25:2; 65-77, 2010

Is success at the IAAF World Junior Athletics Championships a prerequisite for success at World Senior Championships or Olympic Games?

By Stephen Hollings and Patria Hume

ABSTRACT

The debate about whether world-level success as a junior athlete is necessary for world-level success as a senior regularly engages coaches, but the discussion is usually based on anecdotal evidence. This study retrospectively tracked the performances of elite senior athletes as they developed (Part A) and prospectively analysed the transition of medallists at the IAAF World Junior Championships through to their senior performances (Part B). Results from Part A showed that of the World Championships in Athletics and Olympic Games gold medallists who had previously competed at an IAAF World Junior Championships, 80% were finalists at the junior level. This would support the notion that success as a junior is prerequisite for world-level success as a senior. However, a contrasting picture emerges from Part B, which shows that over a half (54%) of junior medallists did not go on to compete at the top global events and only 34% of junior medallist go on to be a finalist at the global level. Following their detailed presentation of the results, authors discuss the implications for maximising the conversion of junior talents to senior performers and reducing attrition and then make suggestions for further research.

AUTHORS

Stephen Hollings is a former Great Britain Olympian (3000m Steeplechase, Munich 1972). He was formerly High Performance Director for Athletics New Zealand and Senior Manager – Education for the IAAF. Currently retired, he is completing a PhD at AUT University, Auckland, New Zealand.

Patria Hume is a Professor at the Sports Performance Research Institute New Zealand at AUT University, Auckland, New Zealand.

Introduction

The debate as to whether success at an IAAF World Junior Championships is a prerequisite for success as a senior athlete at the global level is a topic that regularly engages coaches of junior athletes, but the discussion is usually based on anecdotal evidence. Previous studies have attempted to describe the extent and magnitude of the transition from elite junior to elite senior athlete from both prospective and retrospective viewpoints (see Table 1).

A limitation of prospective studies has been that as more than 12,500 athletes have competed in the 11 editions of the World Junior

Championships from 1986 to 2006, tracking of all athletes has proved difficult. Career data for athletes are incomplete and many athletes have changing circumstances, e.g. name changes due to marriage, change of country, loss of contact with the national federation, and perhaps the greatest factor, dropping out of the sport. Further, the available prospective studies have focussed on small, selected groups of junior athletes, e.g. throwers, or just one gender, and do not give a truly authoritative account of the transition.

On the other hand, as it is unknown how many eventual global-level competitors competed at a previous IAAF World Junior Championships, comprehensive retrospective studies have been limited. Global medallists and global finalists have normally been selected as a representative sample for analysis in these studies, which then ascertain the subjects performances when they were juniors.

A mainly descriptive study by ZELICHENOK (2005) identified four groups with analogous career patterns. The first group comprised athletes (an indicative selection of names only was provided) whose careers could be defined as ideal: they all won either European or World Junior Championships and then went on to become global medallists or global finalists. The second group comprised athletes who did not win a major junior championship but did play a prominent role at that level (finalist or minor medallist) and later became bright stars in the world of athletics. The third group were athletes who did not achieve notable success as a junior but eventually became an elite senior. The fourth group of athletes were dominant as juniors and then either disappeared or became athletes of an average level. The author commented that it is "with regret that this list is very long" and indicated that his analysis of the results of the World Junior Championships showed that 60-70% of the junior medallists and finalists did not go on to achieve any serious success at the senior level.

DEFINITIONS

In the context of this paper the following definitions and terms apply:

Medallist: Winner of a gold, silver or bronze (i.e., 1st, 2nd, 3rd place) medal in a competition

Finalist: An athlete who qualified for a final at the competition; normally top 8 for a laned event, top 12 for all other events

Competitor: A competitor who did not make a final or win a medal.

Global: World Championships (Senior), outdoor or indoor, held every two years or Olympic Games, held every four years

Elite: A Global Medallist or Global Finalist or Global Competitor

Senior: Open-age competition

Junior: An athlete at the World Junior Championships

Transition time: The number of years between an athlete first becoming a Junior medallist or Junior Finalist and becoming, for the first time, a Global Medallist or Global Finalist.

