NATIONAL MASTERS NEWS

The official world and U.S. publication for Masters track & field, long distance running and race walking.

Jan. 5, 1996

To: Rex Harvey Fax: 1-216-531-0038
From: Al Sheahen

Rex: Following are two pages from a guy in Denmark questioning one of our formulas re age-grading.

Do you want to check it and reply to him? If so, send me a copy.

Thanks,

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14. DECEMBER 1995

NATIONAL MASTERS NEWS
P.O. BOX 2372
VAN NUYS, CA 91404
USA

IN DANISH ATHLETIC ASSOCIATION WE ARE USING THE ABOVE FORMULAS, BUT HAVE PROBLEMS WITH THE FORMULA FOR WOMEN 800m. WE HOPE MUCH THAT YOU WILL BE ABLE TO HELP US TO GET THE CORRECT FORMULA.

WE HAVE TRIED TO RECONSTRUCT THE FORMULA WITH THE FOLLOWING RESULT.

$a = 0.154472$ $b = 251.2$ $c = 1.822$

THIS FORMULA ARE NEAR TO BE CORRECT BUT UNFORTUNATELY NOT FULLY.

YOURS FAITHFULLY

J. Grue Jensen

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COPY FROM "AGE-GRADED TABLES"
THIRD PRINTING AUGUST 1994

1985 IAAF Computer Formulas

The 1985 IAAF scoring tables are generated by the following mathematical formulas.

Running Events: Points = a (b - Performance)^c
Jumping and Throwing Events: Points = a (Performance - b)^c

WOMEN:

b = 42.5s

60 m	a=46.0849	b=13s	c=1.81
100m	a=17.857	b=21s	c=1.81
200m	a=4.99087	b=24.5s	c=1.81
800m	a=.11193	b=254s	c=1.81
60m hurdle	a=20.0479	b=17s	c=1.835
100m hurdle	a=9.23076	b=26.7s	c=1.835
high jump	a=1.84523	b=75cm	c=1.348
long jump	a=.188807	b=210cm	c=1.41
shot put	a=56.0211	b=1.5m	c=1.05
discus	a=12.3311	b=3m	c=1.10
hammer	a=17.5458	b=6m	c=1.05
javelin	a=15.9803	b=3.8m	c=1.04

WRONG

MEN:

60 m	a=58.015	b=11.5s	c=1.81
100m	a=25.4347	b=18s	c=1.81
200m	a=5.8425	b=38s	c=1.81
300m	a=2.58503	b=60.1s	c=1.81
400m	a=1.53775	b=82s	c=1.81
1000m	a=.08713	b=305.5s	c=1.85
1500m	a=.03768	b=480s	c=1.85
60m hurdle	a=20.5173	b=15.5s	c=1.92
110m hurdle	a=5.74352	b=28.5s	c=1.92
high jump	a=.8465	b=75cm	c=1.42
pole vault	a=.2797	b=100cm	c=1.35
long jump	a=.14354	b=220cm	c=1.40
shot put	a=51.39	b=1.5m	c=1.05
discus	a=12.91	b=4m	c=1.10
hammer	a=13.0449	b=7m	c=1.05
javelin	a=10.14	b=7m	c=1.08

TURN ROUND!

AGE BEFORE BEAUTY

Willie Loedolff

The majority of runners take part in race after race, heaven knows for what reason, for they never win a race and finish somewhere in the field where the more popular runners usually spend most of their time. Those runners are the backbone of road running and they are the very people who like to share their good times on the road with fellow runners and compare their own performances with due modesty against previous good performances.

To many runners the only basis of comparison is race time. This can be misleading as the runner's time at altitude on a hot summer's day over a hilly and difficult course will not be nearly as impressive as his time at the coast on a cool spring morning over a flat and fast course. To others overall placing is what counts. Again this is not satisfactory because finishing 100th in a field of 150 doesn't sound half as good as being placed 100th in a field of 1500. It doesn't help very much to argue that you would have beaten those young runners if only you were 30 years younger, for there is no way of proving that you actually could have done it. Or is there ?

Yes, there is some sort of a method that appears to work well. It is possible to monitor your performance and progress by converting your race time to a constant which allows for age and gender. Thereby the playing field is levelled to some extent giving all runners an equal chance.

In its simplest form it starts with the calculation of your performance index (PI) for the race by means of a simple equation:

*PI = Tw/Tr, where **Tw** = Winner's time, and **Tr** = runner's time.*

This calculation is easy as pie with a scientific calculator but race times can quite easily be converted to seconds for use in the equation. In this form age is not taken into account, but it is already a useful tool to keep track of your progress from race to race and from season to season, and even to check your level of fitness.

*To compare your own results with those of runners of other ages or gender, you would need a suitable age handicap which sounds much more impressive if called an **age index**. The age indices in the accompanying Table of Age Indices are based on record performances at all ages where age records were available. They can be accepted as realistic except perhaps for the youngsters from 13 to 18 and the antiques over 75 where reliable information is rather scarce.*

To compare performances the following input is required:

- *Winner's time, age and gender;*
- *Runner's time, age and gender.*
- *Age indices*

Then:

- *Calculate winner's adjusted time **Twa** by multiplying his winning time **Tw** with his age index **Fw** (from table);*

- *Calculate runner's adjusted time **Tra** by multiplying his his race time **Tr** with his age index **Fr** (from table);*

- *Calculate runner's performance points **Pr** by dividing **Twa** by **Tra** and multiplying the result with **100**.*

In equation form:

$$Twa = Tw \times Fw$$
$$Tra = Tr \times Fr$$
$$Pr = 100 \times Twa/Tra$$

The system is best illustrated by the following example:

*In the very difficult Baviaanspoort 21,1 km race of 7 January 1995 the winner was a wellknown **male** runner **aged** 22 with a winning time of **1:08:50**. In the same race Carel van Wyk at the **age of** 59 finished the race in a time of **1:24:57** and Coralyn Griffith, **aged 26**, finished ahead of Carel in a time of **1:23:57**. In the race Coralyn ran the old man into the ground. And what a joy to watch beauty in action. But did she prove that a fit and beautiful young female runner is better than an old male bugger who thinks he is still fit enough to tackle the younger generation ? Let's check:*

For the winner:	$Tw = 1:08:50;\ Fw = 0,975$
	$Twa = 1:08:50 \times 0,975 = \underline{1:07:06}$
For Carel:	$Tr = 1:24:57;\ Fr = 0,830$
	$Tra = 1:24:57 \times 0,830 = \underline{1:10:31}$
Carel's points:	$Pr = 100 \times Twa/Tra$
	$= 100 \times 1:07:06/1:10:31 = \underline{95,2}$
For Coralyn:	$Tr = 1:23:56;\ Fr = 0,890$
	$Tra = 1:23:56 \times 0,890 = \underline{1:14:42}$
Coralyn's points:	$Pr = 100 \times Twa/Tra$
	$= 100 \times 1:07:06/1:14:42 = \underline{89,8}$

See what I mean ? This is plainly a case of age before beauty.

The complete exercise was carried out for all members of the club and from the race results it was possible to compile a ranking list which takes age and gender into consideration for all the members who participated.

In the same way an overall ranking list for half marathons can be compiled for all club members based on best performance

points in all 21,1 km races. The exercise can further be extended to all race distances and to finally compile an overall ranking list for all club members based on best performance points for all race distances. That is what the Magnolia running club with membership of some 400 runners has done on an experimental basis over the past two years and it seems to work well.

