A Qualitative Review Of Annual Progress In Powerlifting Disciplines And Total Score

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ABSTRACT

This study drew on data mining from Powerlifting Championships recognized by the International Powerlifting Federation and compiled by the OpenPowerlifting project. Analysis was made using records of the best total score for each athlete by year from 2012 to 2021, evaluating the squat, bench press and deadlift disciplines. The annual progress (AP) of the athletes was then qualitatively codified using the difference between the results of consecutive years for each discipline and total. A positive difference was codified as 1 and a negative or equal result as 0, so obtaining 6 categories. AP was thus calculated for 32,539 men's and 15,700 women's samples from classic powerlifting, and 14,181 men's and 6,518 women's samples from equipped powerlifting. In order to evaluate these APs, decision tree analysis was generated using the CHAID growing method (Chi² p<0.05), with AP as the dependent variable and event, age and sex as factors. The most robust category was "*Improvement of all disciplines and total*" (IA), representing 46.1% of the global results. Age was the most relevant classification factor on the tree, with the youngest groups presenting the highest percentages of IA. Event was the next most significant factor, with Classic powerlifters showing higher percentages of IA than Equipped ones. Likewise, IA results within most weight classes were higher for Classic events than Equipped ones. The third important factor was Sex, with women attaining higher IAs than men, except for the 14–18-year-old group. Notably, the "*No Improvements*" category reflected a considerable percentage (11.7% of global results). The study suggests a sequence of annual outcomes in order of likelihood as follows: 1-*Improvement of all disciplines and total*, 2-*Improvement of two disciplines and total*, 3-*No improvements*, 4-*Improvement of one discipline but not total*, 5-*Improvement of one discipline and total*, and 6-*Improvement of two disciplines but not total*.

Keywords: powerlifting, annual progress, squat, bench press, deadlift.

INTRODUCTION

Powerlifting is a strength sport made up of three disciplines: squat, bench press and deadlift, with three maximum lift attempts made for each, and the score consisting of the sum of the best lifts for each discipline in total. Powerlifting began in the 1950s, and currently boasts many international federations and associations featuring the participation of both sexes (Velázquez-Ormeño, 2009). Since 1972, the International Powerlifting Federation (IPF) and its affiliated regional federations have organized international powerlifting championships, with associated national federations organizing local championships (International Powerlifting Federation, 2022). These feature two main events: Equipped and Classic Powerlifting. The athletes in equipped competitions wear supportive shirts, suits and accessories made up of materials that increase stiffness and reduce the impact of the load on muscle structures by storing elastic potential energy and thereby assisting the lift. In contrast, in classic

competitions athletes can only wear protective accessories without supportive assistance, which has no rebound effect due to elastic potential energy stored (Hernández-Ugalde, 2022).

Equipped powerlifting athletes can lift higher maximal loads than classic athletes. Some research has reported significantly higher barbell results in squat, bench press and deadlift for the Equipped compared to the Classic division for both sexes (Ball & Weidman, 2017; Wilk et al., 2020). Moreover, World Records in squat and bench press for both sexes were found to be significantly better for Equipped over the Classic division, while deadlift World Records showed no statistically significant differences between these divisions (Wilk et al., 2020).

Powerlifting athletes and coaches seek to improve lifts in every competition. In this regard, many training methods have been proposed and tested that show an improvement in lifts, such as the linear periodization and undulating periodization (Bufford et al., 2007; Wendler, 2011; Colquhoun et al., 2017). All of these are arranged into microcycle and mesocycle training periods. Furthermore, a competitive year is considered as a macrocycle period (Phillips et al., 2016), which powerlifting coaches and athletes use to measure performance progress. Some studies have found that on average powerlifting athletes improve their lifts throughout long competitive periods or within the same competitive year at the official championships. (Latella et al., 2020; Pearson et al., 2022). In other strength sports such as weightlifting, elite athletes have shown increased strength performance and hormonal adaptations over one and two monitored years (Häkkinen et al., 1987; Häkkinen et al., 1988). However, the results of training periods could be different than those obtained during championships due to both internal factors (preparation, age) and external factors (environment).

Another topic to consider is the difference between the annual progress of men and women athletes. Some studies have reported that the relative strength of men is greater than women in all disciplines of squat, bench press and deadlift (Latella et al., 2018; Ball & Weidman, 2017). In addition, the ratio between the total load lifted versus body mass for powerlifting and weightlifting athletes is higher for men than for women (Markovic & Sekulic, 2006). However, there is a lack of data and research to evaluate the differences between sexes regarding successful annual progress in each powerlifting discipline, regardless of relative strength.

