COMPARISON OF SNOWSHOEING KNIEMATICS ON GRASSLAND AND SAND COURSE – PILOT STUDY

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The purpose of this study was to compare the kinematics characteristics of snowshoeing on grassland and sand course in elite Hong Kong mentally handicapped athletes. Two athletes were asked to perform the snowshoeing on grassland and sand course with their maximal speed. Kinematics parameters included single leg support time, flight time, stride frequency, velocity of center of gravity (CG), vertical displacement of CG, cycle length, thigh and knee angle were measured. The results of low extremity kinematics supported that there were differences in movement pattern of snowshoeing between grassland and sand course.

KEYWORDS: snowshoeing, grassland, sand course

INTRODUCTION: Snowshoeing (see Figure 1) is one of popular sports and it became the top 20 participatory sports in the US (Connolly, 2002). The movement of snowshoeing is similar to walking/running except the athlete uses a controlled glide called a glissade.

Recently, snowshoeing has become an official event in Special Olympics. The idea of Special Olympics considered that snowshoe racing could help athletes enhance their fitness level during the winter months through a full body workout. Literature founding indicated that snowshoeing at a self-pace for 30 minutes provides sufficient intensity to improve the cardiovascular endurance (Schneider et al., 2001). Another study showed that a six weeks of snowshoe training, 30 minutes at 75-85% maximum heart rate and 3-4 times weekly, provides significant improvement on cardiovascular endurance (Connolly, Henkin, & Tyzbir, 2002).

However, the training venue of snowshoeing may be difficult to find in some countries (Luk, Fung, & Hong, 2005). The sports ground track may not allow snowshoeing training because of policy and the sports ground user guideline according to the design of snowshoes. Sometimes, coaches will use grassland or sand course for snowshoeing training purpose. However, limited study was found to talk about the biomechanics of snowshoeing on different materials of course. Such information may be useful for athletes and coaches to arrange training of snowshoeing at different places or seasons.

Therefore, the purpose of this study was to compare the kinematics characteristics of snowshoeing on grassland and sand course in elite Hong Kong mentally handicapped athletes.

a)  b) 

Figure 1. a) Snowshoeing on sand; b) Snowshoeing on grass

METHOD: Two athletes (2 male) participated in this study. Age, body weight and stature of the participants were 33.50 ± 0.71 years, 64.77 ± 4.82 kg and 169.50 ± 0.71 cm respectively. Their training frequency was 3 hours per section and 3 sections weekly. All subjects were asked to perform the snowshoeing on sand and grassland with their maximal speed for about 30m in distance. The length of grass is about 4.5cm and width is ranging from 2 to 8mm (see Figure 2). A 3CCD digital camcorder with 50Hz filming rate (SONY TRV-950E PAL) was located 14 meters away from the subject and the shutter speed was set at 1000Hz (see Figure 2). A section of running motion was video recorded. The video material was then converted into computer format for further analysis with motion analysis system (APAS). Kinematics parameters such as single leg support time, flight time, stride frequency, velocity of CG, vertical displacement of CG, cycle length, thigh and knee angle were calculated. The descriptive statistics of the snowshoeing kinematics parameters were computed by SPSS statistical software.

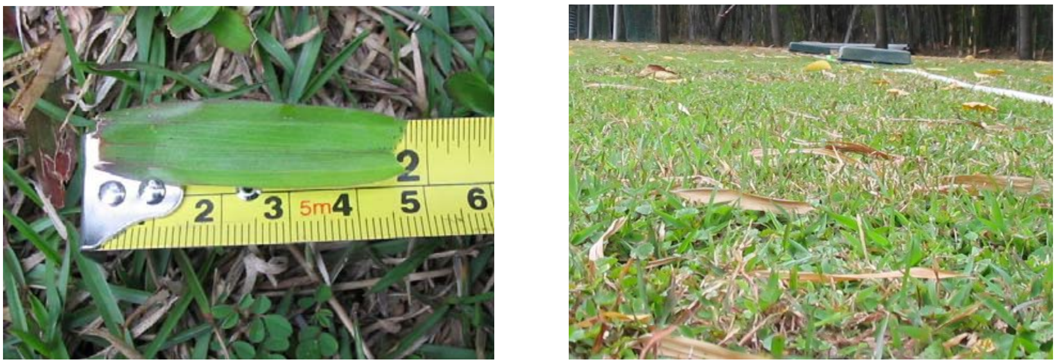
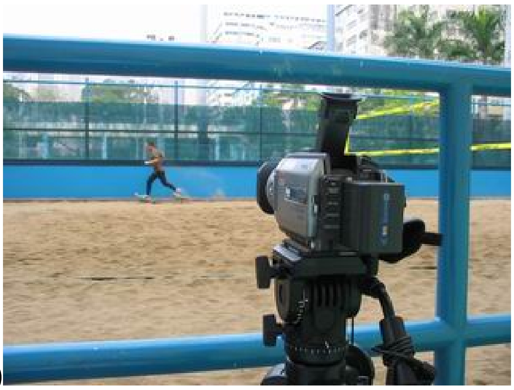


