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THE COMMUNITY AND SPORT PARTICIPATION

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In an earlier paper (Khosla, 1968) it was observed that winning athletes (gold medallists) in many of the Olympic events at the Tokyo Olympiad in 1964 were much above the average heights of all participants in their events. In contrast, it was noted that competitors in a few events (boxing, wrestling, judo, and weightlifting) are matched on rigid weight standards, and because weight and height are positively correlated they are indirectly also matched by height. In a subsequent paper (Khosla, 1970) the complex interrelationships between height, heredity, weight, obesity, physical fitness, smoking habits, and health were explored. On the basis of these studies a system of grading based on height was suggested to provide a reasonable incentive in some of the 'unsporting' events for enthusiasts of average or less than average height. The present paper confirms that the outcome of most of the events at the Mexico Olympiad were also prejudged in favour of the taller competitors, who themselves were drawn from the taller sections of the general population.

DATA

The data are derived from the height measurements recorded in the official handbook of *Participants to the XIX Olympiad, Mexico* 1968. The height distribution in the general population of the United States (Stoudt, Damon, McFarland, Roberts, 1965) is used for purposes of comparison with the height distribution of participants and champions in each of the 42 individual* and team** events considered in the paper.

NULL HYPOTHESIS

The cut-off points representing the four quartiles of height distribution in the United States males aged 18 to 24 years are marked in Figure 1. It should be mentioned that quartiles are chosen to simplify the presentation of results and that they are not intended to represent the groups suggested in the paper for the introduction of grading.

There is a large international variation in height, and young men from the United States form one of the tallest groups in the world. In comparison, the Olympic participants and champions are drawn mostly from nations shorter than United States citizens. Under the null hypothesis of no association between athletic performance and stature, percentages of participants and champions drawn from each quartile would therefore be expected to show a trend of negative slope with the higher quartiles. For the purposes of this paper, however, it is sufficient to assume an expected frequency of 25% under the null hypothesis for each of the four quartiles shown in Figure 1.

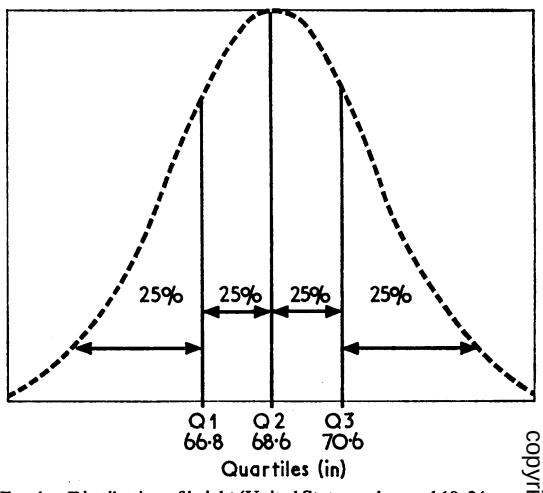


FIG. 1.—Distribution of height (United States males aged 18–24 years).

RESULTS

Table I gives the observed distribution of height within the quartiles in each of the nine swimming events. For example, of the 68 participants in the 100 metre freestyle swimming event, 5·9% (expected 25%) are observed to fall in the 1st quartile of height, and 63·2% in the 4th quartile. All three champions were drawn from the 4th quartile (Gold, Silver and Bronze medallists). Other swimming events display similar trends in favour of the taller participants.

Figure 2 gives a summary of the nine events presented in Table I as multiple bar charts (% participants and % points won on medals) within each quartile. The three medallists are allotted points as follows: 3 points for gold; 2 points for silver; 1

*100m sprint, high jump, etc. are individual events.
**Football, volleyball, etc. are team events.