In general, evaluation of the annual progress in powerlifting is difficult due to the expensive cost of elaborate scientific testing and the lack of voluntary collaboration on behalf of athletes. However, many studies have been able to statistically analyze and perform data mining on Powerlifting Championships from the OpenPowerlifting project (https://www.openpowerlifting.org/data). This platform is a community service which creates a permanent open archive of the world's powerlifting data. The IPF, its affiliated regional federations and countries all contribute to this by uploading the results of championships. Therefore, this platform can serve as a useful tool for the analysis of the annual progress of powerlifters.

The perfect goal of a powerlifting athlete is to improve all disciplines and total score each year. Nonetheless, data on Openpowerlifting.org shows that this is not always possible to achieve. The aim of this research is to review annual progress in disciplines and total score for Equipped and Classic powerlifting events using a qualitative method, taking into account sex and age. The initial hypothesis proposed that there are statistically significant differences among groups of events, ages and sexes.

METHODS

Procedure

For this research, data were selected from World, Regional and National Championships recognized by the International Powerlifting Federation (IPF) from 2012 to 2021. These data were compiled by the Open Powerlifting project (https://www.openpowerlifting.org/data) and were extracted on 01/13/2022. The set of data was grouped into Equipped Powerlifting and Classic Powerlifting and separated by sex. Previously, data cleansing was performed for issues such as misspelled names, different athletes with the same name, different years of birth given for the same athlete, and records published without age being recorded. The records of the best total score for each athlete by year were selected together with their disciplines (squat, bench press, deadlift). Only records of athletes participating for a minimum of two consecutive years were used for this analysis.

The annual progress of each athlete was qualitatively codified using the difference between the results of two consecutive years, subtracting the subsequent

year result from the previous year's result, and then the age and weight data of the subsequent year were used to order the age groups and weight classes in the analysis. A positive difference was codified as 1 and a negative difference or unchanged score was codified as 0. The following order for the code was determined: Total, Squat, Bench Press and Deadlift. This obtained 14 binary codes of results. For example, "1111" denotes improvement of all disciplines and the total score, and "0000" denotes no improvement of any discipline nor total score. The 14 resulting combinations were organized into six categories as shown in Table 1:

The data were classified by the three factors together with their classes: Event (Equipped and Classic), Age (14–18, 19–23, 24–39, 40–49 years of age) and Sex (Men and Women), obtaining 16 groups of combinations (Table 2). Age was not classified according to the divisions established by IPF rules, by which in some cases the beginning of a division is based on birthdate and in others on the full calendar year in which the athlete reaches a particular age. Further, sometimes International and National Federation reports included in Openpowerlifting. org do not contain birthdate and data concerning division. For these reasons, the Age factor was determined in a fashion similar to IPF divisions but not necessarily equal to this.

Statistical analysis

First, it was necessary to apply an upsampling procedure due to the imbalance in sample sizes of consecutive year results observed among all groups (see Table 2). This procedure was applied by means of "groupdata2" Package Version 2.0.0

of R software Version 3.6 (R Core Team, 2020), obtaining a standard size of 13,383 samples for each group. Next, decision tree analysis was conducted to classify annual progress, using the SPSS program (Version 21.0) (SPSS, Chicago, IL, USA). Annual Progress categories were considered as dependent variables and the remaining factors, Event, Age and Sex, were considered as predictors. In order to generate the decision tree, CHAID (Chi-Squared Automatic Interaction Detector) growing method was applied using the followings criteria: a) Pearson's Chi-squared significance level was set at $p < 0.05$, to decide on variable splits; b) the values of significance were fixed using the Bonferroni method; c) nodes were made up of more than 100 iterations; d) the minimum change in expected cell frequencies was set at 0.001; and e) 100 parent and 50 child nodes were established as the minimum number of observations in nodes. Finally, the three most important Annual Progress categories were plotted for Women's and Men's IPF weight classes.

