The walkers who finished Oxfam Trailwalker 2005: who were they?

完成「樂施毅行者 2005」的步行者是怎樣的人？

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In Oxfam Trailwalker, walkers formed a team of four to compete in the 100 km MacLehose Trail within 48 hours. In 2005, 3724 walkers participated in this event. About 82% of these walkers finished the trail. This study aimed at examining those successful walkers. Variables that might affect the finishing time were studied. A total of 231 walkers were recruited. Their training history was obtained. Their body weight, height, Q-angle of both knees, arch index and arch ratio of both feet were recorded. Those walkers who could not complete the trail were excluded from analysis. Data from 202 walkers were analysed. The results showed that mature walkers did better than young ones (p=0.004). Male walkers performed better than female walkers (p=0.019). Experience in previous events was a factor to success (p=0.000). High training hours for hiking might lead to a more favourable finishing time but the finding was not statistically significant (p=0.449). Body mass index, Q-angle of knees and foot shape did not show any statistically significant relationship with the finishing time. In conclusion, except for age, gender and experience, no special trait could be identified from these successful walkers. It would be very reassuring for those who intend to take part in Oxfam Trailwalker and yet not possessing the genetic advantage of an elite sportsman. (*Hong Kong j. emerg.med.* 2007;14:154-162)

在「樂施毅行者」活動上，步行者組成四人隊伍，於 48 小時內徒步競賽完成 100 公里長的麥里浩徑。於 2005 年，共有 3724 名步行者參與是次活動，約 82% 步行者能完成全程。是次研究旨在調查那些成功的步行者，並研究會影響完成賽程時間的因素。共招募了 231 名步行者及取得其訓練史、並記錄體重、身高、雙膝的 Q 角度、雙足的足弓指數及足弓比例。未能完成賽程的步行者並不包括在分析之列。共分析了 202 名步行者的數據，結果顯示成熟的步行者比年輕的表現更好（p=0.004），男性的表現比女性為佳（p=0.019），有以前參賽經驗是成功的因素（p=0.000）；長時間的遠足訓練對完成賽程的時間較為有利，但其結果在統計學上沒有重要性（p=0.449）。至於身體質量指數、膝部 Q 角度及足部形狀與完成時間，在統計學上沒有重要的關係。總括來說，除了年齡、性別及經驗外，成功的步行者並沒有特徵可供識別。故此，如欲參與「樂施毅行者」活動，但遺傳上沒有精英運動員優勢的人士，也可以放心參加。

Keywords: Anthropometry, exercise, hiking, physical endurance, sports

關鍵詞：人體測量學、運動、遠足、體能耐力、體育

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Introduction

Oxfam Trailwalker (OTW), formerly called Trailwalker, is one of the largest fundraising sports events in Hong Kong. Since 1986, more than 42,000 walkers have raised over HK$180,000,000 to support Oxfam's various projects in Africa and Asia. Participants form a team of four to compete in the 100 km MacLehose Trail within a 48-hour time limit. The teams are

divided into Special Teams, Super Trailwalker Teams and Open Teams. Special Teams consist of walkers from sponsors and supporting organisations. Veterans who have completed a previous OTW within 18 hours are invited to form Super Trailwalker Teams. The rest of the walkers form Open Teams.

History and development

Oxfam Trailwalker was originally an endurance training of the Ghurkhas in Hong Kong. In 1981-1985, there was an "Exercise Trailwalker" which expected the Ghurkha soldiers to finish in 24 hours. In 1985, the Ghurkhas invited five non-military teams to join the Trailwalker; and 55 teams participated. In 1986, Trailwalker was officially opened to the public. One hundred teams, consisting of 69 Ghurkha and 31 civilian, braved the stormy conditions. A civilian team won! As Hong Kong faced the transfer of sovereignty in 1997, the Ghurkhas planned to leave the territory. Oxfam Hong Kong began to co-organise the event in 1996. Oxfam Hong Kong enlisted the support of many other community organisations to organise the event. Nurses and doctors from Queen Elizabeth Hospital started to provide medical support in 1996. Nurses and doctors of other partner hospitals of the Kowloon Central Cluster of the Hospital Authority of Hong Kong joined the team in the recent few years.