In order to lift the debate as to whether world-level success as an junior is a prerequisite for global success as an elite senior athlete from an exchange of statements of uncorroborated opinion, which are, in the main, based on anecdotal individual case studies, it is essential that supporting empirical data be obtained and analysed.

In attempting to address the issue of the transition, we analysed performance data from two perspectives. First, our study retrospectively traced the performances of elite senior athletes back to the time they were juniors. For this we selected Olympic Champions, World Champions and Beijing Olympic medallists as the cohort. We attempted to expand on and quantify some of the previous descriptive studies. Secondly, we prospectively followed all junior medallists (1986 – 2004) through to global performances or otherwise. We chose to analyse the issue of the transition from the two perspectives as previous studies involving either a retrospective approach or a prospective approach had produced somewhat differing perspectives of the issue.

Many developed athletics nations have elite junior development programmes where the aim is to identify and develop talent. The success or otherwise of these programmes is whether they produce athletes who succeed on the world stage as juniors. All of these countries also have a high-performance programme or equivalent that is focussed at achieving success of senior athletes on the global stage. The successful transition of athletes from the junior development programme to the high performance programme is vital if senior success is desired. One measure of the success of the transition for a country would be to determine how many of their elite juniors go on to become elite seniors. In this study, we determined which countries had a high "conversion" rate (the sum of the global medallists and global finalists as a percentage of the total number of junior medallist from that country).

STUDY A - RETROSPECTIVE ANALYSIS

Methods

Data extraction

The career performances of 339 athletes who were a world senior champion, or an Olympic champion or a medallist at the 2008 Beijing Olympic Games and had competed at an IAAF World Junior Championships from 1986 – 2006 were identified for the analysis. Athlete biographical data, competition results and competition performances throughout their athletics career were obtained through web-based databases and athletics statistical pages[1]. Official handbooks (BUTLER, 2006, 2008) were used to obtain the competition results from all past IAAF World Junior Championships and to identify medal winners and finalists at these championships. In the case of the Beijing Olympic medallists' analysis, data and results were obtained from the official website[2]. The competition profiles for each world champion, Olympic champion and Beijing Olympic medallist were retrospectively analysed to their performances as junior athletes.

Data statistical analysis

Data obtained were analysed using simple statistics in Excel to calculate frequency and percent.

Results

Table 2 shows the frequency of world champions, Olympic champions and Beijing 2008 Olympic medallists, who had been junior medallists, junior finalists and junior competitors.

World senior champions as juniors

One hundred and thirty seven (67 men & 70 women) athletes who were world senior champion (gold medal) in an individual event at a World Championship in Athletics had previously competed at an IAAF World Junior Championships. Of these, 75 (40 men, 35 women) (55%) were junior medallists. A further 34 (18 men and 16 women) (25%) were junior finalists. Therefore, of world champions who competed at an IAAF World Junior Championships, 80% had been a junior medallist or

Table 1: Studies that have evaluated transition from junior to senior athletics performances

Study	Approach	Results
Julin (1995)	Prospective: n=98 1989 European Junior Championships 1994 European Senior Championships	(a) 7 of the 98 won a medal at 1994 European Championships (b) 7 of the 98 were finalists (c) a further 16 competed (d) 68 (69%) did not compete at 1994 European Championships
	Retrospective: n=36 gold medal winners 1994 European Championships → prior European Junior Championships and prior World Junior Championships	(a) 24 of 36 (66%) had competed at a previous European Junior Championships or previous World Junior Championships. (b) 14 of 36 (38%) had been a medallist at a previous European Junior Championships or previous World Junior Championships.
Otte (2002)	Prospective n=853 male finalists World Junior Championships	(a) 64% showed further performance improvements (b) 26% reached the finals at subsequent World Championships or Olympic Games
Zelichenok (2005)	Retrospective & Prospective: n=~1500 Senior → 1986 – 2000 World Junior Championships	(a) 75 (42 Men, 33 Women) Olympic champions had taken part at a previous World Junior Championships (b) ~ 60–70% of medallists at World Junior Championships did not go on to achieve any serious success at the senior level.
Scholz (2006)	Retrospective n=indicative Throwing events 1991 – 2003 global competitions → 1986 – 2002 World Junior Championships	(a) 18 (8 Men, 10 Women) world and Olympic champions in the throwing events 1991 – 2003 had previously participated at a World Junior Championships (b) 5 of the top 8 placers in the men's shot put at the 2003 World Championships had been a medallist at a World Junior Championships
	Prospective n=7 Throwing events 1986 – 2002 World Junior → 1991 – 2003 global competitions	(a) 7 (4 Men, 3 Women) athletes who were World Junior Championships winners went on to become world or Olympic champions
Grund & Ritzdorf (2006)	Prospective: n=296 1999 World Youth Championships → 2006	(a) 90% of finalists continued to improve in subsequent years (b) 88% made world top 100 ranked performances of the year in their event (c) 21% qualified for World Championships or Olympic Games 2000-2004
Hollings (2010)	Retrospective n=121 2008 Beijing Olympic Games medallists → prior World Junior Championships	(a) 57 (47%) had previously competed at a World Junior Championships (b) 35 of the 57 (61%) had won a medal at a World Junior Championships (c) A further 12 of the 57 (21%) were a finalist at a World Junior Championships