In the process it may be noticed that some runners who end up high on the ranking list for the shorter races do not necessarily end up high in the ranking list for the very long races. The overall ranking list for the club based on all race distances therefore gives credit to every runner for the distance most suited to the genes he inherited. As it is based on best performance irrespective of distance nobody can point an accusing finger and say that your club only caters for marathon and ultra-distance runners.

If you happen to be in the VOS age bracket maybe you will have the satisfaction to prove to yourself and other sceptics that age before beauty is not just a show of respect to the aged and that you are still well enough equipped to catch that beaut, well if not on the road then at least on paper. Let us hope you are not too old to know what to do if you do catch her on the road.

AGE INDICES

(Revision 6, 12 March 1995)

AGE	MALE	FEMALE	:	AGE	MALE	FEMALE
13	0,775	0,690	:	52	0,886	0,789
14	0,800	0,712	:	53	0,879	0,782
15	0,825	0,734	:	54	0,871	0,775
16	0,850	0,757	:	55	0,864	0,769
17	0,875	0,779	:	56	0,856	0,762
18	0,900	0,801	:	57	0,848	0,755
19	0,923	0,821	:	58	0,839	0,747
20	0,944	0,840	:	59	0,830	0,739
21	0,961	0,855	:	60	0,820	0,730
22	0,975	0,868	:	61	0,811	0,721
23	0,986	0,878	:	62	0,800	0,712
24	0,994	0,885	:	63	0,789	0,702
25	0,998	0,888	:	64	0,778	0,692
26	1,000	0,890	:	65	0,766	0,682
27	1,000	0,890	:	66	0,754	0,671
28	1,000	0,890	:	67	0,742	0,660
29	1,000	0,890	:	68	0,729	0,649
30	1,000	0,890	:	69	0,715	0,637
31	0,999	0,889	:	70	0,702	0,625
32	0,998	0,888	:	71	0,687	0,612
33	0,996	0,887	:	72	0,673	0,599
34	0,994	0,885	:	73	0,658	0,586
35	0,991	0,882	:	74	0,642	0,572
36	0,988	0,879	:	75	0,626	0,557
37	0,985	0,876	:	76	0,610	0,543
38	0,981	0,873	:	77	0,594	0,529
39	0,976	0,869	:	78	0,577	0,514
40	0,971	0,864	:	79	0,561	0,499
41	0,966	0,860	:	80	0,545	0,485
42	0,960	0,854	:	81	0,529	0,471
43	0,954	0,849	:	82	0,513	0,457
44	0,947	0,843	:	83	0,496	0,442
45	0,939	0,836	:	84	0,480	0,427
46	0,932	0,829	:	85	0,464	0,413
47	0,924	0,822	:	86	0,448	0,399
48	0,917	0,816	:	87	0,432	0,385
49	0,909	0,809	:	88	0,415	0,370
50	0,902	0,803	:	89	0,399	0,355
51	0,894	0,796	:	90	0,383	0,341

*The age indices are based on record performances for all ages where records were available. From the results of world records for various distances it appears that the male-female ratio varies from 0,8787 to 0,9014 for races between 1 km and 42,2 km with an average of 0,890. If the Comrades Marathon (90 km, South Africa) is also taken into consideration, the figure will not change significantly. The ratio of **0,890** has been accepted for this revision and will be used until new information, which may indicate further revisions, becomes available.*

AGE GRADING

Road running is a sport for all seasons with runners of ages from 15 to 90 participating in races over distances from 10 km to 160 km. Naturally the 26 to 35 year olds have the best chance to break the tape first. If performance is evaluated only according to the best times achieved in the race, it simply follows that the very young and the old have no chance at all while their relative efforts might be the same as, or even better than those of the winner's.

So far the existence of the more mature runners have been recognised, sometimes reluctantly, by categorising them in age categories as veterans (40 to 49), masters (50 to 59), grand-masters (60 to whatever age any runner would care to participate), and juniors for ages up to 19. Typically the juniors and the veterans and older runners represent about 30% of fields which are in many cases well over 1000, which is common for most races in South Africa. Further, in every age category, the younger runners in the group have a distinct advantage over the older ones. It therefore follows that with the present system, a large number of runners never get the recognition they deserve.

There is only one way to solve this problem and that is to apply an index to each year of age. The main problem with this idea is that different people age at different rates and there is no scientific way to calculate such indices. The only way out is to base such indices on the statistics of best known performances at each age, and to develop a method to determine the indices empirically.

Since I started competitive running at the age of 56 in 1983, over all distances from 800 m to 90 km I used to monitor my performances from race to race by using a very simple but practical method where I calculated, what I prefer to call the Performance Index (PI), for each race. The performance index is simply stated as:

$$PI = Tw/Tc$$

where: PI = performance index
Tw = winner's race time
Tc = competitor's race time

Example: Winner's time Tw = 1:04:35
Competitor's time Tc = 1:29:46
PI = 1:04:35/1:29:46 = <u>0.7195</u>

This simple formula works for all races irrespective of distance, gradients, weather conditions and everything that could affect race times. Needless to say that the results are more reliable in top class races where you can compare your performance with that of top runners in the country. The PI is a very useful tool which can be applied to various aspects of road running, and amongst others I used it to develop a series of age indices.

At an early stage in 1983 I came across an article: "Is Old Age Creeping up on You as Well?" by Prof Tim Noakes, in SA Runner of March 1983 (copy included as Annexure 1) which raised my interest. His article, being scientific and technically beyond any criticism, appeared to be a bit difficult for me as a layman to convert into a simple formula. However, with the availability of age records for certain races it was clear that it must be possible to establish age indices by means of performance indices where Tw is the overall record for the specific distance and Tc is the record for each age. In correspondence with Prof Tim Noakes he agreed in principle and later touched on the subject in his wellknown and most authoritative book on road running that exists, Lore of Running.(An extract of the relevant part is included for information as Annexure 2).*

Since that time I have collected and sifted data and applied the PI method to establish indices for all ages. To arrive at realistic values the best available indices for various race distances were plotted against age to represent the values graphically. Naturally there was a scatter of plot points but by drawing a smooth line through the best PI's, the form of the curve was established. To read off interpolated values accurately from the curve proved somewhat difficult and so a series of parabolic curves which run through the best points were developed. The curves were updated from time to time during the last ten years as further information became available. At this stage the table and curve included as Annexures 3 and 4 can be regarded as realistic, even for the ages from 13 to 18 and over 80 which are based on simple linear extrapolation because of lack of information. The section 65 to 80 may also need further ongoing attention as best performances at present are most likely to improve in future.

*The curves have been developed for the male runners where a reasonable number of age records were available. In the senior category the male and female records over several race distances point to a male:female ratio of something between 0,8787 and 0,9014, with an average of 0,890 for ten race distances from 1 km to 42,2 km. There is no definite predictable pattern in the ratios for the various distances which could show that the ratio varies directly with distance. In fact the highest ratios of 0,901 and 0,9014 appear at 1,5 km and at 42,2 km, while the lowest figures of 0,8787 to 0,8794 are at 5 to 21,1 km. This must be ascribed to the fact that the full potential of female runners have not been reached in longer race distances which perhaps may have not been too popular in the past. At this stage the ratio of **0,890** may be used with confidence until new information indicates that revision is necessary. As a matter of fact it is to be expected that the figure of 0,890 will rise within the next five to ten years. As records for the older female runners are scarce at this stage, the factor of 0,890 is applied in the mean time for all ages. These statements may be debatable but will have to be accepted until proved inaccurate, and until new records are established.*

Further, it is impossible to arrive at exact age indices based on a scientific approach and together with the different rates of aging it is a case of hair splitting to quote indices to four decimal places. For that reason the tables and curves in Annexures 3 and 4 represent figures rounded off to the third decimal place.