RESULTS

The decision tree (Fig. 1) shows three levels with 28 nodes. Most branches showed a hierarchical order of factors as follows: Age at the first level, Event at the second level and Sex at the third level. Nonetheless, the 14–18-year-old group branch had Sex at the second level and Event at the third level. Statistically, division among all factors for all branches was always observed. In general, the findings show that 46.1% powerlifters obtained full successful progress for all disciplines and their total scores (Table 3), with the most robust category being "Improvement of all disciplines and total" (IA). For the first level of the

Table 1. Categories of annual progress

Category	Binary Codes	Category	Binary Codes
- Improvement of all disciplines and total.	1111	- Improvement of two disciplines but not total.	0110, 0101, 0011
- Improvement two disciplines and total.	1011, 1101, 1110	- Improvement of one discipline but not total.	0001, 0010, 0100
- Improvement one discipline and total.	1001, 1010, 1100	- No improvements.	0000

Table 2. Number of annual progress samples studied for each group

	Classic					**Equipped**				
Age Group	14–18	19–23	24–39	40–49	Total	14–18	19–23	24–39	40–49	Total
Men	6024	10175	13383	2957	32539	3679	4222	4955	1325	14181
Women	2626	4152	6958	1964	15700	2381	1813	1809	515	6518

decision tree, the 14–18-year-old group presented the highest percentage (62.3%) of annual progress in IA, while the 40–49-year-old group showed the lowest (29.4%) in terms of the Age factor. In addition, the "No improvements" (NI) category obtained the highest percentage (17.5%) for the 40–49-year-old group and lowest for 14–18-year-old group (7.4%) at this level (Table 3).
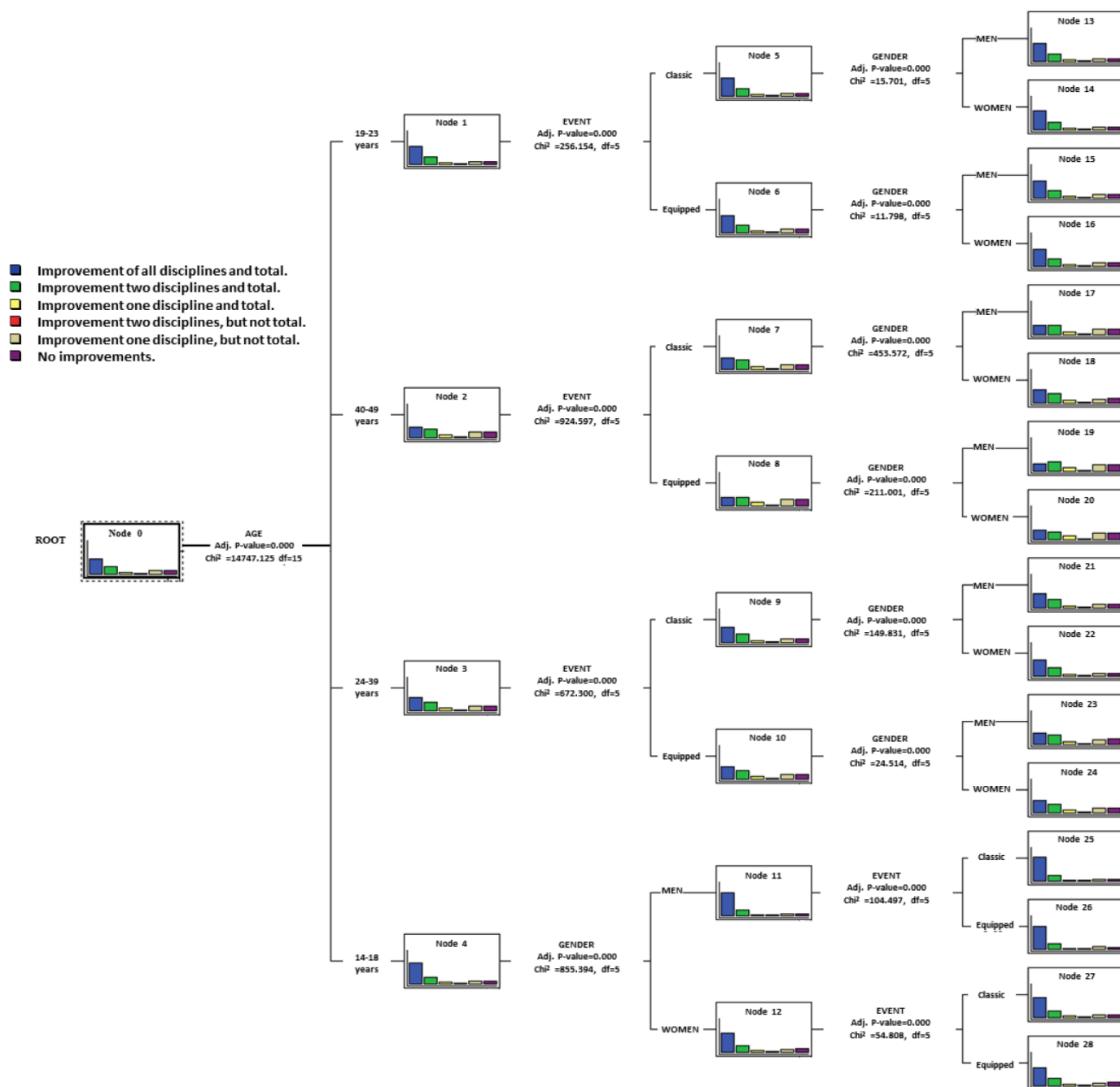

Figure 1. Decision tree on annual progress for Men and Women Classic and Equipped Powerlifters in four Age groups. The criteria of P < 0.05 was used to cluster nodes. This tree was re-designed from the original version generated by SPSS.