TABLE I

PERCENTAGE EXPECTED AND OBSERVED IN NINE SWIMMING EVENTS (MEXICO 1968)

No.	Event	% Expected within Quartiles 1st 25	2nd 25	3rd 25	4th 25	All Quartiles 100
		% observed				
1	100m freestyle	5·9	11·8	19·1	63·2 (G, S, B)	100 (68)*
2	200m ,,	4·3	14·5	21·7 (B)	59·5 (G, S)	100 (69)
3	400m ,,	4·7	20·9	27·9 (G)	46·5 (S, B)	100 (43)
4	100m breaststroke	4·8	23·8 (S)	33·3 (B)	38·1 (G)	100 (42)
5	200m ,,	5·3	26·3 (S)	34·2 (G)	34·2	100 (38)
6	100m backstroke	7·3	7·3	14·7	70·7 (G, S, B)	100 (41)
7	200m ,,	7·9	7·9	26·3	57·9 (G, S, B)	100 (38)
8	100m butterfly	6·0	24·0	30·0 (B)	40·0 (G, S)	100 (50)
9	200m ,,	5·6	30·6 (B)	36·1 (G)	27·7 (S)	100 (36)
All events (% Participants)		5·6	17·9	26·1	50·4	100 (425)
% Points won on medals)		0	9·5	22·6	67·9	100 (53)**

G, Gold; S, Silver; B, Bronze
* No. of participants
** Based on 53 points because height of bronze medallist was not recorded (Event 5)

point for bronze. The total of 54* points (9 × 6) is taken as 100% in drawing the bar charts. The figure shows an increasing trend in participants with the quartiles. No point was won on medals by participants representing the 1st quartile and 68% of the points were won by participants representing the 4th quartile.

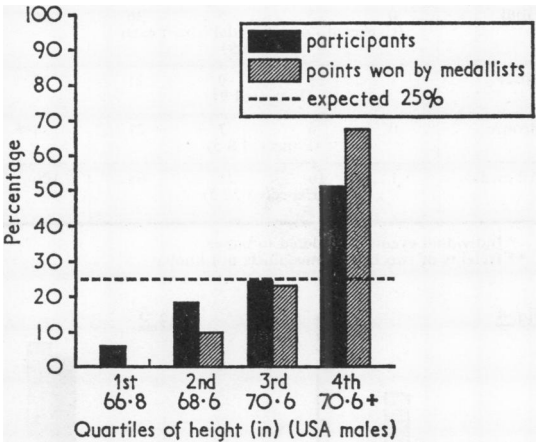


FIG. 2.—Summary of nine swimming events, Mexico 1968.

The multiple bar charts in some of the other individual events are summarized in Figures 3, 4, and 5. They confirm trends of progressive bias in favour of the taller competitors in many other events. The last column in Table II summarizes the percentage points won by participants representing the 4th quartile in 27 individual events. The points range from 68% (swimming) to 100% (canoeing) compared with the expected 25% under the assumption of null hypothesis. It should be noted that not a single point was won by participants representing the 1st quartile in any of the 27 events summarized in Table II.

The observed trends in walking (Figure 6) and cycling events (Figure 7) are not differentiated among the three upper quartiles. But the participants from the 1st quartile appear to be at a disadvantage because no point was won by them. In long distance and marathon events (Figure 8) medallists were mostly drawn from the 2nd quartile.

TEAM EVENTS

Table III gives the observed distribution of height within quartiles of the comparison group for five team events. For example, in field hockey 38·8% of 142 players from eight western countries were drawn from the 4th quartile and only 8·4% from the 1st quartile. There was a virtual absence of participants from the 1st quartile in football. The remaining

TABLE II

PERCENTAGE POINTS WON ON MEDALS BY 4TH QUARTILE IN 27 EVENTS

Description of Event	No. of Events	% Points won by 4th Quartile (Expected 25%)
Swimming (Fig. 2)	9	68
Jumping (Fig. 3)	4	92
Hurdling (Fig. 4)	3	78
Throwing (Fig. 5)	4	92
Short and medium distance running*	5	70
Canoeing*	2	100
No. of events	27	

*Based on 53 points because the height of a bronze medallist was not recorded.

* For figures on short and medium distance running and canoeing see Khosla (1971).

TABLE III
PERCENT EXPECTED AND OBSERVED IN TEAM EVENTS (WESTERN COUNTRIES)

Team Event	% Expected within Quartile				Total 100	No. of Teams
	1st 25	2nd 25	3rd 25	4th 25		
	% Observed					
Field hockey	8·4	19·0	33·8	38·8	100 (142)	8
Football (soccer)	4·0	22·7	44·0	29·3	100 (75)	4
Waterpolo	0	1·8	20·9	77·3	100 (110)	10
Volleyball	0	3·6	7·2	89·2	100 (84)	7
Basketball	0	0	1·7	98·3	100 (60)	6

events (waterpolo, volley ball, and basketball) attracted only taller competitors.