These indices are applied to all race distances. This can be criticised but it must be remembered that certain runners are better equipped to run the longer distances and will score better in the longer races, while those who excell only in the shorter distances will likewise score better in the shorter races. Thus runners in all distances will have the same advantage and nobody will be favoured unfairly. Further, as the calculation of indices is not an exact science as mentioned before, the aim was to obtain a set of age indices which is realistic and acceptable universally. I believe the table in Annexure 3 is as close to that ideal as possible at this stage.

Once the age indices have been established, it is quite simple to determine a runner's real performance in terms of race time: just multiply the competitor's race time with his age index and you have his handicapped time. Everybody starts at the same time and when the results are fed into the computer together with the age and sex, the position on handicap can be calculated without any waste of time.

COMPARISON WITH WAVA STANDARDS

At the moment the only system of age grading used elsewhere is that of the World Association of Veteran Athletes (WAVA). They have done important pioneering work and must be commended on a job well done. It does not mean that one has to accept blindly that every figure they propose will be the correct figure. I therefore take the liberty to comment on the WAVA table (Annexure 5), which has come to my notice, without trying to detract from the great work they have done. I base my comments on the assumption that they apply their Age-graded Scoring Factors in the same way as I do, that is by multiplying the competitor's time by the applicable listed factor to obtain the handicapped time. The WAVA factors and my own indices are represented on the enclosed comparative curves Annexure 6).

1. The WAVA factors are presented to four decimal places. As mentioned before, this is not an exact science and working to four decimal places could be seen as unnecessary refinement.

2. The WAVA factors start at the age of 35 years. What happens below that age? My conclusion, which might not be necessarily correct, is that the factor for men jumps from 0,9724 for the 35-year old to 1,000 for the 34-year old and younger. This does not sound correct.

3. The factors for males aged 35 to 65 are too lenient and will give results which favour the competitors unfairly. Similarly the factors for ages 65 to 90 are too harsh.

4. According to the heading of the WAVA table the female to male equivalent is based on a conversion factor of 0,901. If I understand it correctly then there is an anomaly in the table itself where the male/female ratio varies from 0,997 to 0,916.

5. The WAVA factors only apply to distances from 5 km to 25 km. What are we to do about the longer distances? In my own case I have tried to arrive at a set of indices applicable to all distances. While some people will not agree, the table in Annexure 3 is in fact quite representative of all race distances as the figures are based on records for all distances. It must be emphasized that the whole process of age grading, though it may to a certain extent be predictable medically, cannot be easily converted to figures by any scientific formula and that any set of figures must rely heavily on record performances, irrespective of distance.

With my own experience of road running in age groups over 50 and 60, I believe that the indices as reflected on the attached curves and tables are realistic and could be adopted to the benefit of all runners.

G W LOEDOLFF

ANNEXURE 3

AGE INDICES

(Revision 6, 12 March 1995)

AGE	MALE	FEMALE	:	AGE	MALE	FEMALE
13	0,775	0,690	:	52	0,886	0,789
14	0,800	0,712	:	53	0,879	0,782
15	0,825	0,734	:	54	0,871	0,775
16	0,850	0,757	:	55	0,864	0,769
17	0,875	0,779	:	56	0,856	0,762
18	0,900	0,801	:	57	0,848	0,755
19	0,923	0,821	:	58	0,839	0,747
20	0,944	0,840	:	59	0,830	0,739
21	0,961	0,855	:	60	0,820	0,730
22	0,975	0,868	:	61	0,811	0,721
23	0,986	0,878	:	62	0,800	0,712
24	0,994	0,885	:	63	0,789	0,702
25	0,998	0,888	:	64	0,778	0,692
26	1,000	0,890	:	65	0,766	0,682
27	1,000	0,890	:	66	0,754	0,671
28	1,000	0,890	:	67	0,742	0,660
29	1,000	0,890	:	68	0,729	0,649
30	1,000	0,890	:	69	0,715	0,637
31	0,999	0,889	:	70	0,702	0,625
32	0,998	0,888	:	71	0,687	0,612
33	0,996	0,887	:	72	0,673	0,599
34	0,994	0,885	:	73	0,658	0,586
35	0,991	0,882	:	74	0,642	0,572
36	0,988	0,879	:	75	0,626	0,557
37	0,985	0,876	:	76	0,610	0,543
38	0,981	0,873	:	77	0,594	0,529
39	0,976	0,869	:	78	0,577	0,514
40	0,971	0,864	:	79	0,561	0,499
41	0,966	0,860	:	80	0,545	0,485
42	0,960	0,854	:	81	0,529	0,471
43	0,954	0,849	:	82	0,513	0,457
44	0,947	0,843	:	83	0,496	0,442
45	0,939	0,836	:	84	0,480	0,427
46	0,932	0,829	:	85	0,464	0,413
47	0,924	0,822	:	86	0,448	0,399
48	0,917	0,816	:	87	0,432	0,385
49	0,909	0,809	:	88	0,415	0,370
50	0,902	0,803	:	89	0,399	0,355
51	0,894	0,796	:	90	0,383	0,341

The age indices are based on record performances for all ages. From the results of world records for various distances it appears that the male-female ratio varies from 0,8787 to 0,9014 for races between 1 km and 42,2 km. The average of ten race distances was calculated and the ratio ***0,890*** *thus obtained appears to be realistic and will be used as above until proven wrong by new information.*

ANNEXURE 1

Is old age creeping up on you as well?

ASKS TIM NOAKES

Even if I were to be granted an extension for good service, I cannot reasonably expect to outlive the biblical three score and ten years. So the reality is that I am rapidly approaching life's half-way mark and will within 16 months, join the ranks of the middle-aged. So as I prepare to bid farewell to my youth, it is time to take stock. To consider how the advance of years is likely to affect my future running performance. How can I, and indeed all us aging runners, expect to perform in the future years?

One of the first scientists to ponder this question was Professor L E Böttiger of Stockholm's famous Karolinska Hospital, headquarters for the annual Nobel awards. For his study, Böttiger[1] collected the results of the 1972 Lidingö 30km and the 1971 Vasa 87km cross-country ski races and analysed the average time that successive five-year age-groups took to complete the races. (Note: Road running and cross country skiing times are almost the same for races of equal length). He found that the skiers in the age group 26–31 years had the fastest average time for the shorter race and, for the longer race, the fastest were those aged between 31–36 years. After those ages, the average times for each successive 5 year age-groups rose in an identical, almost linear fashion, equivalent to a slowing in skiing speed of about six percent for every ten years. In the 30km race this was equivalent to a slowing of about 9¼ minutes for each decade after age 26; in the longer race of about 21¼ minutes per decade after age 31.