junior finalist and 20% or 28 (nine men and 19 women) were junior competitors only.

Of the 269 unique world senior champions between 1995 and 2007, 131 (49%) did not compete at a prior IAAF World Junior Championships.

Olympic champions as juniors

Eighty-one (50 men and 31 women) athletics Olympic Games gold medallists from 1992 – 2008 had previously competed at an IAAF World Junior Championships. Thirty male Olympic Champions (60%) had been junior medallists and a further 17 (34%) had been junior finalists. Twenty-two (71%) women Olympic gold medallists were junior medallists and a further four (13%) were junior finalists. Therefore, of Olympic champions who competed at an IAAF World Junior Championships, 93% had been a junior medallist or junior finalist and 7% or six (three men and five women) were junior competitors only.

Of the 121 unique Olympic champions at the 2000, 2004 and 2008 Olympic Games, 66 (54%) did not participate at a prior World Junior Championships. Somewhat surprisingly, we could not find a single Olympic champion from the 1996 Olympic Games who competed at a World Junior Championships.

Beijing Olympic medallists as juniors

In an analysis of the 2008 Beijing Olympic track and field medallists, HOLLINGS (unpublished) found that of the 62 men's athletics Beijing medallists, 28 (45%) had been elite juniors. Of these, 17 were junior medallists and a further seven were junior finalists. Only four male athletes who won medals in Beijing and who competed at an IAAF World Junior Championships did not make at least a final at them. For the women, the statistics were almost identical: 29 (49%) of the 59 women's athletics Beijing Olympic medallists had been elite juniors. Of these 29, 18 were junior medallists and a further five were junior finalists. Six women who won athletics medals in Beijing and had competed at an IAAF World Junior Championships did not make at least a final at them. In summary, the overall analysis shows that 39% of Beijing Olympic track and field medallists had been a junior medallist or a junior finalist.

Table 2: Frequency of world champions, Olympic champions and Beijing 2008 Olympic medallists, who had been junior medallists, junior finalists and junior competitors

		Outcomes at previous World Junior Championships
World champions (gold medallists) 1987 – 2007 who had competed at a World Junior Championships	(n=137)	75 JM – 55% 34 JF – 25% 28 JC – 20%
Olympic champions (gold medallists) 1988 – 2004 who had competed at World Junior Championships	(n=81)	52 JM – 64% 21 JF – 26% 8 JC – 10%
Beijing 2008 Olympic medallists (1st – 3rd)	(n=121)	35 JM – 29% 12 JF – 10% 10 JC – 8%

JM: Junior medallists JF: Junior Finalists JC: Junior Competitors

STUDY B - PROSPECTIVE ANALYSIS

Methods

Data extraction

For the tracking of junior medallists (1986 – 2004) we identified them from the official handbook (BUTLER, 2006) and then followed their achievements as senior athletes using the web-based database and athletics statistical page of Tilastopja OY. We used the same data sources to collect the information on each athlete's country of representation.

We tracked only the athletes who had won individual medals at the IAAF World Junior Championships from 1986 – 2004. Although the data is available for the two subsequent editions of the World Junior Championships (2006 and 2008), the time span between these championships and the present time may be too short to allow junior medallists to demonstrate their abilities at the global level. JULIN (1995) in a study of the transition between the European Athletics Junior Championships and the European Athletics Championships (senior) used a separation of five years between the two competitions, assuming that the former junior athletes would have established themselves in the senior ranks by this time "if they were ever going to."