Oxfam Trailwalker 2005

The number of participants increased gradually. A total of 3875 walkers registered for the event in 2005. The age group and gender distribution are summarised in Table 1. Out of these, 931 teams actually started off. The gender composition of these walkers is summarised in Table 2. It is obvious that male walkers dominated the event. The youngest walker had just fulfilled the minimal age criteria (age 18). The oldest participant was 71 years old! As illustrated in Table 3, over half of the walkers were new to the event. According to Oxfam Hong Kong, 82% of individual walkers (3054 out of 3724 walkers) completed the whole trail of 100 km. The team successful rate was 67% (624 out of 931 teams) finished as whole teams.

Objectives

This study aimed to study the characteristics in age, gender, experience, training and physical build-up of those walkers who finished the 100 km trail successfully in OTW 2005.

Methods

Study design

It was a prospective observation study. Research assistants approached the walkers at Check Point 4 and at the Finishing Point. They explained the study to

Table 1. Distribution of age group and gender among the successful applicants

	Female	%	Male	%
18-20	35	0.90%	178	4.59%
21-23	42	1.08%	157	4.05%
24-26	92	2.37%	323	8.34%
27-29	125	3.23%	411	10.61%
30-39	298	7.69%	1167	30.12%
40-49	121	3.12%	726	18.74%
≥50	13	0.34%	187	4.83%
Subtotal	726	18.74%	3149	81.26%

Grand total = 3875 successful applicants (100%)

Table 2. Gender distribution among walkers

	No. of walkers	%
Male	3019	81.2%
Female	701	18.8%
Total	3720	100%
	No. of teams	**%**
Male only team	523	56.2%
Female only team	45	4.8%

N.B. Missing data of team = 1

Table 3. Experience among walkers

Trailwalker experience	No. of walkers	%
Novice	2171	58.4%
Once	729	19.6%
Twice	323	8.7%
Thrice	185	5.0%
4 times	117	3.1%
Over 4 times	195	5.2%
	3720	100%

N.B. Missing data of team = 1

the walkers. Formal written consent was obtained from the participants.

The first part of the study consisted of standardised questions on age, gender, previous experience, pre-existing lower limb pathology, previous operation in the lower limbs and development of knee pain during the event. The training time in hiking in the previous three months, as a proxy of preparation for the event, was documented. Training in other forms like swimming and workout in gymnasium were not counted.

The second part consisted of anatomical measurement. The body weight, height and quadriceps angles (Q-angles) of both knees were recorded. The body mass indexes (BMI) were then calculated. The shape of the foot was studied. Data for the calculation of arch ratio and arch index were obtained.

Locations

Walkers were invited to participate in the study at Check Point 4 and the Finishing Point. Check Point 4 was set at the Gilwel Campsite located at 47.4 km from the Start Point. In other words, it was half way through by distance. Many walkers took a break at this Check Point as it was spacious with good facilities. Physiotherapists and podiatrists were available at peak hours. Recruitment was relatively easy as walkers tended to spend more time at this Check Point. As this study was targeted at those walkers who could successfully finish the 100 km trail, recruitment of walkers at the Finishing Point was essential.

Measurements

Quadriceps angle

The Q-angle is the angle between the line joining the anterior superior iliac spine with the centre of the patella and the line of the patellar ligament. According to McRae, the subject must be standing and a normal angle is about 6°.[1] However, different authorities hold different views. The normal Q-angle for females is often larger than males as females usually have wider pelvis. For example, the online Wheeless' Textbook of Orthopaedics quotes that the normal Q-angle is 14° for males and 17° for females.[2] The only consensus is that athletes with large Q-angles have mechanical disadvantage and are prone to injuries. In this study, we standardised the measurement of Q-angles with the subjects standing. In some occasions, especially when encountering subjects who were tired, the Q-angles were measured with the subjects lying flat.