This study was followed by that of Dan Moore[2] of Livermore, California. Moore analysed the world track and marathon records for each 1 year age group from 18 to 78, and plotted the speed of each record against the age at which it was set. He found that, in general, speed improves up to the age of 20 and deteriorates after age 30. He also showed that for all events, the age of maximum performance increases with increasing distance so that the sprint records are held by men in their early twenties, whereas the standard marathon record was held (then) by a 26-year-old (Derek Clayton). Another interesting observation was that the rate of decline in speed after age 30 was greater the shorter the distance. Thus, at age 50, speed in the 200m sprint was slowing at a rate of 0,09 metres per second per year, whereas in the marathon the rate of decline was only 0,06 metres per second per year. Moore concluded that this indicates that strength deteriorates rather more quickly with age than does speed. Of additional interest was his finding that the rate of speed deterioration with age in the marathon (0,06 metres per second per year) is equivalent to a performance deterioration of about 12 % per decade, or more than twice that calculated by Böttiger for the cross-country skiers. Could it be that running is associated with a more rapid decline in performance with age than is skiing?

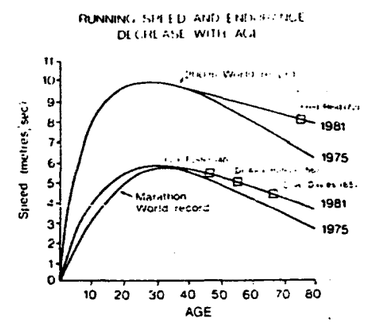
Of course something that neither Moore's nor indeed Böttiger's data can allow for is the fact that, as people get older, they tend to train less and compete less seriously. Thus the fall in performance apparent in both these studies is not only due to age, but is also due to the effects of reduced training and decreased racing motivation. Fortunately though, the Master's movement has gone a long way to changing all that. The result has been that more people over 40, including some outstanding athletes, are now training and competing as ferociously as ever they did in their "youth". The past 7 years has seen many Master's records re-written so that Moore's 1975 data are now obsolete. Although I am still awaiting receipt of the most recent world-age records for the marathon, some that I do have are listed in Table 1 and have been used to update Moore's 1975 graph (Figure 1).

Table 1

World Standard Marathon Records at four different ages

Athlete	*Age*	*Time Hr: Min*	*% Fall-off (vs Salazar)*	*% Fall-off per decade (vs Salazar)*
Alberto Salazar	23	2:08	—	—
Jack Foster	40	2:11	2	1
Dr Alex Ratelle	56	2:30	17	6
Clive Davies	62	2:42	27	6

These rough results in Table 1 seem to indicate that from age 23 to age 40, the percentage fall-off in running performance is minimal (±2 %) but thereafter increases to average about 6 % per decade. Again one should remember that this 6 % reduction in performance is almost certainly not due solely to the physiological effects of aging. It is also due to reduced training, lessened motivation and one additional hidden factor not yet mentioned. At age 23, Jack Foster, Dr Alex Ratelle and Clive Davies may not have been as physiologically-gifted for running as was Salazar at that age. Thus it may be incorrect to compare their performances in later life with Salazar's.



Despite these limitations, Figure 1 has been drawn to show what has happened with the world age records since 1975. On that figure, the 1975 lines for the 200m world record (upper graph) and standard marathon world records (lower graph) come from Moore's data. The 1981 lines have been drawn in to include the 200m world record performance of our own Dr Fred Reid of Johannesburg (please note that the 1981 curve for the 200m is slightly erroneous. Dr Reid's record is not quite as good as it appears on this graph) and those of Foster, Ratelle and Davies in the marathon. These new lines show that both curves fall less steeply with advancing age; a change that is almost certainly due to the increased opportunity and motivation for older athletes to compete.

What does this graph indicate? It suggests that after age 40 we can expect our marathon times to deteriorate by about 6 % per decade. This means that my best marathon of 2:50 at age 30 which will have weakened to 2:53 by age 40, will, God willing, slip to a 3:03 by age 50, a 3:14 by age 60, and a 3:25 by age 70; figures that can hardly be described as alarming. Indeed they are very encouraging, and another good reason to keep running past middle-age.

Finally, what about the Comrades Marathon? How does age affect performance in ultra-marathon races like the Comrades? To my knowledge, no one has attempted to answer that question and as a first step, I have drawn up a tentative listing of what seem to me to be the age-records for the "up" and "down" Comrades Marathons. (Tables 2 and 3). I invite readers to check the lists and inform me of any errors by writing to me at the UCT Medical School, Observatory, 7925. Please note that the records are judged as **speeds** not **times**. Thus it is possible that some will feel they have run faster times than those listed. However, only by expressing the result as a speed, thereby correcting for the different race distances (see note at bottom of each table) will it become clear whether any particular performance was, in fact, a record.

For example, check ages 34 and 40 for the 'down' comrades (Table 3). At both those ages, runners with the fastest times had not run the fastest speeds for those ages.

Once these lists have been checked they will be analysed by the same methods used by Böttiger and Moore to determine the rate of performance decline with age in the Comrades.

In the interim these lists can serve as an additional incentive for runners preparing for the Comrades. As is apparent from the lists, there are many years for which the records are probably less than excellent.

References

1. Böttiger L E., "Regular decline in physical working capacity with age", *British Medical Journal* 1973, 3:270–271.
2. Moore D H., "A study of age group track and field records to relate age and running speed", *Nature*, 1975, 253:264–265.

ANNEXURE 1

Table 2

Age records for the 'up' Comrades

Age (Years)	*Name*	*Time*	*Speed*	*Year*
18	B P Jansen van Vuuren	7 11 25	203 8	1981
19	A N Bosch	6 38 28	221 3	1979
20	A G Robb	6 06 45	245 1	1974
21	J H Gordon	6 27 00	231 8	1977
22	D R Biggs	5 54 08	248 2	1981
23	A G Robb	5 47 09	258 4	1977
24	G E Lindenberg	6 18 08	232 5	1981
25	B M S Fordyce	5 32 28	260 4	1981
26	D Bagshaw	5 51 27	243 8	1970
27	D B C Anderson	5 57 07	246.1	1981
28	P F Vorster	5 45 02	255.6	1979
29	J P Halberstadt	5 50 30	251 6	1979
30	S Adams	5 57 48	250 7	1977
31	J Halberstadt	5 46 00	254 1	1981
32	G A Frazer	5 54 12	248 2	1981
33	R J Swanepoel	6 15 55	234 6	1979
34	M C Bain	6 01 52	243 7	1979
35	A M Abbott	5 52 41	249 7	1981
36	J Meckler	6 01 11	240 3	1968
37	G A Wood	6 23 08	229 4	1981
38	G Bacon	5 54 50	247 7	1981
39	D H Boyle	6 26 03	228 5	1979
40	C P Benade	6 23 09	234 1	1977
41	D Boo	5 58 07	245 7	1970
42	C P Benade	6 09 56	238 4	1979
43	P Makoba	6 35 11	222 4	1981
44	C P Benade	6 10 54	237 0	1981
45	W Hayward	6 12 55	231 7	1954
46	W N Olivier	7 00 51	208 9	1981
47	C J R Steyn	7 01 40	208 4	1981
48	R U Wise	6 59 00	214 1	1977
49	C S van Groeningen	7 05 44	206 5	1981
50	C H Crawley	7 13 26	202 8	1981
51	W Mavuma	7 04 00	207 3	1981
52	W B Hobbs	7 29 42	195 5	1981
53	W C van Jaarsveld	7 56 13	185 2	1979
54	G M Hepburn	8 22 02	175 1	1981
55	A H Ferguson	7 57 00	186 1	1977
56	J L Elliott	8 27 35	173 8	1979
57	C V L Fick	7 30 59	194 9	1981
58	G C Oosthuizen	8 12 13	178 6	1981
59	I A T Dehgrier	7 52 49	186 4	1981
60	I D Pritchard	7 41 09	191 3	1979
61	M D Peters	8 41 47	169 0	1979
62	I D Pritchard	8 34 11	170 9	1981
63	A R Boyce	8 53 00	168 3	1977
64	C K Ogevsky	8 58 14	163 3	1981
65	A H Crystal	9 26 40	155 8	1979
66	D A Horton	9 40 40	151 4	1981
67	A R Boyce	10 04 16	145 5	1981
68	—	—	—	—
69	—	—	—	—
70	L Boulle	10 01 49	146 6	1979
72	L Boulle	10 12 37	143 5	1981