Data statistical analysis

For the junior medallists progressing to elite senior we categorised subsequent achievement in ranking order as:

1. Global Medallist;
2. Global Finalist;
3. Global Competitor;
4. Did not compete at a world championships or Olympic Games.

Junior medallists winning more than one medal at the same, or more than one, IAAF World Junior Championships were recorded as one individual medallist. Only athletes who won a medal in an individual event (i.e., excluding relays) were analysed.

For the country analysis we tabled the countries (n=22) that had produced, in total, more than 10 individual junior medallists over the 10 editions of the IAAF World Junior Championships from 1986 to 2004 and calculated the "conversion rate" as being the sum of the global medallists and global finalists as a percentage of the total number of junior medallist from that country. The "attrition rate' was the percentage of junior medallist from each country who did not compete at a subsequent global competition.

Results

Conversion and attrition

Of the 1,054 individual junior medallists (1986 – 2004), 22% of men and 21% of women went on to become global medallists, a further 13% of men and 12% of women went on to be global finalists, and a further 14% of men and 10% of women were global competitors. Slightly more than half (51% of men and 57% of women) of the junior medallists did not compete at as an elite senior (Table 3).

The mean conversion rate of the 22 countries that had more than 10 athletes who were junior medallists, was 35%, whilst the mean attrition rate was 53% (Table 4).

The countries that had a higher than mean conversion rate were (in alphabetical order) Australia, Belarus, Bulgaria, Cuba, Ethiopia, Great Britain, Jamaica, Kenya, Morocco, Nigeria, South Africa and Spain. Countries that had a higher than the mean attrition rate were Belarus, Bulgaria, China, Finland, France, Germany, Italy, Japan, Kenya, Romania, Russia and USA. Countries that had both a better than the mean conversion rate and a lower than the mean attrition rates were Australia, Cuba, Ethiopia, Great Britain, Jamaica, Morocco, Nigeria, South Africa, and Spain (Table 4).

Of the 22 countries analysed, the five that produced the most individual junior medallists from 1986 to 2004 (USA, Kenya, China, Germany and Russia) had both a conversion rate that was lower than the mean, and an attrition rate higher than the mean.

Transition time

The transition time ranged from one year to 11 years with a mean of 4.1 SD ±2.8 years for the men. The women had a longer transition time with a range of one to 13 years (mean 7.8 ±3.7 years). The analysis also shows that a large majority of the junior medallists and junior finalists stayed at or near the top of their event for a further 10 to 15 years.

Discussion

This study focussed on competition performance aspects of the transition from an elite junior athlete to an elite senior athlete. We acknowledge that there are many other factors that determine or influence whether the transition will be successful or otherwise (e.g. social, psychological, economic, educational, career and sport political issues), which we did not consider.

In general, national athletics federations and coaches who deal with the high performance aspects of sport agree that the goal for their athletes should be to achieve their peak performances in adulthood rather than in late adolescence. Federations have, in the main, invested considerable amounts of time plus financial and other resources into junior athletes with the expectation that there will be a return on the inputs when these athletes reach the senior level. Many of these same federations see the IAAF World Junior Championships as an obligatory stepping-stone in the preparation of senior level performers. There is a conviction that high achievers at the IAAF World Junior Championships will automatically follow the same pathway as previous other junior high achievers and become a force on the global stage as a senior.

Our analysis shows that this assumption is flawed. A subsequent study of ours shows that half of New Zealand and Australian junior medallists and junior finalists did not go on to represent their country at the senior level. ZELICHENOK's estimate that 70% of all junior medallists and junior finalists did not go on to be elite seniors consistent with our finding that 54% of junior medallists did not compete at a subsequent global championships. There must be concern therefore, amongst federations, at the high attrition rate of proven elite junior athletes.

The difference between competing in a junior category and competing as a senior is markedly different. Being an elite junior means that an athlete is among the very best of those of the same age. The "junior age group" in athletics extends over a two-year period. Competing as a senior or open age athlete means that an athlete is competing against the very best in a 10 to 16 year window. Put another way, this means when competing as a senior athlete they compete against the best athletes from 5 to 8 cumulative junior age groups. Consequently, an athlete can be more evident as an elite junior, than as an elite senior – the difference between being "a large fish in a small pond (junior) to being a large fish in a much larger pond (senior)".