For the second level of the decision tree, the highest percentage for IA category was attained by 14–18-year-olds→Men group (68.2%), while the lowest was the 40–49-year-olds→Equipped group (24.8%). Moreover, the highest percentage in the NI category was attained by the 40–49-year-olds→Equipped group (20.0%), while the lowest was attained by 14–18-year-olds→MEN group (5.5%).

For the third level of the decision tree, the category showing the highest percentage of IA was the 14–18-year-olds→Men→Classic group (69.88%), while the lowest was the 40–49-year-olds→Equipped group (21.95%). Moreover, the highest percentage for the NI category was attained by the 40–49-year-olds→Equipped group (20%), while the lowest was attained by the 14–18-year-olds→Men (5.5%).

Table 3. Annual progress percentages per group, based on the root and the 1st level of the decision tree

Nodes	Group	Improvement of all disciplines and total	Improvement of two disciplines and total	Improvement of one discipline total	Improvement of two disciplines but not total	Improvement of one discipline but not total	No improvements
0	ROOT	46.1%	23.2%	6.0%	2.1%	11.0%	11.7%
4	14–18-year-olds	**62.3%**	18.5%	3.7%	1.6%	6.5%	7.4%
1	19–23-year-olds	52.3%	22.7%	5.1%	2.0%	8.7%	9.2%
3	24–39-year-olds	40.4%	**25.8%**	6.5%	2.3%	12.4%	12.6%
2	40–49-year-olds	29.4%	25.6%	**8.6%**	**2.4%**	**16.5%**	**17.5%**

Note: The highest percentages for each category are highlighted in bold

Table 4. Annual progress percentages per group, based on the 2nd level of the decision tree

Nodes	Group	Improvement of all disciplines and total	Improvement of two disciplines and total	Improvement of one discipline total	Improvement of two disciplines but not total	Improvement of one discipline but not total	No improvements
11	14–18-year-olds → MEN	**68.2%**	16.5%	2.9%	1.2%	5.6%	5.5%
12	14–18-year-olds → WOMEN	56.5%	20.4%	4.4%	2.0%	7.4%	9.3%
5	19–23-year-olds → CLASSIC	55.0%	22.8%	4.6%	2.0%	7.7%	7.9%
6	19–23-year-olds → EQUIPPED	49.6%	22.7%	5.6%	2.0%	9.6%	10.6%
9	24–39-year-olds → CLASSIC	45.3%	25.2%	6.0%	2.3%	10.6%	10.6%
10	24–39-year-olds → EQUIPPED	35.5%	26.3%	7.0%	2.3%	14.2%	14.7%
7	40–49-year-olds → CLASSIC	33.9%	**27.4%**	7.2%	2.4%	14.2%	14.9%
8	40–49-year-olds → EQUIPPED	24.8%	23.9%	**9.9%**	**2.5%**	**18.9%**	**20.0%**

Note: The highest percentages for each category are highlighted in bold

Table 5. Annual progress percentages per group, based on the 3rd level of the decision tree

