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A Retrospective Analysis of Powerlifting Performances in the U.S. (1995 – 2005)

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ABSTRACT

In this retrospective study, powerlifting performances in the United States from 1995 – 2005 were taken from annual top 100 rankings published in Powerlifting USA magazine. The rankings included results for the squat, bench press, deadlift, and total for each standard weight class during a calendar year. In the current study, average performances for each weight class were compiled for the #1, #10, #50, and #100 ranks. The weights lifted for each category increased as a function of the competitor's weight class in a curvilinear pattern, with the heaviest classes showing diminishing improvement in weight lifted with increased body weight. When weights lifted were standardized to the lifter's weight class, a unimodal curve was observed, with maximal values being in the middle weight classes. The lower mass-specific performance in heavier lifters is the basis for Wilks coefficient and other adjustments for comparing performances among different weight classes. This coefficient is a mathematical formula based on a polynomial transformation of a lifter's weight class. It was derived to compensate for the curvilinear nature of lifting performance as a function of body weight. Based on the patterns documented, it is proposed that part of this flattening of performance can be attributed to systematic differences in body composition across weight classes. During this 11-year period, significant improvements were observed for some lifts, ranks, and weight classes. However, many did not change, while others showed significant declines. These data demonstrate that U.S. powerlifters at the turn of the century were highly competitive, particularly within the middle through the heaviest weight classes. Overall, the lifting performances in the U.S. during this decade provide an historical reference point, from a time before powerlifting records became more widely available via the internet.

Keywords: maximal strength, skeletal muscle, fat free mass, squat, bench press, deadlift

INTRODUCTION

Functional strength is an important component of most competitive sports, as well as being an important aspect of basic health and wellbeing (American College of Sports Medicine, 2009; Brill et al., 2000; Suchomel et al., 2016). For most sports, sophisticated motor control, speed, and agility interact with foundational strength levels in complex ways (American College of Sports Medicine, 2009; Suchomel et al., 2016). By contrast, powerlifting is a competitive sport that focuses on functional strength in its most basic form. The three lifts in powerlifting (squat, bench press, and deadlift) are relatively simple movements that permit heavy weights to be moved by recruiting large, compound muscle groups. Other strength-based sports, including Olympic weightlifting and strongman competition, also depend on maximal force development, but involve more dynamic movements. Powerlifting as a competitive sport, as well as performance of individual lifts, can serve as a measure of functional strength. Using these lifts for training purposes can also serve to develop foundational strength in individuals with different goals and objectives. Many competitive athletes of different sports engage in powerlifting movements to improve their strength. The performances documented here may serve as reference values for both athletes and strength coaches.

Powerlifting as a sport was born principally in the U.S. during the 1950's and 1960's, from training lifts performed for Olympic Weightlifting (Warpeha, 2015). The first recognized national championship sanctioned by the American Athletic Union (AAU) took place in York, PA in 1965 (Glossbrenner, 1996; Warpeha, 2015). The popularity of powerlifting grew quickly and national championships have continued in the U.S. each year since 1965 (Warpeha, 2015). Over time, the AAU was overtaken by the United States Powerlifting Federation (USPF) as a sanctioning body. In 1981, a group of lifters broke away from the USPF over issues of drug testing, to form the American Drug Free Powerlifting Federation (ADFPA) (Hunt & Todd, 2007). At about the same time, the American Powerlifting Federation (APF) also split off from the USPF, expressly because the APF's founding members did not support drug testing (Hunt & Todd, 2007). In 1973, the International Powerlifting Federation was founded, and powerlifting has been growing internationally ever since. In 1997, negotiations to unite the USPF and ADFPA failed and shortly thereafter, the ADFPA changed its name to the USA Powerlifting. USA Powerlifting then displaced the USPF as the organization sending its top lifters to IPF World Championships (Warpeha, 2015). Although the specific rules may differ slightly among powerlifting organizations, the fundamental guidelines are the same. All sanctioned competitions rely on the independent judgement of three referees who assess whether each lift was performed according to the standards of competition.