Foot shape assessment

Foot shape can be classified into normal foot, low-arched foot (pes planus) and high-arched foot (pes cavus). Foot shape of the walkers can be easily classified by visual assessment or through footprint studies. In this study, two methods were used to assess the foot shape. In the first method, a pedoprint imprinter was used to record the footprint. A grid paper was superimposed on each print to measure different areas. Different amount of weight bearing can be used, ranging from 10% to 90%.[3] In this study, 50% body weight bearing was used. The participant first stepped one foot on the supporting plate of the pedoprint imprinter and then the other foot stepped on the recording plate. The whole process was repeated for the other foot. Cavanagh and Rodgers introduced the arch index (AI) in 1987 to define foot shape:[4]

$$\text{Arch index (AI)} = \frac{\text{Area of the mid-third (toeless)}}{\text{Total area (toeless)}}$$

A low-arched foot has an AI greater than 0.257 while a high-arched foot has an AI less than 0.169.[4]

The second method used was the arch ratio (AR). It is defined as:[5]

$$\text{Arch ratio (AR)} = \frac{\text{DORS}}{\text{TFL}}$$

DORS = Height to dorsum of foot at half foot length

TFL = Truncated foot length as measured from the most posterior point of the calcaneum to the medial joint space of the first metatarsophalangeal joint.

The TFL was obtained from the footprint. The DORS was measured from each foot. An AR $\leqq$0.275 is regarded as a low-arched foot while an AR $\geqq$0.356 is regarded as a high-arched foot.

The finishing times were obtained from the database of Oxfam Hong Kong. It must be noted that only team finishing time was recorded.

Inclusion and exclusion criteria

All walkers regardless of age, gender, and experience were eligible to enter the study. Those who could not complete the 100 km were excluded. Members of the same team were accepted.

Ethical consideration

Approval for the study was obtained from the Ethics Committee of the Chinese University of Hong Kong. Subjects were provided with an information sheet. Written consent was obtained from each subject.

Personnel

All research assistants who interviewed the walkers and did the anatomical measurement were senior university students. The areas of footprints were measured with the help of another group of trained personnel.

Equipment and materials

Standard rulers were used to measure the quadriceps angles. The body weight and height were either measured on spot or reported by the walkers. The pedoprint imprinter was imported from Germany. The grid paper used to measure the foot areas consisted of grids of 1 mm x 1 mm.

Logistics

All research assistants travelled to Check Point 4 and the Finishing Point by taxi or private cars. They carried with them the necessary equipment. The equipment was stored at the medical tents of Check Point 4 and the Finishing Point. All completed data-sheets from the research assistants were collected on spot by one of the co-investigators.

Results and analysis

A total of 231 (6.2%) walkers were recruited. Twenty-nine walkers did not complete the 100 km trail and were excluded from analysis. Of the remaining 202 walkers, complete data set was obtained in more than 98% of the cases. The only exception was the BMI data with a completeness of only 95%. Some subjects came from the same team and they shared the same finishing time. Statistical analysis was done with SPSS for Windows version 14.0.

A normal Q-Q plot was used to test the distribution of the finishing time among the subjects (Figure 1).