Nodes	Group	Improvement of all disciplines and total	Improvement of two disciplines and total	Improvement of one discipline total	Improvement of two disciplines but not total	Improvement of one discipline but not total	No improvements
25	14–18-year-olds → MEN → CLASSIC	**69.88%**	16.08%	3.34%	1.27%	4.60%	4.83%
27	14–18-year-olds → WOMEN → CLASSIC	58.38%	19.58%	4.54%	1.76%	7.27%	8.47%
26	14–18-year-olds → MEN → EQUIPPED	66.49%	17.01%	2.46%	1.20%	6.59%	6.25%
28	14–18-year-olds → WOMEN → EQUIPPED	54.60%	21.27%	4.30%	2.26%	7.47%	10.10%
13	19–23-year-olds → CLASSIC → MEN	54.26%	22.60%	4.61%	2.05%	8.20%	8.27%
14	19–23-year-olds → CLASSIC → WOMEN	55.65%	23.00%	4.61%	1.97%	7.26%	7.51%
15	19–23-year-olds → EQUIPPED → MEN	49.48%	23.18%	5.23%	2.06%	9.74%	10.30%
16	19–23-year-olds → EQUIPPED → WOMEN	49.73%	22.19%	5.87%	1.88%	9.45%	10.88%
21	24–39-year-olds → CLASSIC → MEN	42.31%	25.26%	6.08%	2.47%	11.92%	11.95%
22	24–39-year-olds → CLASSIC → WOMEN	48.38%	25.14%	5.83%	2.18%	9.27%	9.20%
23	24–39-year-olds → EQUIPPED → MEN	34.16%	26.51%	7.07%	2.39%	14.67%	15.21%
24	24–39-year-olds → EQUIPPED → WOMEN	36.82%	26.13%	6.99%	2.16%	13.66%	14.23%
17	40–49-year-olds → CLASSIC → MEN	28.89%	26.79%	7.39%	2.83%	16.88%	17.22%
18	40–49-year-olds → CLASSIC → WOMEN	38.91%	**27.93%**	7.05%	1.90%	11.54%	12.67%
19	40–49-year-olds → EQUIPPED → MEN	21.95%	26.53%	9.48%	**3.06%**	18.50%	**20.48%**
20	40–49-year-olds → EQUIPPED → WOMEN	27.71%	21.23%	**10.35%**	1.96%	**19.27%**	19.49%

Note: The highest percentages for each category are highlighted in bold

The three most important categories from these results were plotted in Figures 2, 3 and 4, showing the breakdown by Women's and Men's weight classes. Figure 2 shows the percentage obtained for the IA category, Figure 3 shows the "Improvement of two disciplines and total" (I2T) category, while Figure 4 shows the NI category.

Figure 2 compares the data by each weight class according to Event and Sex. In general, 59 of the 68 combinations of Classic-Age group were higher achieving classes than their equivalent Equipped-age group for both sexes. The 40-49-year-old groups for both Classic and Equipped obtained the lowest percentages of IA category, while the 14–18-year-old groups presented the highest percentages.

Figure 3 shows the I2T category by weight class according to Event and Sex. Of the 68 combinations of Event-Age group, 37 of Equipped-Age group classes obtained higher results than their equivalent Classic-Age group for both sexes. The 40–49-year-old groups obtained the lowest percentage of IA category, while the 14–18-year-old groups obtained the highest percentages.

Finally, Figure 4 shows that of the 68 combinations of Event-Age group in the NI category, 59 Equipped-Age group classes obtained higher results than their equivalent Classic-Age group for both sexes.

For most weight classes, the 40–49-year-old group obtained the highest percentages in this category, while the 14–18-year-old groups from both events obtained the lowest.
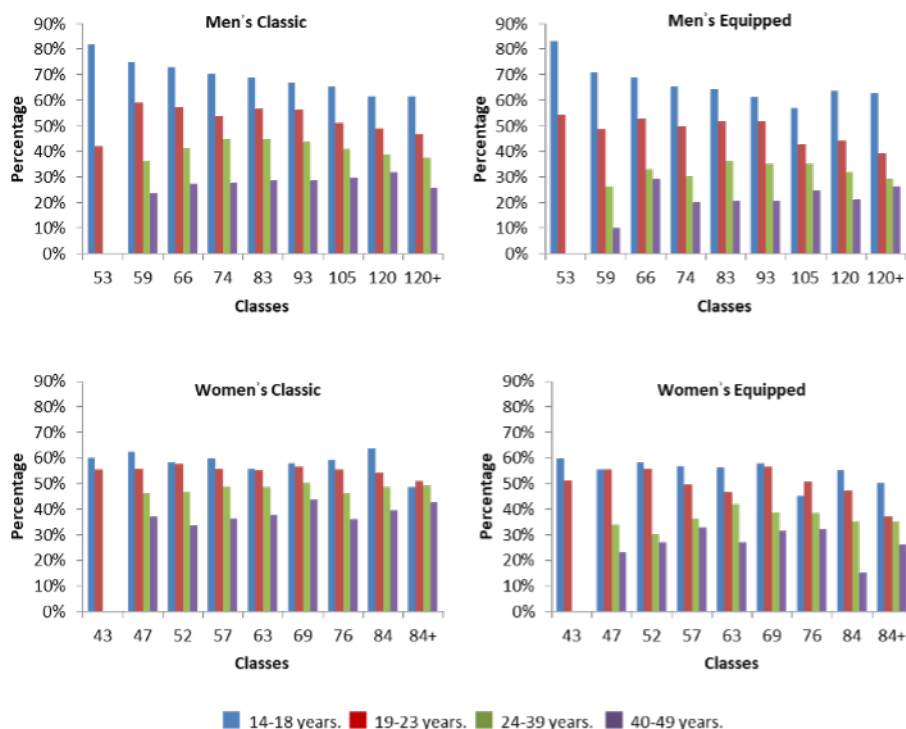

