantly ($r = -.60$, $p < .01$) with a 45-s bike test, and skating acceleration correlated significantly ($r = -.59$, $p < .01$) with a 6-s bike sprint as measured by total revolutions. The results of this study indicate that there were no drastic differences in office fitness between 10-15-year female and male hockey players, and any differences that did exist seemed to be age dependent (YPE, VJ, and PUPS). The only component of fitness on which that the males were consistently better than the females was a lower FAT%. The males however, had consistently better performance on the on-ice tests. The males out-performed the females on 7 of 12 skating tests. Most important, the males were significantly faster and produced more power on the ice. If off-ice fitness was the only consideration, the results of this study would indicate that 10-11-, 12-13-, and 14-15-year female and male hockey players could play hockey together or against each other (in their respective playing categories) because they seem to have the same levels of fitness.

The males in this study were superior in skating ability. Since skating ability, and particularly speed, is central to success in ice hockey (12), the poor performance of the females on many skating tests would make competition against, or with, males very difficult despite similarities in off-ice fitness. There are some exceptionally talented females that are good skaters and can compete with males, but they are few in number. The reason for the better skating performance of the males in this study may be simply that the males have more playing experience, with the exception of the 10-1 1 -year group. In addition to having played the game longer, the males in this study may also have had more specialized training in hockey such as skating clinics and summer hockey camps. Typically young male hockey players are socialized into participation in summer and pre-season hockey1 skating camps and clinics. Females are starting to play hockey at earlier ages (like males have done for decades) and are participating more in specialized hockey training programs. With increased training, females may be able to show the same skating performance as males (at younger ages) in the future. However, until females can produce the same skating performance as males, it is unlikely that 10-1 I-, 12-13-, and 14-15- year females will be able to play hockey on the same level as males.

References

1. Bar-Or, 0. The wingate anaerobic test: an update on methodology, reliability and validity. ***Sports Med.*** 4:381-394, 1987.

2. Baumgartner, T., and AS. Jackson. ***Measurement for Evaluation in Physical Education and Exercise Science.*** Dubuque, **IA:** Wm. C. Brown, 1987.

3. Blatherwick, J. ***A Physiological Projile of an Elite Ice Hockey Player; the Importance of Skating Speed and Acceleration.*** Unpublished Doctoral Dissertation, University of Minnesota, 1989.

4. Bracko, M.R. On-ice performance characteristics of elite and non-elite female ice hockey players (abstract). ***J. Strength Cond Res.*** (In press).

5. Bracko, M.R., and G.W. Fellingham. Prediction of ice skating performance with office testing in youth hockey players (abstract). ***Med. Sci. Sports Exerc.*** 29:S172. 1997.

6. Bracko, M.R., G.W. Fellingham, and R.D. Lyons. Glenohumeral kinematics: a com**p a r i s o n i ~ ~ & r & W ~ = b) - M e b S c L -** ***Sports Exerc.*** 28:S55, 1996.

7. Bracko, M.R., and J.D. George. Prediction of skating performance with off-ice testing in young female ice hockey players. J. ***Strength Cond Res.*** (In press).

8. Bracko, M.R., L.T. Hall, A.G. Fisher, G.W. Fellingham, and W. Cryer. Performance skating characteristics of professional ice hockey forwards. ***Sports Med., Training and Rehab.*** 8: 251-263. 1998.

9. de Boer, R.W., G.J. Van Ingen Schenau, and G. de Groot. Specificity in training inspeed skating. In: ***Physiology, Biornechanical and Technical Aspect of Speed Skating,***
P. Rispens and R. Lamberts (Eds.). Groningen, The Netherlands, 1985, pp. 49-59.

10. Geijsel, J., G. Bornhoff, J. vanvelzen, G. deGroot, and G.J. van Ingen Schenau. Bicycle ergometry and speed skating performance. ***Int. J. Sports Med.*** 5:241-245, 1984.

ISSN- 2394-5125 VOL 07, ISSUE 19, 2020

11. Greer, N., J. Blatherwick, R. Serfass, and W. Picconato. The effects of a hockey-specifictraining program on the performance of bantam players. ***Can. J. Spt. Sci.*** 17:65- 69, 1992.

12. Hansen, H., and A. Reed. Functions and on-ice competencies of a high caliber hockey player-a job analysis. In: ***Science in Skiing, Skating, and Hockey. Proceedings of the International Symposium of Biomechanics in Sports,*** J. Terauds and H.J. Gros (Eds.). Del Mar, CA: Academic Publishers, 1979, pp. 107-1 15.

13. Montegomery, D.L. Physiology of ice hockey. ***Sport Med.*** 599-126, 1988.

14. Mascaro, T., B.L. Seaver, and L. Swanson. Prediction of skating speed with off-ice testing in professional hockey players. ***JOSPT*** 15(2), 92-98, 1992.

15. Naud, R.L., and L.E. Holt. A comparison of selected hockey skating starts. ***Can. J. Appl. Spt. Sci.*** 4:8-10, 1979.

16. Naud, R.L., and L.E. Holt. A comparison of selected stop, reverse and start (SRS) techniques in ice hockey. ***Can. J. Appl. Spt. Sci.*** 594-97, 1980.

17. Thomas, J.R., and J.K. Nelson. ***Introduction to Research in Health, Physical Education, Recreation, and Dance.*** Champaign, IL: Human Kinetics, 1985.

18. Watson, R.C., and T.L.C. Sargeant. Laboratory and on-ice test comparisons of anaerobic power of ice hockey players. ***Can. J. Appl. Spt. Sci.*** 11:218-224, 1986.