Note Age uncertain M J Orton 5 48 57 (1972–90 4km)

Race distances

1954	86.4km	1975	89 9km
1968	86.8km	1977	89 7km
1970	88 0km	1979	88.2km
1972	90 4km	1961	87.9km
1974	89.9km		

Table 3

Age records for the 'down' Comrades

Age (years)	*Name*	*Time*	*Speed*	*Year*
18	C N Bantom	7 06 00	211 50	1978
19	A Hector	6 25 36	237 03	1982
20	Raal	6 25 00	234 03	1978
21	D Lewis	5 48 53	263 64	1971
22	A G Robb	5 40 43	264 42	1976
23	D Lewis	5 39 09	260.18	1973
24	A G Robb	5 29 14	273 67	1978
25	H Tjale	5 50 12	256.71	1980
26	B Foroyce	5 34 22	273 35	1982
27	D Bagshaw	5 47 06	265.05	1971
28	A G Robb	5 41 26	267 66	1982
29	H G Hotzhausen	5 52 44	258 11	1982
30	D Wright	5 46 49	263.57	1982
31	P Vorster	5 50 20	261 09	1982
32	D R Tivers	5 55 10	257 32	1982
33	G A Frazer	5 41 55	267 33	1982
34	G Baker	5 45 53	257 22	1973
34	A M Abbott	5 47 27	258.74	1980
35	M C Bain	5 40 45	263 83	1980
36	A M Abbott	5 42 32	266 85	1982
37	H W Schubert	6 02 07	248 82	1978
38	T Metcalfe	5 59 36	254 21	1982
39	B Barber	5 57 38	252 01	1978
40	G F Hugo	6 20 15	240 37	1982
40	H Spires	6 19 00	237.20	1980
41	D E Ryan	5 52 46	254 85	1980
42	J F Dixon	6 08 57	247 71	1982
43	C P Benade	6 04 00	246.98	1980
44	W Hayward	5 52 30	246.64	1953
45	P Makoba	6 33 31	232 26	1982
46	L A Paddol	6 46 00	221.92	1976
47	D E Kay	6 28 00	232 90	1980
48	C J R Steyn	6 58 13	218.56	1982
49	W V Mavuma	6 40 00	225.25	1978
50	C S van Groenigen	7 01 05	217 05	1982
51	L S Nayler	7 12 00	211.57	1982
52	D B Chase	7 07 00	210 54	1980
53	R O Wise	7 27 51	204.09	1982
54	W C van Jaarsvelt	7 06 00	211.03	1980
55	G C Oosthuizen	7 25 00	202.47	1978
56	W C van Jaarsvelt	7 38 36	199 30	1982
57	E Pritchard	7 16.00	206 65	1976
58	E A Deneren	8 00 00	187 29	1980
59	E D Pritchard	7 28 00	201 12	1978
60	M Bestar	7 57 00	188 47	1980
61	R E Ashington	7 58 50	190 89	1982
62	A K Boyce	8 10 00	183.88	1976
63	G H Mackenzie	9 17 00	161 46	1980
64	F Hargraves	9 14 00	162 64	1976
65	D A Horton	8 26 00	177 67	1980
66	A K Boyce	8 55 00	168 04	1980
67	D A Horton	9 05 04	167 46	1982
68	A K Boyce	9 30 27	160 21	1982
69	—	—	—	—
70	—	—	—	—
71	L Boulle	10 10 00	147.36	1980
72	—	—	—	—
73	L Boulle	10 07 59	150 33	1982

Note Race distances were taken as follows

1953	86 44 km	1978	90 1 km
1971	92 00 km	1980	89 9 km
1973	88 24 km	1982	91.4 km
1976	90 1 km		

ANNEXURE 2

ANNEXURE 2

Extract from Lore of Running, Noakes, Oxford

The effects of age on athletic performance

Another interesting insight that a study of world records allows, is of the effects of age on human performance capacity. The first scientist to suggest this use of athletic records was Professor L. E. Bottiger of Stockholm's Karolinska Hospital (Bottiger, 1971; 1973).

By studying the average finishing times of competitors of different ages in a 30 km cross-country running race and in the 90 km Vasa cross-country ski race, he showed that the fastest runners in the shorter race were aged 26-30 years, whereas the best performers in the longer race were 31-36 years. After these ages, performances fell uniformly 5-10% per decade.

A similar study was carried out by Dan Moore (1975) of the Lawrence Livermore Laboratory in California. He plotted the 1974 world age records for the 200 m and standard marathon and noted that performance in these races reached a peak in the age ranges 20-30 years. Thereafter, performance in both races fell quite steeply but the decrease in speed was greater in sprint than in distance running. This suggests that speed deteriorates faster than endurance with increasing age. The reduction in speed with age was 6,9% and 10% per successive decade after age 30 in sprinting, and 4,8 and 8% per successive decade in marathon running.

I have subsequently plotted the more recent (1983) world standard marathon age records and compared these with the current age records for the up-Comrades Marathon (*Figure 9.10*) and come up with similar results.

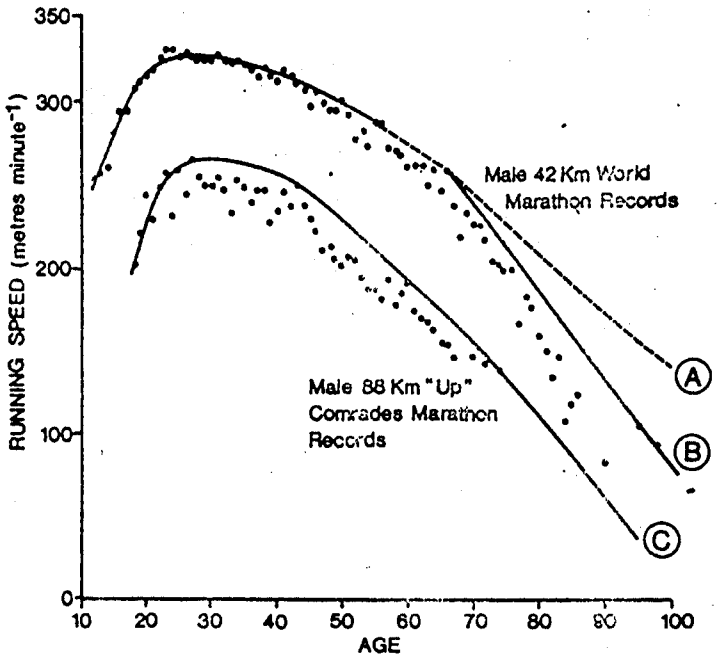


Figure 9.10 Plot of age records for the male 42,2 km World (B) and 88-90 km Comrades Marathon (C) records

Figure 9.10 shows that peak performance in both races occurs in the range of 23-30 years, and that after the age of about 40 years, there is an almost linear and parallel decline in performance in both races. The slope of the fall in performance with age is quite similar to the curve describing the reduction in $\dot{V}O_2$ max. with age.