Fig 2. Spread of percentages in the "Improvement of all disciplines and total" category for all Women's and Men's weight classes, grouped by four age ranges and classic or equipped powerlifting
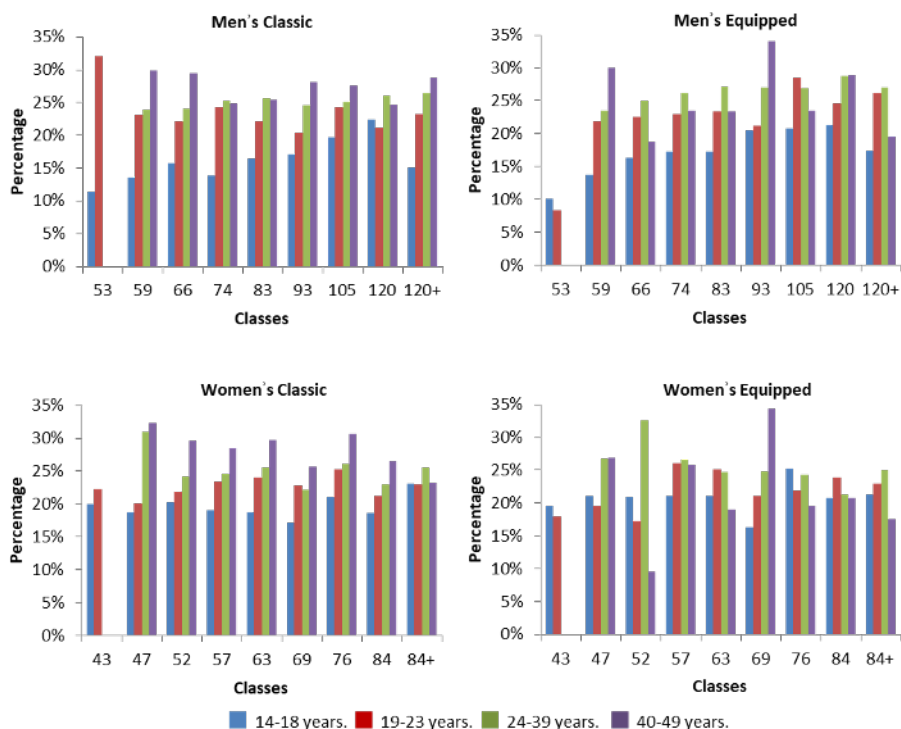

Fig 3. Spread of percentages in the "Improvement of two disciplines and total" category for all Women's and Men's classes, grouped by four age ranges and Classic or Equipped powerlifting
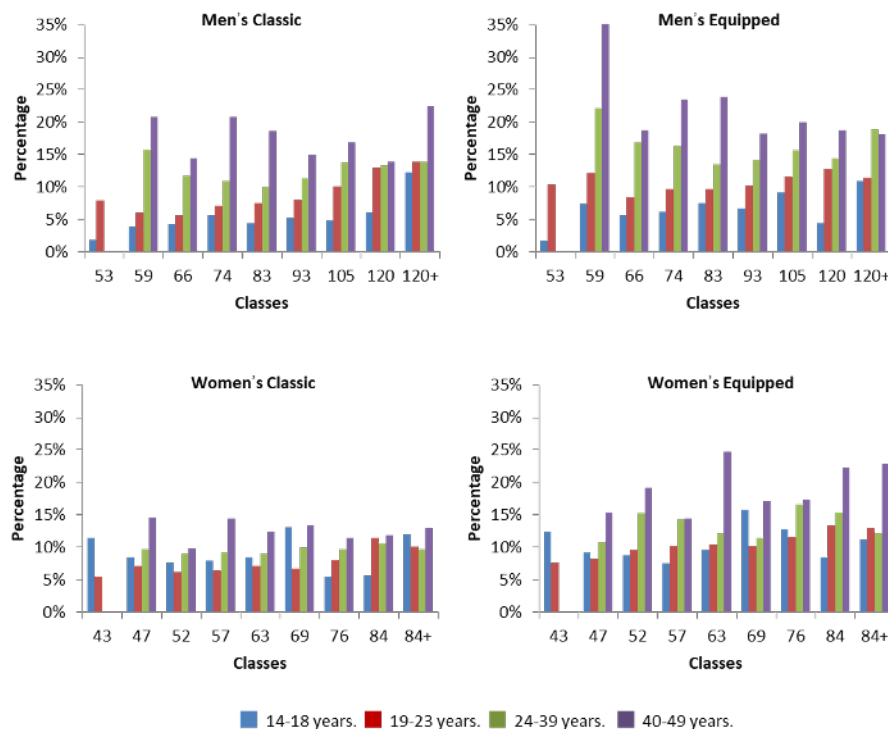
Fig 4. Spread of percentages in the "No improvements" category for all Women's and Men's classes, grouped by four age ranges and Classic or Equipped powerlifting.