From 1977 – 2012, Powerlifting USA was the leading publication reporting on powerlifting in the U.S. and internationally. Each month, the magazine posted information for upcoming local meets and reported on the results of national-level and local meets alike. The publisher and editor of Powerlifting USA, Mike Lambert, also compiled top 100 lists from meet reports sent in by meet directors from around the country. The lists reported the top 100 lifts (squat, bench press, deadlift, and total) for each weight class over a calendar year. Although the names of lifters within top 10 rankings are probably recognizable to those who follow powerlifting, most of the lifters comprising the ranks within the top 100 each year were simply dedicated lifters training in garages and local gyms.

In the current paper, top 100 rankings published in PL USA were compiled for the years 1995 – 2005. This eleven-year period represents a span largely before the internet and social media took the place of traditional published magazines. As such, these data document benchmarks for U.S. powerlifters during the end of the 20th Century and the beginning of the 21st Century. The current analyses include patterns from the #1, #10, #50, and #100 ranked lifters. Lifting performance was evaluated in three ways. First, the total weight successfully lifted was examined. Second, the mass-specific weight lifted (weight lifted/weight class) was determined. Finally, the Wilks coefficient was determined for lifters in each weight category (Vanderburgh & Batterham, 1999).These analyses show that powerlifting performances overall were very consistent over this period, suggesting a high level of competition. Many of the #1 - #10 ranked U.S. lifters were competitive at the international level.

Not surprisingly, total weight lifted in all the lifts was strongly determined by the weight class represented. This pattern forms the basis for the Wilk's coefficient and other measures for comparing performances across weight classes (Vanderburgh & Batterham, 1999). One facet of the current analyses focuses on understanding the patterns of lifting performance as a function of weight class. In the biological sciences, allometry refers to the relative changes in anatomical structures or physiological process with changes in absolute size (Calder, 1996). Although some researchers have applied allometric scaling relationships to explain the lower mass-specific performance of heavier lifters, other authors have demonstrated that the allometric approach is not appropriate (Batterham & George, 1997; Cleather, 2006). The current study examines the possible explanations for this well-known trend.

METHODS

Data collection and analyses

Top 100 lists for each weight class in kg (52, 56, 60, 67.5, 75, 82.5, 90, 100, 110, 120, and super-heavy weight (SHW)) for results from 1995 – 2005 were obtained from issues of Powerlifting USA magazine from April 1995 (Vol. 18 No. 9) – March 2006 (Vol. 29 No. 6). The Institutional Review Board (IRB) at St. Bonaventure University determined this protocol to be exempt from review, because it involves only deidentified secondary data. Each list comprises a ranking of the top 100 lifts (squat, bench press, deadlift, and total) reported by meet directors in the United States over the period of a year. These lists were agnostic with respect to lifting organization, drug-testing, lifting equipment, age, and sex. The results from these lists were compiled into spreadsheets and averaged over the 11-year period indicated. In addition to the averages of these lifts, the variability (standard deviation) was also determined. The average weights lifted were plotted as a function of weight class for each of the three lifts and the totals. In addition, the weights lifted were standardized to the weight of the lifters, as estimated by the limits of each weight class. This mass-specific performance provides important insights into systematic differences in strength as a function of body size.

To examine the relationship between lifter weight and performance, averaged lifts were plotted as a function of weight class. To examine whether mass-specific performance followed well known allometric scaling relationships, weight classes and lifting performances were log-transformed and simple linear regression was applied to the data. The results showed that the log-transformed data were still curvilinear, meaning that allometric scaling relationships did not accurately fit the data (Fig. 1). Therefore, polynomial regression equations were applied to the data, as were used in a similar analysis of Olympic lifting performance (Batterham & George, 1997). 3rd order polynomial equations consistently resulted in higher R^2 values and eliminated the downward curve in the SHW class imposed with 2nd order equations. Statview 5.0.1 (SAS Institute) was used for all statistical analyses.

Changes in performance over time

Changes in performance over time were calculated for each lift, weight class, and rank over this 11-year period. Simple linear regression analyses were performed, and significant changes were noted if the p-value for the regression was < 0.05.