DISCUSSION

The evidence in the literature suggests that physical fitness is unrelated to height, and physical fitness tests adjust for differences in human size (Åstrand, 1960; Shephard, 1968). Cadets in the United States Military Academy at West Point, who can be assumed to be fit, range in height from 65 to 76 in (1·65 to 1·98m) (Clark, Allen and Wilson, 1967). Some cadets in the Royal Navy and Royal Air Force are even shorter than 65 in (1·65m) (Roberts, Provins, and Morton, 1959; Elbel, 1949).

Table IV gives the distribution of medals within quartiles of height distribution in 36 individual events considered in the paper. It should be noted that out of 106 winners of gold, silver, and bronze medals, only one silver medal was won in the marathon by a participant representing the 1st quartile compared to 68 winners from the 4th quartile. In this context it should be noted that short persons can become champion boxers, wrestlers, and weightlifters because they are fairly matched with contestants of their own build. For example, fly weight olympic champions are about 63 in (1·6m) tall, well within the lower quartile. These events cater for a full range of height. If protection were to be denied by removing this restriction such sports would overwhelmingly favour the heavy weights (indirectly tall persons), a situation which in fact exists in the throwing events (Figure 5).

TABLE IV
NUMBER OF MEDALLISTS WITHIN QUARTILES OF HEIGHT IN 36 EVENTS*

Medal	Quartiles (Observed no. of medals) 1st	2nd	3rd	4th	Total Medals
Gold	0	5	5	26	36
	(Expected nos. of medallists in each quartile 9)				
Silver	1	5	9	21	36
	(Expected 9)				
Bronze	0	6	7	21	34**
	(Expected 8·5)				
All medals	1	16	21	68	106
	(Expected 26·5)				

* Individual events considered in paper
** Heights of two bronze medallists not known

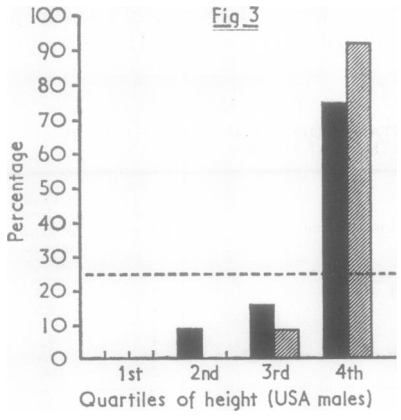


FIG. 3.—Summary of jumping events, Mexico 1968. High, long, triple, and pole vault.

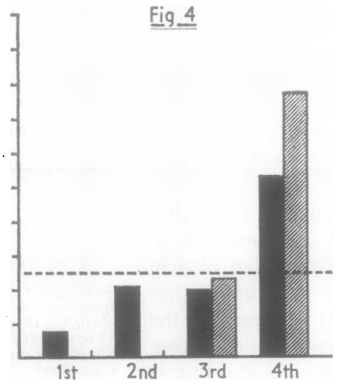


FIG. 4.—Summary of hurdling events, Mexico 1968. 100m, 400m, and steeple chase.

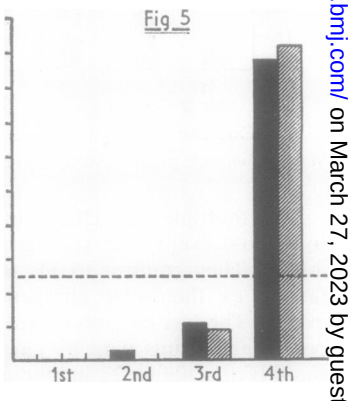


FIG. 5.—Summary of throwing events, Mexico 1968. Shotput, discus, javelin, and hammer.