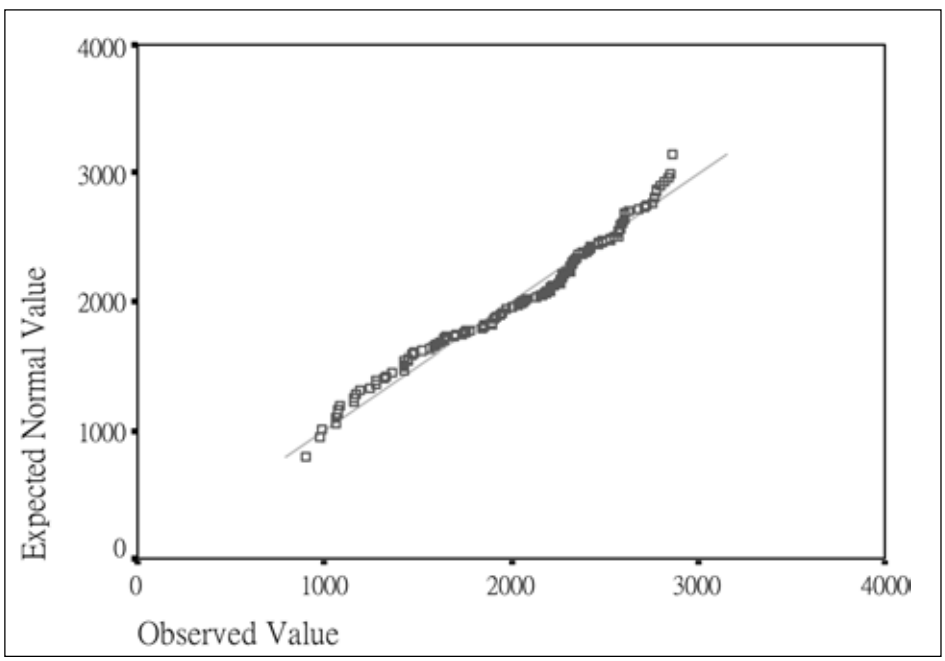

Figure 1. Normal Q-Q plot of finishing time (in minutes).

The plot showed the sample followed the normal distribution and allowed the calculation of average speed (km/h) in subsequent tables.

The relationship of age group distribution and finishing time is shown in Table 4. It shows that the older the walkers, the faster they walked. The finding was statistically significant (p=0.000).

The relationship between gender and finishing time is shown in Table 5. It shows that male walkers walked faster than female walkers with a mean difference of 180.46 minutes. T-test shows that the difference is statistically significant (p=0.026).

The relationship between previous experience and finishing time is summarised in Table 6. The more experienced the walker, the faster they walked (p=0.000). If the subjects are grouped into novice and veteran walkers, the difference is over 265 minutes and is statistically significant (p=0.000).

The relationship between training hours (hiking) and finishing time is shown in Table 7. About half of the walkers spent 48 hours or less in hiking in the preceding three months. There is no linear relationship between training hours and mean finishing time.

Table 4. Relationship of age group distribution and mean finishing time

Age group	n	Mean finishing time (min)	SD	Average speed (km/h)	F-value
18-20	9	2664.33	281.781	2.25	4.837*
21-23	7	2268.29	461.249	2.65	
24-26	22	2091.91	538.260	2.87	
27-29	37	2120.32	491.196	2.83	
30-39	82	2036.79	448.496	2.95	
40-49	30	1888.07	449.819	3.18	
≥50	11	1661.45	579.950	3.61	
Total	198	2051.85	496.785	2.92	

N.B. Missing data of walkers = 4; *p-value = 0.000; Degree of freedom: 6

Table 5. Relationship of gender and mean finishing time

Gender	n	Mean finishing time (min)	SD	Average speed (km/h)	t-test
Female	50	2180.26	518.892	2.75	-2.25*
Male	150	1999.80	481.968	3.00	

N.B. Missing data of walkers = 2; *p-value = 0.026; Degree of freedom: 198

Table 6. Relationship of previous participation and mean finishing time

No. of previous participation	n	Mean finishing time (min)	SD	Average speed (km/h)	F-value
0	104	2174.59	437.680	2.76	18.64*
1	42	2143.48	411.839	2.80	
2-3	33	1929.03	481.451	3.11	
≥4	22	1432.05	445.153	4.19	

N.B. Missing data of walker = 1; *p-value = 0.000; Degree of freedom: 3

Previous participation	n	Mean finishing time (min)	SD	Average speed (km/h)	t-test
Yes (veteran)	97	1909.165	519.013	3.14	-3.905**
No (novice)	104	2174.587	437.680	2.76	

N.B. Missing data of walker =1; **p-value = 0.000; Degree of freedom: 188

The relationship between body mass index (BMI) and finishing time is shown in Table 8. Most of the walkers belonged to the normal BMI group (defined as BMI between 18.5-24.9) and the mean finishing time was best among these 'normal' BMI groups. However, there was no statistically significant relationship between BMI and finishing time.