The retrospective analysis of how elite senior athletes performed as juniors supports the notion that having a high-level of success as a junior (e. g. being a junior medallist or junior finalist) is a prerequisite for success as a senior athlete at a global championship. However, when the analysis is undertaken prospectively, in other words looking at what happens to elite junior athletes when they become senior athletes, a contrasting description of the transition emerges.

Elite seniors as elite juniors

At the senior global level, a high proportion of world champions, Olympic champions and Olympic medallists have been highly successful junior athletes. We showed that over 70% of gold medallists at global competitions who previously competed at an IAAF World Junior Championships achieved high-level success by virtue of being a junior medallist or junior finalist. However, career achievements at the senior level are not solely dependant on being a junior medallist: the analysis showed that a further 30% of athletes who were "just" a junior finalist, went on to become global medallists.

Table 3: Frequency of junior medallists 1986- 2004, who went on to become global medallists, global finalists, global competitors or did not compete further

	No. of Medallists at World Junior Championships	Global			Did not compete at a Global event
		Medallist	Finalist	Competitor	
Men					
1986 Athens, GRE	61	13	6	2	40
1988 Sudbury, CAN	63	19	8	2	34
1990 Plovdiv, BUL	59	16	2	8	33
1992 Seoul, KOR	47	12	3	6	26
1994 Lisbon, POR	61	12	8	10	31
1996 Sydney, AUS	57	14	13	8	22
1998 Annecy, FRA	58	12	13	9	24
2000 Santiago, CHI	58	11	12	11	24
2002 Kingston, JAM	57	8	6	15	28
2004 Grosseto, ITA	57	11	5	11	30
Total Men	**578**	**128**	**76**	**82**	**292**
		22%	**13%**	**14%**	**51%**
Women					
1986 Athens, GRE	47	13	1	3	30
1988 Sudbury, CAN	38	7	6	2	23
1990 Plovdiv, BUL	46	8	5	4	29
1992 Seoul, KOR	43	11	2	3	27
1994 Lisbon, POR	46	11	5	6	24
1996 Sydney, AUS	45	6	13	3	23
1998 Annecy, FRA	55	10	5	4	36
2000 Santiago, CHI	51	13	5	5	28
2002 Kingston, JAM	47	13	8	10	16
2004 Grosseto, ITA	58	5	8	7	38
Total Women	**476**	**97**	**58**	**47**	**274**
		21%	**12%**	**10%**	**57%**
Total (M & W)	**1054**	**225**	**134**	**129**	**566**
		21%	**13%**	**12%**	**54%**

Table 4: Frequency, by country of junior medallists 1986 - 2004, who went on to become a Global Medallist, Global Finalist, Global Competitor or did not compete at a global competition

Country	Individual Medals at World Junior Championships (1986-2004)	Global Medallists	Global Finalists	Global Competitor	Conversion rate to Global Medallist or Global Finalist	Did not compete at a Global Competition	Attrition rate of Junior medallists
USA	85	15	5	9	22%	57	67%
Kenya	76	17	10	6	**35%**	43	56%
China	62	8	7	8	24%	39	60%
Germany (from 1992)	46	5	7	6	26%	28	61%
Russia (from 1994)	45	9	6	5	33%	25	55%
Cuba	42	13	9	3	**52%**	17	40%
Ethiopia	37	16	2	1	**48%**	18	48%
Australia	35	6	8	8	**40%**	13	37%
Romania	34	5	6	2	32%	21	61%
Great Britain	28	7	3	4	**35%**	14	50%
South Africa (from 1992)	20	6	2	3	**40%**	9	45%
Finland	20	1	5	3	30%	11	55%
Jamaica	19	5	3	2	**42%**	9	47%
Spain	17	4	5	2	**53%**	6	35%
Poland	17	2	3	3	29%	9	52%
Nigeria	16	4	2	5	**37%**	5	31%
Japan	15	1	1	0	13%	13	86%
France	13	2	1	1	23%	9	69%
Bulgaria	13	1	4	1	**38%**	7	53%
Belarus (from 1994)	12	4	1	0	**42%**	7	58%
Morocco	12	6	1	0	**58%**	5	41%
Italy	11	2	0	2	18%	7	63%

Bold: Conversion rate of Junior medallists from these countries to Global Medallists and Global Finalists is higher than the mean (35%) of the 22 countries
Italic: Attrition rate of Junior medallists from these countries is higher than the mean (53%) of the 22 countries.