Figure 2. The size of grass and the overview of grassland

a) 

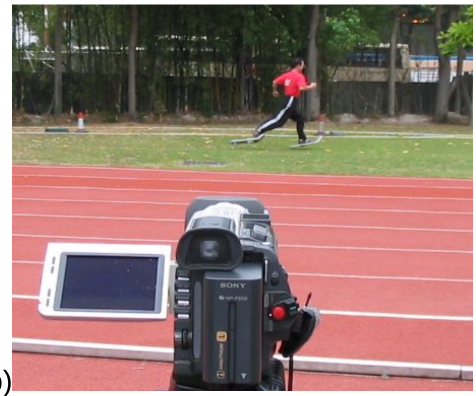
b) 

Figure 3. The video camcorder setting at the a) outdoor beach volleyball court; b) grassland

RESULTS AND DISCUSSION: The descriptive statistics of the snowshoeing kinematics parameters in different courses were shown in Table 1.

The purpose of this study was to compare the kinematics characteristics of snowshoeing on grassland and sand course. The results may be applied in snowshoeing training arrangement and provided data for further study such as differences between snowshoeing on snow, sand and grassland.
When compare with the snowshoeing velocity on sand and grassland, both mean velocity and maximum velocity were higher in grassland than sand course snowshoeing.

Table 1 Descriptive Statistics of the Snowshoeing Kinematics Parameters on Grassland and Sand Course

	Sand		Grassland	
	Mean	SD	Mean	SD
single leg support time (s)	0.22	0.00	0.20	0.05
flight time (s)	0.09	0.05	0.13	0.05
stride frequency (Hz)	1.66	0.27	1.87	0.43
mean velocity (m/s)	3.75	0.04	4.47	0.88
max velocity (m/s)	4.08	0.05	4.83	0.91
CG vertical displacement (cm)	11.24	4.60	10.25	3.64
cycle length (m)	2.39	0.43	2.92	0.61
LTO thigh angle (deg)	19.85	12.18	64.44	3.45
RTO thigh angle (deg)	13.38	1.20	54.03	2.67
L max thigh angle (deg)	52.96	6.44	53.05	4.05
R max thigh angle (deg)	49.08	3.65	60.35	7.97
LTO knee angle (deg)	149.78	28.92	164.99	7.41
RTO knee angle (deg)	140.58	27.21	173.34	6.21

Note: LTO = left toe off and RTO = right toe off.

When looking at temporal characteristics, the mean value of single leg support time was higher when snowshoeing in sand course than in grassland. The flight time showed longer in grassland snowshoeing than on sand. Besides, stride frequency in grassland (1.87 ± 0.43 Hz) was much higher than in sand course (1.66 ± 0.27 Hz). According to the temporal characteristics of snowshoeing on sand and grassland, snowshoeing on grassland could achieve fast speed, long flight time and short single leg support time. Although the kinematics characteristics of snowshoeing on snow was lacking in the literature, it may assume that the slow speed and short flight time could be found when snowshoeing on snow. Moreover, the vertical displacement of CG within running cycle were higher in sand course (11.24 ± 4.60 cm) than grassland of snowshoeing (10.25 ± 3.64 cm). It may also assume that the vertical displacement of CG when snowshoeing on snow would be high. Therefore, when compare with grassland and sand course of snowshoeing, sand course will provide better environment for training purpose based on similarity of competition condition.

Moreover, the longer of cycle length could be found in snowshoeing on grassland (2.92 ± 0.61 m) when compare with on sand (2.39 ± 0.43 m). It may also assume that the short cycle length would be used in snowshoeing on snow.

The results of low extremity kinematics supported that there were differences in movement pattern of snowshoeing between grassland and sand. Both toe-off thigh angle and toe-off knee extension angle were greater in snowshoeing on grassland than on sand. Therefore, when training was conducted in different environments (sand and grassland), which may provide different training effect on the overall performance of athletes when undergo snowshoeing competition on snow.

CONCLUSION: The results of this study indicated that the movement pattern and the lower extremity kinematics of snowshoeing on sand and grassland are different. Although the biomechanical analysis of snowshoeing on snow was lacking in the literature, under the assumption that snowshoeing on snow would be slower when compared to sand and grassland, snowshoeing on sand seems to provide a more appropriate environment for the athlete when compared to grassland in this study. However, the size of grass may affect the result of movement pattern. It may suggest to conduct further analysis on grassland with different size of grass such as longer or wider grass. Besides grassland, mud course could be considered to use for training purpose provided that some biomechanical analysis was conducted to identity the effect of mud on snowshoeing.

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