Since OTW is a hiking event and is an endurance sport, the anatomy of the lower limbs may affect performance. Simply relate Q-angle, arch index and arch ratio to finishing time did not show any statistically significant results. The characteristics of the walkers' knees and feet are summarised in Tables 9, 10 and 11. The data from male and female walkers were combined in Tables 10 and 11. Subgroup analysis on homogeneity between the left lower limb and right lower limb in relation to finishing time was performed. The results are summarised in Table 12. In essence, homogeneity in lower limb anatomy did not show any statistically significant relationship with the finishing time.

Multiple regression analysis of finishing time and all the aforementioned variables was performed. The analysis is summarised in Table 13. Maturity was a favourable factor (p=0.004). Male walkers performed better than female walkers (p=0.019). Experience in previous OTW was an important factor (p=0.000). All other physical parameters did not show any statistically significant results. The overall adjusted R-square is 0.230. It indicates that there was little linear relationship between the finishing time and the variables studied. Only about 23% of the variation in the finishing time can be explained by these variables.

Discussion

The convenient sample might not represent all walkers of OTW in general. The original study intended to use the dropouts as controls. However, the number of dropouts recruited was too small. Recall bias is prone to occur in terms of training times estimation.

Table 7. Relationship of training hours and finishing time

Training hour	n	Mean finishing time (min)	SD	Average speed (km/h)	F-value
≤24 hours	53	2020.68	520.03	2.97	0.228*
25-48 hours	52	2058.75	475.55	2.91	
49-72 hours	49	2080.10	517.45	2.88	
73-96 hours	22	2078.77	387.46	2.89	
>96 hours	25	1981.48	551.48	3.03	

N.B. Missing data of walkers = 1; *p-value = 0.923; Degree of freedom: 4

Table 8. Relationship of body mass index (BMI) and finishing time

BMI	n	Mean finishing time (min.)	SD	Average speed (km/h)	F-value
<18.5	24	2135.38	497.904	2.81	1.569*
18.5-24.9	141	2014.74	492.970	2.98	
25-29.9	25	2220.88	477.383	2.70	
>29.9	2	2241.00	490.732	2.68	

N.B. Missing data = 10; *p-value = 0.198; Degree of freedom: 3

Table 9. The distribution of Q-angles of walkers' knees

Q-angle (Male)					Q-angle (Female)				
		Left					Left		
		>14	≤14	Total			>17	≤17	Total
Right	>14	31	21	52	**Right**	>17	2	0	2
	≤14	22	76	98		≤17	0	49	49
	Total	53	97	150		Total	2	49	51

Table 10. The distribution of arch index of walkers' feet (data from male and female walkers were combined)

		Right			
		>0.257 (LA)	0.169≤index≤0.257	<0.169 (HA)	Total
Left	>0.257 (LA)	79	26	0	105
	0.169≤index≤0.257	17	70	2	89
	<0.169 (HA)	0	8	0	8
	Total	96	104	2	202

LA = low-arched foot; HA = high-arched foot

Table 11. The distribution of arch ratio of walkers' feet (data from male and female walkers were combined)

		Right			
		≤0.275 (LA)	0.275<ratio<0.356	≧0.356 (HA)	Total
Left	≤0.275 (LA)	70	30	0	100
	0.275<ratio<0.356	27	75	0	102
	≧0.356 (HA)	0	0	0	0
	Total	97	105	0	202

LA = low-arched foot; HA = high-arched foot

Table 12. Relationship of Q-angle, arch index and arch ratio (homogenous vs. heterogeneous) and finishing time (data from male and female walkers were combined)

	n	Mean finishing time (min)	SD	Average speed (km/h)	t-test
			Q-angle		
Heterogeneous	35	2176.46	392.954	2.76	1.715*
Homogenous	166	2019.10	511.450	2.97	
			Arch index		
Heterogeneous	53	2044.245	515.063	2.94	-0.038**
Homogenous	148	2047.304	490.254	2.93	
			Arch ratio		
Heterogeneous	56	2148.893	434.227	2.79	1.831***
Homogenous	145	2006.952	513.312	2.99	