There are a number of circumstances that have perhaps prevented these statistics from being even better. There are known instances where the best junior athletes in an event have not been selected for the IAAF World Junior Championships for whatever reason. Personal circumstances such as injury, finance, schooling and employment commitments may have prevented some athletes from attending. Perhaps more significantly, some athletes came from nations where the standard was high and there was considerable depth, particularly in specific events. A junior athlete could have been among (say) the best ten in the world in an event, but was precluded from attending the championships as s/he was unable to qualify for either of the two places available for his/her event on the national team. For example, the dissolution of the Soviet Union into its constituent member states in 1991 enabled more junior athletes to attend the subsequent editions of the IAAF World Junior Championships, but prior to this the Soviet team, like every other nation was restricted to a maximum of two athletes per event. By way of contrast, the unification of Germany in 1990 restricted the number of German athletes attending the championships to two per event, whereas prior to re-unification, four German junior athletes per event – two from the German Democratic Republic and two from the German Federal Republic.

Junior medallists to elite seniors

Almost half (46%) of junior medallists between 1986 and 2004 went on to a global competition, with over a third of them becoming a global medallist or global finalist. It was three times more likely that junior medallists, if s/he stayed in the sport, would become a global medallist or global finalist rather than "just" a global competitor.

At the same time, the attrition rate of junior medallists is a cause for concern. Over a half did not go on to compete at the global level. This is not to say that they did not compete as a senior athlete; they may have competed at the Area or regional, or group games level, but, for whatever reason, they did not produce the same level of achievement as their junior medallist peers.

Elite seniors who were not elite juniors

It is difficult to quantify the number of elite seniors who were not elite juniors, let alone the reasons why they became elite seniors without having been an elite junior. However, from our analysis of the Beijing Olympic medallists we see that 53% of them had not competed at a previous IAAF World Junior Championships. Conversely, in a subsequent study of New Zealand and Australian elite athletes (n=536) we could identify only two New Zealanders and 11 Australians who were elite seniors and had not competed at an IAAF World Junior Championships when they were eligible to do so by age. They were either late-comers into the sport or did not demonstrate sufficient ability as a junior.

Transition time and event bias

The most recent editions (2004 onwards) of the IAAF World Junior Championships have not yet produced as many world or Olympic champions as those produced from earlier editions of the World Junior Championships. The reason for this may be in the variable time gap that it takes between being a junior medallist and becoming a global medallist. The time span could be less than one year or it could be much longer, as exemplified by athletes who took 12 to 13 years to progress from being a junior medallist to becoming a global medallists. We did find that there is a tendency towards women taking longer to make the successful transition.

There is a feeling that in some of the technical disciplines (e.g. throwing events and jumping events), that the transition time from elite junior to elite senior athlete is longer but our analysis does not support this premise, as we did not find a particular bias towards any event.

Notwithstanding, there are implications for both athletes and for national federations in that they need to account for the fact, in the planning of any transition programme, that some athletes will make a quick transition, whilst others will take longer to achieve the success expected of them.

Country analysis

It is extremely difficult to quantify the total number of athletes who have achieved success at the global level yet did not compete at an IAAF World Junior Championships when eligible by age to do so. Notwithstanding, our data showed that there was a very large number of athletes from the USA who were junior medallists or junior finalists, but were not seen on the global stage. Similarly, a high number of the USA's global medallists and global finalists did not compete at an IAAF World Junior Championships when they were eligible by age to do so. This situation is not unique to the USA but in their case it is probably the result of the structure of the sport, i.e., a wealth of opportunities at high school and college level and fewer opportunities post college, and is exacerbated by a large population. The high attrition rate post juniors in the USA can easily be handled due to the high population base; athletes are easily replaced with others of similar ability.

Another populous country, China, also had a low conversion rate and a high attrition rate. Unlike the USA, they did not produce many global medallist but they are like the USA in that from their large population base, they were able to produce a large number of elite senior (though not necessarily global medallists)) athletes.