When Willie Loedolff from Brooklyn, Pretoria noted this regular predictable decline in running performance with age, he suggested that this could be used as a system for age handicapping in long distance races.

If we take the curves for the world age records for the standard 42 km and Comrades Marathons, we see that the peak performance in each race is achieved at ages 25 and 26 respectively. This performance then becomes the standard for that race. Equivalent relative performances at different ages is calculated by dividing the time (in seconds) of the standard

performance into the time (in seconds) of the records at all other ages. Thus the world marathon record at age 25 is 02:08:13 (7 963 seconds) and that at age 95 is 06:42:10 (24 130 seconds). Thus the relative performance of the 95 year old record is (7 963/24 130) which equals 0,33. Using this idea to calculate the relative performance at all ages allows us to draw *Figure 9.11*.

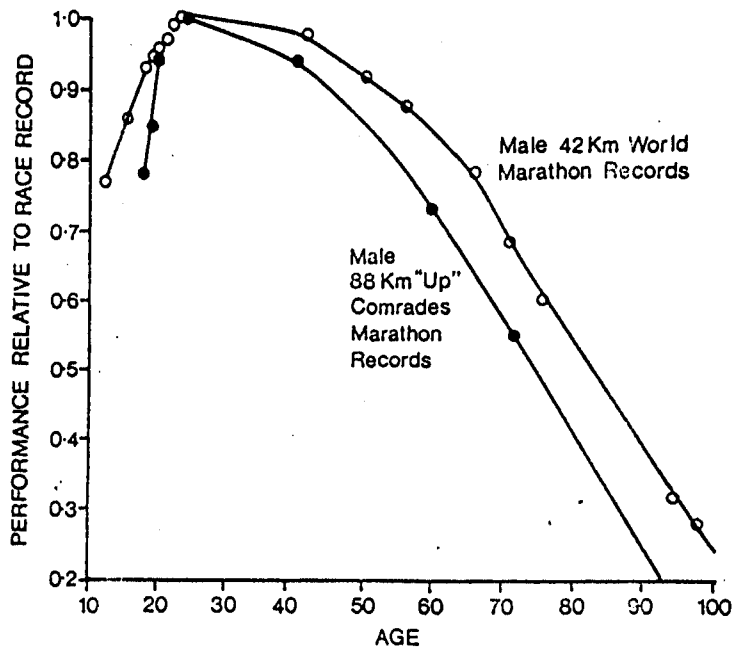


Figure 9.11 Plot of relative performance at different ages in the 42,2 km and Comrades Marathons

Note that *Figure 9.11* includes *only* the best age records at both these distances. This can be justified on the assumption that the best records are set by the athletes who come closest to the physiological limits set by their age and that the weaker records are not representative of the true physiological limits at that age. For example, the fastest runners at those ages may either be less gifted, that is they might have disproportionately lower $\dot{V}O_2$ max. values than runners at other ages, or they may not train as hard.

The curves in *Figure 9.11* show that relative performances in the standard marathon are better than they are in the Comrades, particularly between ages 40-66. Thereafter the lines are almost parallel. Either performance falls off more precipitously in ultra-distance races than it does in the standard marathon; or, more likely, the Comrades Marathon age records are 'soft' when compared with world marathon records. The athletes competing in the Comrades Marathon are relatively few in number and come from only one country, whereas many thousandfold more compete in standard marathons and they come from very many different nations.

From these figures we can draw up a table of relative performances for different ages at the standard and Comrades Marathon distances (*Table 9.4*).

Table 9.4 Equivalent relative performances for 5-year age groups in the 42,2 km standard and 90 km Comrades Marathons

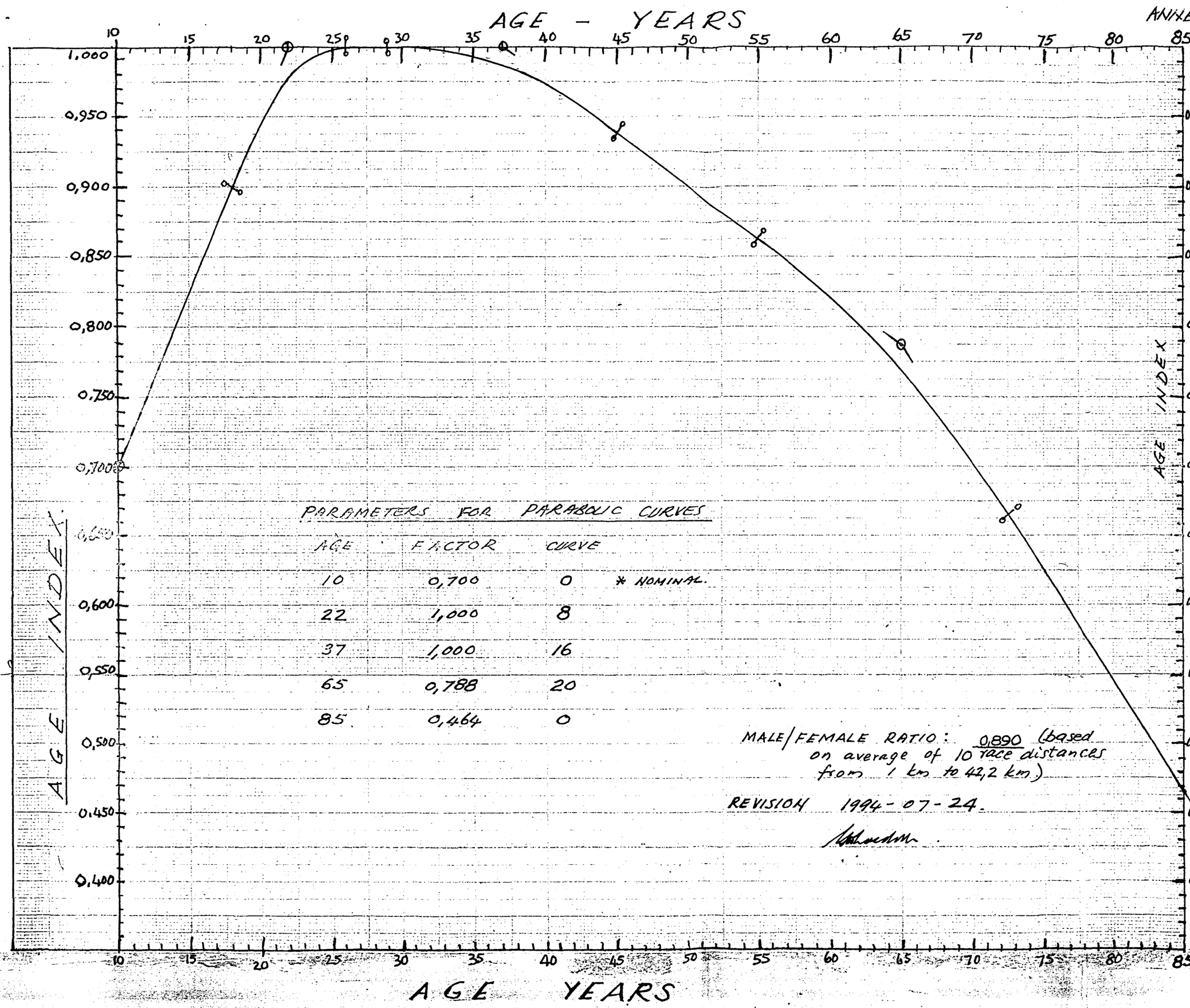
Age	*42 km Standard Marathon*	*90 km Comrades Marathon*
15-20	0,82-0,96	0,78-0,95
21-25	0,97-1,00	0,97-1,00
26-30	1,00-0,99	1,00-0,98
31-35	0,99-0,99	0,98-0,96
36-40	0,99-0,98	0,96-0,94
41-45	0,98-0,95	0,93-0,90
46-50	0,94-0,92	0,89-0,85
51-55	0,91-0,88	0,84-0,80
56-60	0,87-0,84	0,79-0,74
61-65	0,83-0,79	0,72-0,66
66-70	0,78-0,71	0,64-0,58
71-75	0,69-0,62	0,56-0,50
76-80	0,60-0,54	0,49-0,42
81-85	0,53-0,47	0,41-0,33
86-90	0,45-0,39	0,32-0,26
91-95	0,37-0,31	-
96-100	0,30-0,25	-