*p-value = 0.088; **p-value = 0.969; ***p-value = 0.069; Degree of freedom: 199

Table 13. Multiple regression analysis of finishing time and different variables

Variable	Regression coefficient	t	p-value	Adjusted R-square
Age	-0.211	-2.931	0.004	0.230
Gender	-0.167	-2.360	0.019	
No. of previous participation	-0.359	-5.010	0.000	
Training hours	-0.050	-0.758	0.449	
Body mass index	0.131	1.832	0.069	
Q-angle (right)	0.036	0.405	0.686	
Q-angle (left)	0.048	0.551	0.582	
Arch index (right)	0.016	0.162	0.871	
Arch index (left)	0.074	0.740	0.460	
Arch ratio (right)	0.008	0.103	0.918	
Arch ratio (left)	-0.0003	-0.004	0.997	

Finishing time was the main outcome measure in this study. It must be noted that Oxfam recorded performance of the whole team. In other words, fast walkers of the same team had to wait for the slow walkers and cross the finish point together. On the other hand, slow walkers were forced to walk faster as a result of peer pressure. It is difficult to estimate whether these two factors could balance out or not. The finishing time was found to be normally distributed among the subjects. Hence average speeds were calculated. However, walkers took variable durations of rest during the event. Resting time ranged from minutes to hours. The calculated average speed might not carry much significance.

The results showed that mature walkers did better than younger ones. The relationship between previous OTW experience and finishing time as shown in Table 6 indicated veterans did better than novices. Yeung et al showed that experience was one of the most important determinants among successful walkers in OTW 2000.[6] The reasons can be attributed to better preparation and better strategies. Success does not rely on aerobic level alone. Young inexperienced walkers might not have a good strategy like walking too quickly in the first sessions and overexerting themselves. Conflicts among young fatigued team members were common. Mature walkers might handle emotional conflicts better and maintain a favourable team spirit for better results.

Training hours (hiking) was used as a proxy for pre-event preparation. Mileage might be a better alternative but it has its own limitations. One kilometre of grade 1 slope is different from that of grade 2 slope. As hiking is an endurance sport, exercise that improves aerobic performance such as running and the use of stepping machine could be beneficial as well. However, it is difficult to quantify all these exercises in the analysis.

Anatomical variation of lower limbs might affect the performance of walkers. In this study, only the Q-angles of knees, the arch index and arch ratio of feet were measured. None of these showed any statistically significant relationship with finishing time. As the lower limbs work in pair, would heterogeneity affect performance? Would a knee with normal Q-angle work well with another knee with an abnormal Q-angle? Similarly, would a low-arched foot work well with a normal foot? The subgroup analysis, as shown in Table 12, did not show any statistically significant results. By employing modern sports technology, walkers born with unfavourable biomechanics can improve performance with devices like insoles or braces. Physical training may also make some improvement. It must be noted that the reference Q-angle was set at 14° for males and 17° for females.[2] A different conclusion might be reached if different reference angles were used. The Q-angles are quite narrow indeed and it is easy to commit measurement error.

Other possible parameters are leg-length discrepancy, tightness of hamstring muscle, history of previous injuries, operation and rehabilitation. As the lower limbs work as a functional unit, a functional analysis may be more appropriate. Gait analysis by sophisticated computer graphics may be more appropriate. However, subjects walk on level ground in the usual gait analysis, which is very different from the condition in outdoor hiking.

Alternative methodology

Walkers can be recruited three months before the event. A training log can be distributed beforehand. This can reduce recall bias. Detailed physical measurement and aerobic level assessment can be performed before the event. Walkers can then be classified as finishers and dropouts after the event. Factors leading to success can then be analysed although distribution of finishers and dropouts may not fulfil certain statistical requirements. Furthermore, psychological, social and emotional factors might affect the performance. Some walkers dropped out as a result of team disharmony rather than physical breakdown. These factors are difficult to quantify.

Conclusion

OTW, a kind of hiking activity, is getting more and more popular in Hong Kong. Walkers would like to know how to improve their performance. The results of this study suggest that experience is far more important than physical characteristics. These findings

should be very encouraging for many who do not possess the genetic advantage of an elite sportsman. This study serves as a pilot study for further studies.

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