DISCUSSION

The qualitative findings of this study worked to determine that annual progress in powerlifting is affected by age, event and sex factors, obtaining significant differences among groups, reflecting a new method of analysis and evaluation for this sport. The most important factor influencing the annual progress of powerlifting athletes is age. The decision tree includes age as the first level of separation, in which the completely successful IA category decreases as the groups' age ranges increase, going from 62.3% for the 14–18-year-old group to 29.4% for the 40–49-year-old group. Powerlifting athletes in childhood and adolescence thus have higher probabilities of annual improvement of all lifts and total score. This stage of life features fast-growing muscle systems and the development of strength (Parker et al., 1990), which many authors have related to high hormonal concentrations and neuromuscular adaptations (Arabi et al., 2010; Handelsman et al., 2016; Kelsey et al., 2014; Mauras, 2006). In contrast, master athletes present less probabilities of successful improvement, which could be due to the aging process. Some authors have associated the loss of strength in this period to sarcopenia together with loss of neuromuscular adaptations and fat mass accumulation (Gallagher et al., 2000; Janssen et al., 2000; Verdijk et al., 2014; Wilkinson et al., 2018).

Other research has shown results regarding the age factor, which could be related to the findings of this study. Latella et al. (2018) observed a decline in strength ratios in the squat, bench press and deadlift disciplines with increasing age. Anton et al. (2004) also observed a linear decline in performance in powerlifting for both sexes after 40 years of age. These findings could be related to the declining percentages of the IA category observed in the 40–49-year-old group. On the other hand, Hernández-Ugalde (2022) found an exponential growth in performance from youth up to the third decade, showing a peak performance between 27 and 31 years of age, followed by a linear decrease starting in maturation and older age, using three types of scoring systems: Wilks Points, IPF Points and IPF GoodLift Points. Likewise, Solberg et al. (2019) reported that equipped powerlifters show performance progress in weight lifted of ~12% on average during the five years before peak age (35 ± 7 years). Although these calculated peaks from the two previously mentioned studies are within the range of 24 to 39 years old, this study showed no association with the achievement of greater annual progress than other age groups. Nonetheless, the exponential growth of performance during youth and early adulthood reported by Hernández-Ugalde (2022) could be associated with the high percentage of annual progress observed for 14–18- and

19–23-year-old groups.

The second most important factor was the type of event, in which Classic powerlifters are seen to achieve more successful annual progress than Equipped athletes. Although Equipped powerlifters have been statistically shown to be stronger than classic ones as reported by some authors (Ball & Weidman, 2017; Wilk et al., 2020), the success rate in terms of annual progress shows the opposite. This was demonstrated in the results of IA in Table 4 (nodes 5, 6, 7, 8, 9 and 10) and Table 5 (nodes 25, 26, 27 and 28). For the nodes mentioned, the percentages of IA category for Classic lifters were always higher than those of Equipped lifters. This might be because the usage of suits for squat and deadlift, and bench press shirts and knee wraps are so complex that they could increase the likelihood of failure. During a competition the equipment must be well fitted to the athlete's body to achieve its greatest elastic potential and any mistakes can cause loss of elastic strength. In addition, the usage of old equipment or bodily weight loss could also reduce elastic potential energy during lifting, being another reason for failure. In terms of IA category within weight classes, most Classic groups attained higher percentages than their equivalent weight class in Equipped groups, with similar results for age and sex groups (Figures 2, 3 and 4). In contrast, the NI category showed the inverse result, with Equipped classes having higher percentages. Moreover, only for 14–18-year-olds was Sex more relevant as a second factor. This could be explained by either of two reasons: 1- Young athletes having little experience using shirts, suits and accessories as equipment; and 2- The greater participation, experience and more frequent training of male over female athletes during this age period. In general, all these findings evidence that Classic powerlifters attain greater successful progress than Equipped ones do.