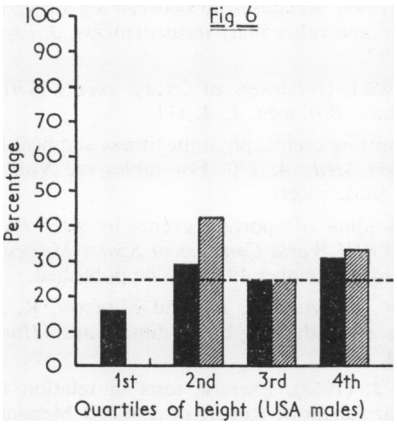


FIG. 6.—Summary of walking events, Mexico 1968. 20km, and 50km

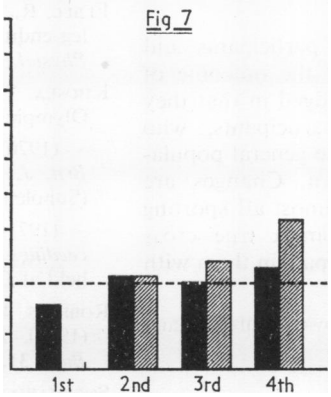


FIG. 7.—Summary of cycling events, Mexico 1968. 1000m time trial, 1000m sprint, 4000m pursuit, and road race.

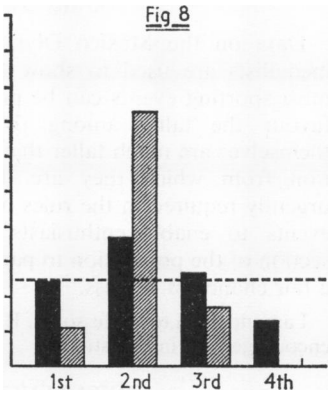
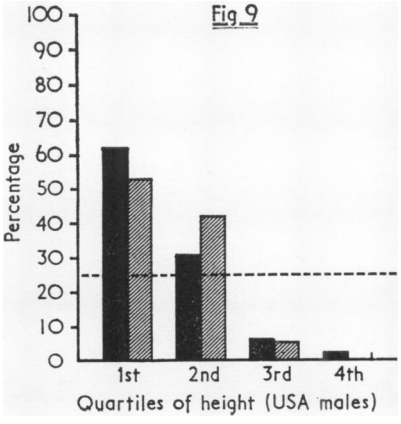


FIG. 8.—Summary of long distance events, Mexico 1968. 5000m, 10,000m, and marathon.

Adult stature is positively correlated with linear body dimensions (leg length, arm length, etc.), body weight, and vital capacity. These in turn imply that stature is also positively correlated with absolute strength and maximal speed in running and jumping. Therefore, it is not surprising that running and swimming events (assessed quantitatively on a time scale) or jumping and throwing events (assessed quantitatively on a distance scale) are so biased in favour of the tall that there is little point in participants of average height hopefully competing in them. On the other hand, enthusiasts of average height were able to win medals in events which are assessed qualitatively by judges. Figures 9 and 10 show trends in gymnastics and diving events.

Great changes have taken place in the economic and social circumstances of the western countries during the last 30 years. Automation in industry and at home and the general availability of cars and television have all helped to induce inactive habits, and diseases associated with obesity and smoking have become major health problems. A five-day week has already become normal and in 20 years' time the working week may be reduced still further.

Pursuit of leisure time physical activities and participation in sporting events are important health influences in the formative years of adolescence and in young adult life. However, if all sporting activities are to be encouraged in the general population, it necessarily follows that they must provide incentive to enthusiasts of average height and below. Some remedial action is needed to encourage the widest participation by the community in sport.



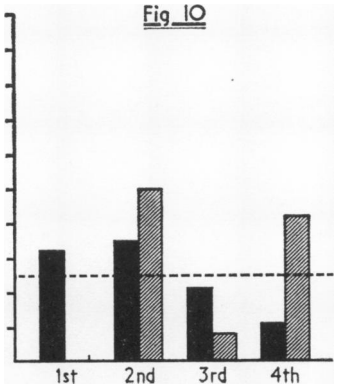


FIG. 9.—Summary of gymnastic events, Mexico 1968.

FIG. 10.—Summary of two diving events (spring and high board), Mexico 1968.

SUMMARY

Data on the Mexico Olympic participants and medallists are used to show that the outcome of most sporting events can be prejudged in that they favour the taller among the participants, who themselves are much taller than the general population from which they are drawn. Changes are urgently required in the rules of almost all sporting events to enable enthusiasts from a true cross section of the population to participate in them with a fair chance of success.

I am indebted to Professor C. R. Lowe for his help and encouragement in this study.

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