These figures can then be used as an age handicapping system in marathon and ultra-marathon races. For example, if the winner in a particular standard marathon race is 25-30 years old and runs a time of 02:20:00, then his time (8 400 seconds) is taken as the reference standard. If a 100 year old runner competed in the same race his performance relative to that of the winner should be 0,25; that is he should take (1/0,25) or four times as long (33 600 seconds = 09:20:00) to run the race. Thus if our centanarian completed the race quicker than 09:20:00, his performance would have been statistically better than that of the winner.

Unfortunately, I could not find world age records for distances shorter than the standard marathon. It would obviously be of considerable value if such records were to be kept as they would allow an appropriate handicapping system to be developed for races of distances shorter than the marathon.

An important advantage of this type of handicapping system is that it is independent of the difficulty of the course or the prevailing environmental conditions because these will be the same for all the competitors. The first competitor to finish the race will be either helped or hindered by the environmental conditions or the course, and the index will be automatically corrected for that. Hopefully, some time in the future this handicapping index will become a feature of all running races.

ANNEXURE 4



PARAMETERS FOR PARABOLIC CURVES

AGE	FACTOR	CURVE
10	0,700	0 * NOMINAL.
22	1,000	8
37	1,000	16
65	0,788	20
85	0,464	0

MALE/FEMALE RATIO: 0,890 (based on average of 10 race distances from 1 km to 42,2 km)

REVISION 1994-07-24.

AGE	INDEX	AGE	INDEX
13	0.775	50	0.902
14	0.800	51	0.894
15	0.825	52	0.886
16	0.850	53	0.879
17	0.875	54	0.871
18	0.900	55	0.864
19	0.923	56	0.856
20	0.944	57	0.848
21	0.961	58	0.839
22	0.975	59	0.830
23	0.986	60	0.820
24	0.994	61	0.811
25	0.998	62	0.800
26	1.000	63	0.789
27	1.000	64	0.778
28	1.000	65	0.766
29	1.000	66	0.754
30	1.000	67	0.742
31	0.999	68	0.729
32	0.998	69	0.715
33	0.996	70	0.702
34	0.994	71	0.687
35	0.991	72	0.673
36	0.988	73	0.658
37	0.985	74	0.642
38	0.981	75	0.626
39	0.976	76	0.610
40	0.971	77	0.594
41	0.966	78	0.577
42	0.960	79	0.561
43	0.954	80	0.545
44	0.947	81	0.529
45	0.939	82	0.513
46	0.932	83	0.496
47	0.924	84	0.480
48	0.917	85	0.464
49	0.909	86	0.448
		87	0.432
		88	0.415
		89	0.399
		90	0.383.

ANNEXURE 5.

Why Age-Graded Scoring?

by Joe McDaniel
Oklahoma Runner Magazine

Ever ask the question, "Who has the best performance?" in a road race?

Your answer might be, "The runner with the fastest time."

That answer would be true if performances were based solely on the time, which is in the case of the open and age-bracket categories. The first runner across the finish line is the winner.

But what if you are scoring runners for prize money within a large age range, such as the masters division, which include ages 40 through 79 in the Tulsa Run.

Certainly, if top honors go to the first runners across the finish line, they almost invariably will be in the 40-44 age group, excluding all of the older runners from any chance of receiving prize money.

Which is the best performance — a 40-year-old runner posting a 49:50 or a 65-year-old who is timed in 1:02:30? What about a 53-year-old who posts a 55:45, or even a 79-year-old runner who covers the course in 1:16:12?

This year, the Tulsa Run master's division was scored using an innovative "best performance" method. The World Association of Veteran Athletes did a lengthy and comprehensive study, which involved the tracking of times for runners age 35 and over. The study took into consideration the aging and slowing process.

The result was a formula that converts a runner's actual time to an "open" time, or, in theory, what a runner would have run in his/her prime of 20-34 years old.

With this formula it was possible to determine the best performance among all masters finishers regardless of age. Note that Claudia Ciavarella, 40, was the first female master to cross the finish line and was first in the 40-44 age group. But, Jane Hutchison, 44, had the "best performance."

This age-graded formula, along with a sex-graded calculation, also was used to score the team division. The age- and sex-graded system allows team members, regardless of sex or age, to contribute.

In team scoring, male open runners age 20-34 received no handicap. Males 35 and over were age-graded. Female open runners age 20-34 were sex-graded with a handicap of 0.901. The times of females 35 and over were age- and sex-graded.