The third most relevant factor was the sex of the athletes. Women were slightly more successful in improving annual progress than men for most groups, although 14–18-year-old men showed slightly higher improvement levels than women. It may be unsurprising that men lift more weight than women according to competition records and that women have a lower participation ratio with respect to men (Ball & Weidman. 2017), but this is not related to men achieving greater success in annual progress according to these findings. On the other hand, it is not possible to be certain that these results are not affected by the sample size due to lesser participation. In this same regard, a team of Australian researchers found that

powerlifting men had greater absolute and relative strength at the beginning of the competitive stage, but that gains in strength on a day-by-day basis was similar between sexes (Latella et al., 2020). Another hypothesis supported by numerous studies is that men may take more risks than women (Azanova et al., 2021; Byrnes et al., 1999; Pawłowski et al., 2008), in this case, in asking for increased weight to lift. With respect to the results of the youngest group of 14–18-year-olds, it is possible that the inexperience of female adolescents and young women in strength sports could be a considerable factor, outweighing the significance of their greater reluctance to take risks. Future research would benefit from determining whether women tend to attempt more realistic weights while men tend to take more risks to break personal records in championships.

This paper highlights that annual progress in powerlifting must not be measured only by total score but must also include progress in all disciplines. Previous studies have found an increase in total mean score between first competitions and best competition (observed highest total) or last competition, for both sexes, over 15 years (Latella et al., 2020), but each discipline was not considered separately in the analysis. Finally, these findings suggest that annual progress in powerlifting presents a sequence of likely outcomes according to an order. For all combinations of groups on a third level decision tree (Table 5), the following pattern was observed in the Table 6, from most to least, with a few exceptions.

Fortunately, the IA category is the most frequent result of the combinations studied (46.1% of the global results). If athletes do not achieve the IA target, the second most common result is I2T (23.2% of the global results). The least likely outcome that is "Improvement of two disciplines but not the total", with this being an unlikely event. It is relevant to point out that prior to this study, it was assumed that the result NI would have taken up last place in the outcomes, however this was found to be in third place (11.7% of the global results). Powerlifting coaches and athletes ought to very seriously consider these statistics and find solutions to avoid this issue.

Some limitations observed during this research need to be resolved in the future. For instance, even though these results represent powerlifting on a world level, many countries have not yet contributed information to the OpenPowerlifting project. Another relevant consideration arises from the mistakes in athletes' data such as full name and birthdate, which causes information to be discarded. For this

Table 6. Order of likely outcomes for annual progress in powerlifting

Order	Category	Exception
1st	Improvement of all disciplines and total.	Node 19: First, "Improvement of two disciplines and total" and second, "Improvement of all disciplines and total."
2nd	Improvement of two disciplines and total.	
3rd	No improvement.	Node 26: Third "Improvement of one discipline but not total" and fourth "No improvements."
4th	Improvement of one discipline but not total.	
5th	Improvement of one discipline and total.	None
6th	Improvement of two disciplines but not total.	

reason, it is necessary to suggest good registration practices so as to obtain the athletes' information of correctly, to identify the person with true data during the analysis. Finally, it was not possible to take into consideration the importance level of championships (local, national, regional or world) into the analysis; due to frame data used by openpowerlifting.org does not highlight this issue.

CONCLUSIONS

This study successfully determines three main factors that affect annual progress in powerlifting. Age is the most important factor of these, with a decline in the percentage of successful progress attained with increasing age. The second factor is the kind of event, with Classic powerlifting athletes showing greater probability of successful progress than Equipped athletes. Finally, the third factor of importance was sex, with women showing more successful progress than men, even though the latter are stronger. This result may have an association with gendered human behavior regarding risk, but it would require evaluation to corroborate these findings before any larger practical applications can be made. The most robust category in terms of annual progress was "Improvement of all disciplines and total" (IA), in which increased weight was lifted for all disciplines and the total score was improved. If the athlete did not attain the target of IA category, the next most significant result was "Improvement of total score and two disciplines". On the other hand, "No improvements" was notable, representing a considerable percentage of the global results, which should be considered as an alert signal for powerlifting coaches and athletes, requiring internal evaluation about weights requested during championships in order to avoid falling into this failure. In general,

the findings suggest a sequence of likely outcomes according to an order of probability that occurred as follows: 1-Improvement of all disciplines and total, 2-Improvement of two disciplines and total, 3-No improvements, 4-Improvement of one discipline but not total, 5-Improvement of one discipline and total, and 6-Improvement of two disciplines but not total. For the future, this kind of research could work as a base to create algorithms to achieve accurate predictions regarding annual progress in powerlifting.

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