A similar situation was evident amongst the middle- and long-distance runners of East Africa, particularly Kenya. Athletes from Kenya, who have been junior medallists and junior finalists, infrequently appear at the global level, whilst many of their global medallists and global finalist did not compete at an IAAF World Junior Championships. Kenya had a reasonable conversion rate, but a high attrition rate of junior medallists and junior finalists. The reason for this would relate to the intensity of competition amongst a large number of highly ranked and of similar standard athletes at the senior level for the three places available to them at the World Championships or Olympic Games. Most other countries in the world do not share this enviable situation. Ethiopia, Kenya's rival in the middle- and long-distance events, by contrast, has a conversion rate equal to its attrition rate.

Ideally a country should have a high conversion rate and a low attrition rate. Our analysis identified nine countries (in alphabetical order), Australia, Cuba, Ethiopia, Great Britain, Jamaica, Morocco, Nigeria, South Africa and Spain, who had an above average conversion rate and a below average attrition rate. These nine have diverse socio-political, ethnic and cultural, economic, population and geographical size, as well as general sport structure and athletics cultural characteristics. Whether it is because they have programmes in place to achieve the aspiration of low attrition and high conversion, or whether this happens by chance of having gifted athletes, requires further investigation.

General points

Our data showed that there was no particular bias towards the gender of the athlete who makes the successful transition from junior medallist or junior finalist to elite senior. Approximately the same numbers of male global champions as female global champions were junior medallists or junior finalists. Similarly, there appeared to be no bias towards an event or an event group. Each event and event group was represented throughout the prospective and retrospective data sets, with no single event or event group dominating.

From our analysis a fifth category, the general attrition rate, could be added to ZELICHENOK's initial four categories assigned to IAAF World Junior Championships competitors. The general attrition rate of elite junior athletes who did not compete as seniors at a global championship is extremely high. Our analysis, using the Australian and New Zealand data as an example, showed that the general attrition rate was greater than 70%.

One concern that has been expressed about the transition from elite junior athlete to elite senior athlete has been that the intensity of the necessary preparation and the level of competition faced at an early age may have a detrimental effect on an athlete's prospect as a senior athlete. The results of our analysis do not appear to substantiate this concern as many successful senior athletes who were

successful at the junior level continued to be global medallists and global finalist over a period of 10 – 15 years. However, that is not to say that there have not been athletes who were encouraged to participate at the IAAF World Junior Championships when they were neither physically or emotionally ready for the level of competition and subsequently the event was their last athletics competition. Added to this there may well be cases where the early physical maturity and the imposition of intensive training have been capitalised on to bring short-term success only for the athlete to lose interest in the sport.

Another barrier to advancement could also be associated with limited competition opportunities. Post IAAF World Junior Championships, junior athletes may well find themselves competing with more experienced and better-performed senior athletes from the same country for places on the national team. Depending on the strength of a particular event in the country and with the limited number of event team places available, a former elite junior athlete just may not have the opportunity to compete at global championships.

The results of our analysis give national athletics federations some quantitative basis on which to develop or restructure their athlete development programmes. Many developed national federations do have established and worthwhile junior development programmes, where the emphasis is on the development of junior age grade athletes. These same federations also normally have high performance or elite programmes, where the emphasis is directed towards supporting athletes who will compete at global championships. In between these two programmes there is sometimes a void. The purpose of a transitional development programme should be to determine the best way for the talented and proven young athlete to make the transition to the senior ranks. It would appear from our analysis that the selection of junior athletes into such a programme should be those who have the ability to achieve high-level results in winning a medal or making a final at a World Junior Championships and therefore have a greater probability of a positive return on the investment if they are appropriately nurtured through such a programme.

In the light of our analysis, the challenge therefore for athletics federations, if they wish to achieve success at the senior global level is two-fold. First, is to aim to have a greater number of juniors who achieve success by becoming a junior medallist or junior finalist. Secondly, to retain these athletes post IAAF World Junior Championships.