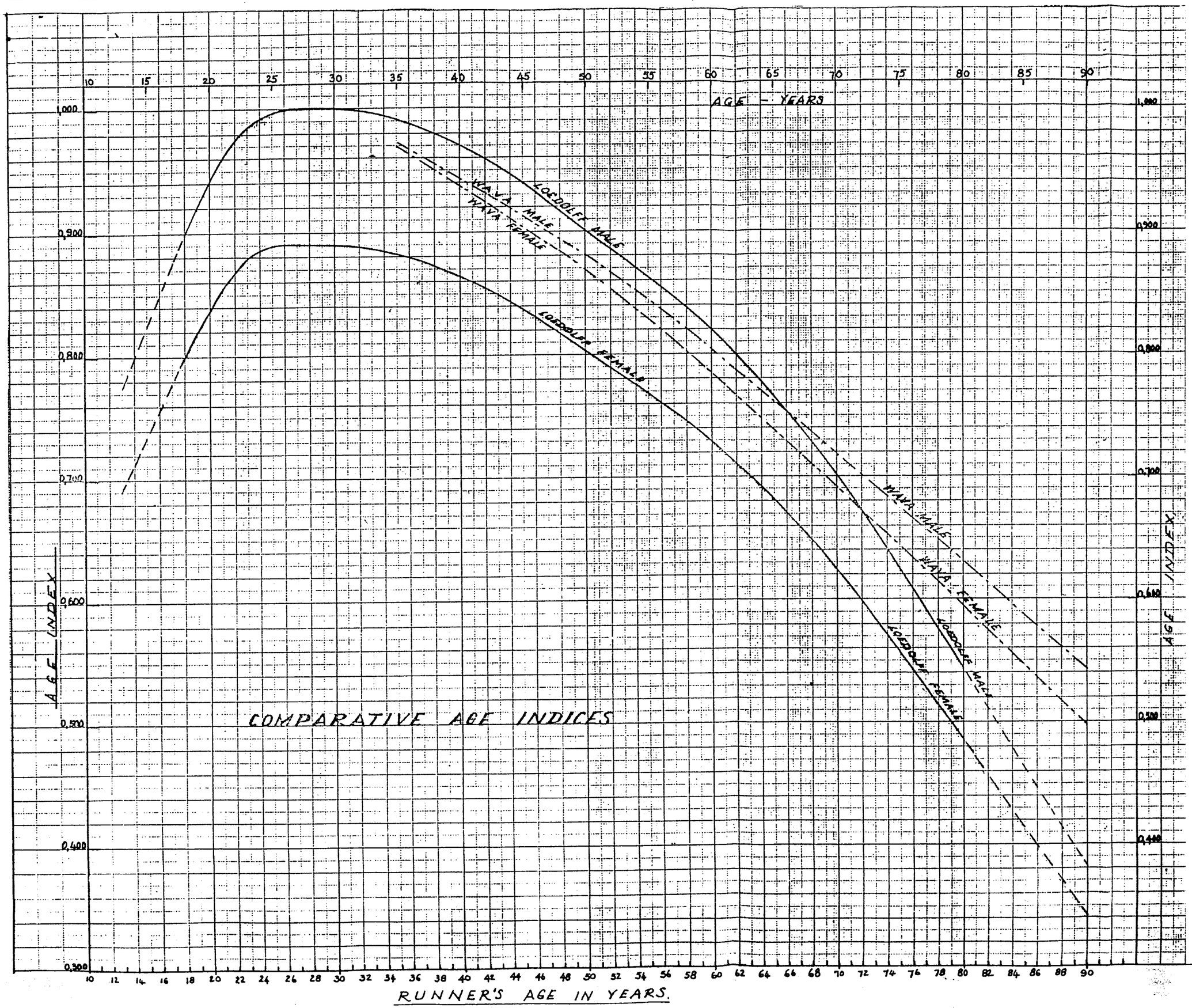
Age-Graded Scoring Factors

To determine an age-graded time, multiply the actual race time by the age factor. These factors apply to distances from 5 kilometers to 25 kilometers.

To convert the female to male equivalent, multiply the open or age-graded time by .901.

Age	Male	Female
35	.9724	.9696
36	.9666	.9633
37	.9608	.9568
38	.9549	.9504
39	.9490	.9539 x .9439
40	.9430	.9373
41	.9370	.9307
42	.9310	.9241
43	.9249	.9174
44	.9187	.9106
45	.9125	.9037
46	.9064	.8970
47	.9002	.8902
48	.8938	.8831
49	.8872	.8759

Age	Male	Female	Age	Male	Female
50	.8804	.8684	70	.7192	.6911
51	.8735	.8608	71	.7106	.6816
52	.8664	.8530	72	.7019	.6721
53	.8591	.8450	73	.6932	.6625
54	.8517	.8369	74	.6844	.6529
55	.8441	.8285	75	.6757	.6433
56	.8362	.8198	76	.6670	.6337
57	.8282	.8110	77	.6582	.6241
58	.8201	.8021	78	.6495	.6144
59	.8120	.7932	79	.6406	.6047
60	.8038	.7842	80	.6318	.5950
61	.7956	.7752	81	.6230	.5853
62	.7874	.7661	82	.6141	.5755
63	.7790	.7569	83	.6052	.5657
64	.7706	.7477	84	.5963	.5559
65	.7622	.7384	85	.5874	.5461
66	.7537	.7290	86	.5785	.5363
67	.7451	.7196	87	.5695	.5264
68	.7365	.7101	88	.5606	.5166
69	.7279	.7006	89	.5516	.5068
			90	.5427	.4970



ANNEXURE 6

AGE	AGE INDICES			
	LOEDOLFF		WAVA	
	M	F	M	F
13	0,775	0,690		
14	0,800	0,712		
15	0,825	0,734		
16	0,850	0,757		
17	0,875	0,779		
18	0,900	0,801		
19	0,923	0,821		
20	0,944	0,840		
21	0,961	0,855		
22	0,975	0,868		
23	0,986	0,878		
24	0,994	0,885		
25	0,998	0,888		
26	1,000	0,890		
27	1,000	0,890		
28	1,000	0,890		
29	1,000	0,890		
30	1,000	0,890		
31	0,999	0,889		
32	0,998	0,888		
33	0,996	0,887		
34	0,994	0,885		
35	0,991	0,882	0,9724	0,9696
36	0,988	0,874	0,9666	0,9633
37	0,985	0,876	0,9608	0,9568
38	0,981	0,873	0,9549	0,9504
39	0,976	0,869	0,9490	0,9439
40	0,971	0,864	0,9430	0,9373
41	0,966	0,860	0,9370	0,9307
42	0,960	0,854	0,9310	0,9241
43	0,954	0,849	0,9249	0,9174
44	0,947	0,843	0,9187	0,9106
45	0,938	0,836	0,9125	0,9037
46	0,932	0,829	0,9064	0,8970
47	0,924	0,822	0,9002	0,8902
48	0,917	0,814	0,8938	0,8831
49	0,909	0,809	0,8872	0,8759
50	0,902	0,803	0,8804	0,8684
51	0,894	0,796	0,8735	0,8608
52	0,886	0,789	0,8664	0,8530
53	0,879	0,782	0,8591	0,8450
54	0,871	0,775	0,8517	0,8369
55	0,864	0,769	0,8441	0,8285
56	0,856	0,762	0,8362	0,8198
57	0,848	0,755	0,8282	0,8110
58	0,839	0,747	0,8201	0,8021
59	0,830	0,739	0,8120	0,7932
60	0,820	0,730	0,8038	0,7842
61	0,811	0,721	0,7956	0,7752
62	0,800	0,712	0,7874	0,7661
63	0,789	0,702	0,7790	0,7569
64	0,778	0,692	0,7706	0,7477
65	0,766	0,682	0,7622	0,7384
66	0,754	0,671	0,7537	0,7290
67	0,742	0,660	0,7451	0,7196
68	0,729	0,649	0,7365	0,7101
69	0,715	0,637	0,7279	0,7006
70	0,702	0,625	0,7192	0,6911
71	0,687	0,612	0,7106	0,6816
72	0,673	0,599	0,7019	0,6721
73	0,658	0,586	0,6932	0,6625
74	0,642	0,572	0,6844	0,6529
75	0,626	0,557	0,6757	0,6433
76	0,610	0,543	0,6670	0,6337
77	0,594	0,529	0,6582	0,6241
78	0,577	0,514	0,6495	0,6144
79	0,561	0,499	0,6406	0,6047
80	0,545	0,485	0,6318	0,5950
81	0,529	0,471	0,6230	0,5853
82	0,513	0,457	0,6141	0,5755
83	0,496	0,442	0,6052	0,5657
84	0,480	0,427	0,5963	0,5559
85	0,464	0,413	0,5874	0,5461
86	0,448	0,399	0,5785	0,5363
87	0,432	0,385	0,5695	0,5264
88	0,415	0,370	0,5606	0,5166
89	0,399	0,355	0,5516	0,5068
90	0,383	0,341	0,5427	0,4970