Future Directions

Having established that there is a high probability that a high-achieving junior will go on to be an elite senior athlete, further research needs to focus on determining the reasons why others of comparable ability do not make a successful transition. The reasons are not necessary exclusively performance related and will include, but not be confined to, social, psychological and environmental factors. It also needs to be determined how good of a junior the athlete needs to be to amplify the probability of a successful transition. Just achieving the World Junior Championships qualifying standard to participate will not necessarily identify the junior athlete who has the performance ability to succeed as a senior athlete.

It is desirable to determine whether athletes who were elite juniors and went on to be elite seniors, annually progress at a different rate to those athletes who come into the sport at a later stage and achieve senior success, or whether this latter mentioned group come into the sport at a high level and then continue to progress at the same rate as the aforementioned group.

Similarly, it is necessary to establish if the athlete, who does not become a junior finalist and only makes a lesser impact at the senior level, annually progresses at the same rate as the high-achieving junior who has success at the senior level. If this is so, it will further support the premise that a junior athlete needs to be very good in order to succeed as a senior athlete.

Perhaps most importantly, research is needed on the optimum structure for transitional development programmes in order to ensure that the attrition rate, both generally, and specifically of those elite juniors is reduced. The basis for selection of athletes into both junior development and transitional programmes requires refinement to include some subjective and social and environmental parameters rather than just focussing on the more traditionally applied performance objective standards.

Conclusions

The analysis, when looked at retrospectively of how elite senior athletes performed as juniors, would support the notion that success as a junior medallist or junior finalist is a prerequisite for success as a senior athlete at a global championship. However, when the analysis is undertaken prospectively, i.e., what happens to elite junior athletes when they become senior athletes, a contrasting description of the transition emerges. The transition in this case is characterised by a high attrition rate (54%) of junior medallists and junior finalists, whilst from a subsequent study of New Zealand and Australian junior competitors, we see that the overall attrition rate was ~70%. Thus, there is a reasonable probability that athletes who have achieved a high level of success as a junior athlete will go on to be a high achieving senior athlete at the global level. The probability is greater if the junior athlete won a medal or made a final of their event at an IAAF World Junior Championships.

Conversely, there are athletes who have succeeded at the global level who were not finalists or medallists when they competed at an IAAF World Junior Championships but they are rare when compared to the junior medallists and finalists who made the transition to the global level.

Countries with large populations have the luxury of being able to produce elite seniors despite the high attrition rate of their elite juniors. Less populous countries, if they wish to produce elite senior athletes, need to start by producing more junior medallists and finalists and then retain them in the sport.

Please send all correspondence to:

Stephen Hollings

hollings@athletic.co.nz

NOTES

1 International Association of Athletics Federations: www.iaaf.org; Tilastopja OY: www.tilastopja.org; All-Athletics: www.All-Athletics.com

2 Beijing 2008 Olympic Games: en.beijing2008.cn

REFERENCES

BUTLER, M. (Ed.). (2006). The 11th IAAF World Junior Championships in Athletics - Statistics Handbook. Monaco: IAAF.

BUTLER, M. (Ed.). (2008). The 12th IAAF World Junior Championships - Fact & Figures. Monaco: IAAF.

GRUND, M, & RITZDORF, W. (2006). From talent to elite athlete: A study of the performance development of the finalists at the 1999 IAAF World Youth Athletics Championships. New Studies in Athletics, 21(2), 43.

HOLLINGS, S. C. (2006). World junior success is a prerequisite for world senior success. Modern Athlete and Coach, 44(1), 14-17.

HOLLINGS, S. C. (in print). The competition pedigree of Beijing Olympic track and field medallists. Modern Athlete & Coach.

JULIN, A. L. (1995). Where have all the flowers gone? In P. Matthews (Ed.), Athletics 1995 (pp. 140-142). Surbiton, Surrey: SportsBooks Ltd.

OTTE, M. (2002). Die Finalisten internationaler Leichtathletik-Junioren-Weltmeisterschaften von 1986-1996 und ihre Leistungsentwicklung im Aktivenalter. Unpublished Diplomarbeit, Deutsche Sporthochschule, Koln.

SCHOLZ, W. (2006). The throwing events at the IAAF World Junior Championships - A whistle stop on the journey to elite athletics. New Studies in Athletics, 21(2), 7-27.

ZELICHENOK, V. (2005). The long-term competition activity of the world's top athletes. New Studies in Athletics, 20(2), 19-24