Comparison of performances across weight classes

To compare the relative performance of lifters competing in different weight classes, two approaches were used. First, totals of lifters in each weight class were transformed using the Wilks coefficient ($500/a + bx + cx^2 + dx^3 + e^4 + fx^5$), where x is the lifter's weight in kg (Ferland, Allard, et al., 2020). This coefficient is one of the most common transformations used to compare performances among the different weight classes. Wilks scores for each weight class and rank (#1, #10, #50, and #100) were compared to observe overall trends Second, the ranked performances of U.S. lifters were compared with the International Powerlifting Federation (IPF) world champion totals for the same years (1995 – 2005). These totals were averaged over this 11-year period for comparison with the U.S. performances. The IPF Open World Championships results were obtained from the IPF website (https://www.powerlifting.sport/championships/results).

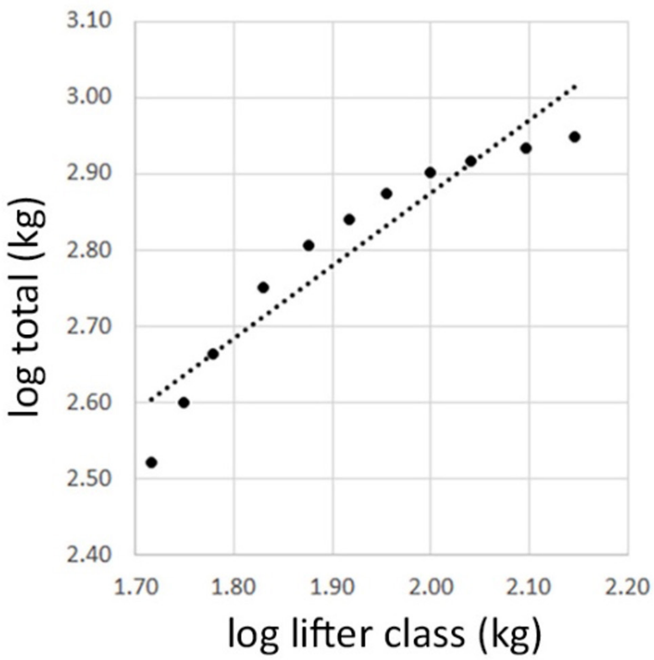

Figure 1. Average totals plotted as a function of lifter weight class on a log-log plot. The linear regression line does not accurately fit the data.

RESULTS

General patterns

The averaged lifts from 1995 – 2005 are compiled in Tables 1 – 4. Overall, the reported lifts were very consistent within a given rank (#1, #10, #50, and #100). However, the variability was greater for the #1 and #10 ranked lifts across the board. The coefficient of variation (standard deviation/ mean) was approximately 3-5% for the #1 and #10 ranked lifts, compared with 1-2% for the #50 and #100 ranks. For all lifts, there was a positive correlation between weight lifted and weight class of the lifter (Fig. 2). Each of these curves was fit with a 3rd degree polynomial regression equation that significantly matched the data ($p < 0.0001$ for each curve; r^2 ranged from 0.994 – 1.00, with an average of 0.998). The slope of this relationship was steepest at the lighter end of the curve, but gradually flattened, particularly for lifters above 90 kg (Fig. 2). The difference between ranked lifts was much larger between #1 and #50 than between #50 and #100. For example, for most of the weight classes, the #1 total was approximately 25% greater than #50 total, whereas the #50 was only 6-7% greater than the #100 (Fig. 2D and Table 4). Similar trends can be observed for the individual lifts (Figs. 2A – C and Tables 1 – 3). Overall, the top #1 – #10 lifts were in the national and world class caliber at that time, whereas the #50 - #100 could be considered as very competitive at a state-level.

The three lightest weight classes (52, 56, and 60 kg) were consistently less competitive as a group, compared with the other weight classes. This pattern was revealed through several relationships. The first is the depth of the ranks compared with the #1 rank. In the 52 kg weight class, the average #50 total was about 62% of the #1, and the #100 total was about 54% (Table 4). Similar, though less dramatic, trends were observed for the 56 and 60 kg weight classes (Tables 1 – 4). By comparison, the heavier weight classes posted average totals in the range of 75-80% of the #1 lifters at the #50 rank and about 70-75% at the #100 rank. Further evidence of this pattern is reported with the mass-specific lifts.

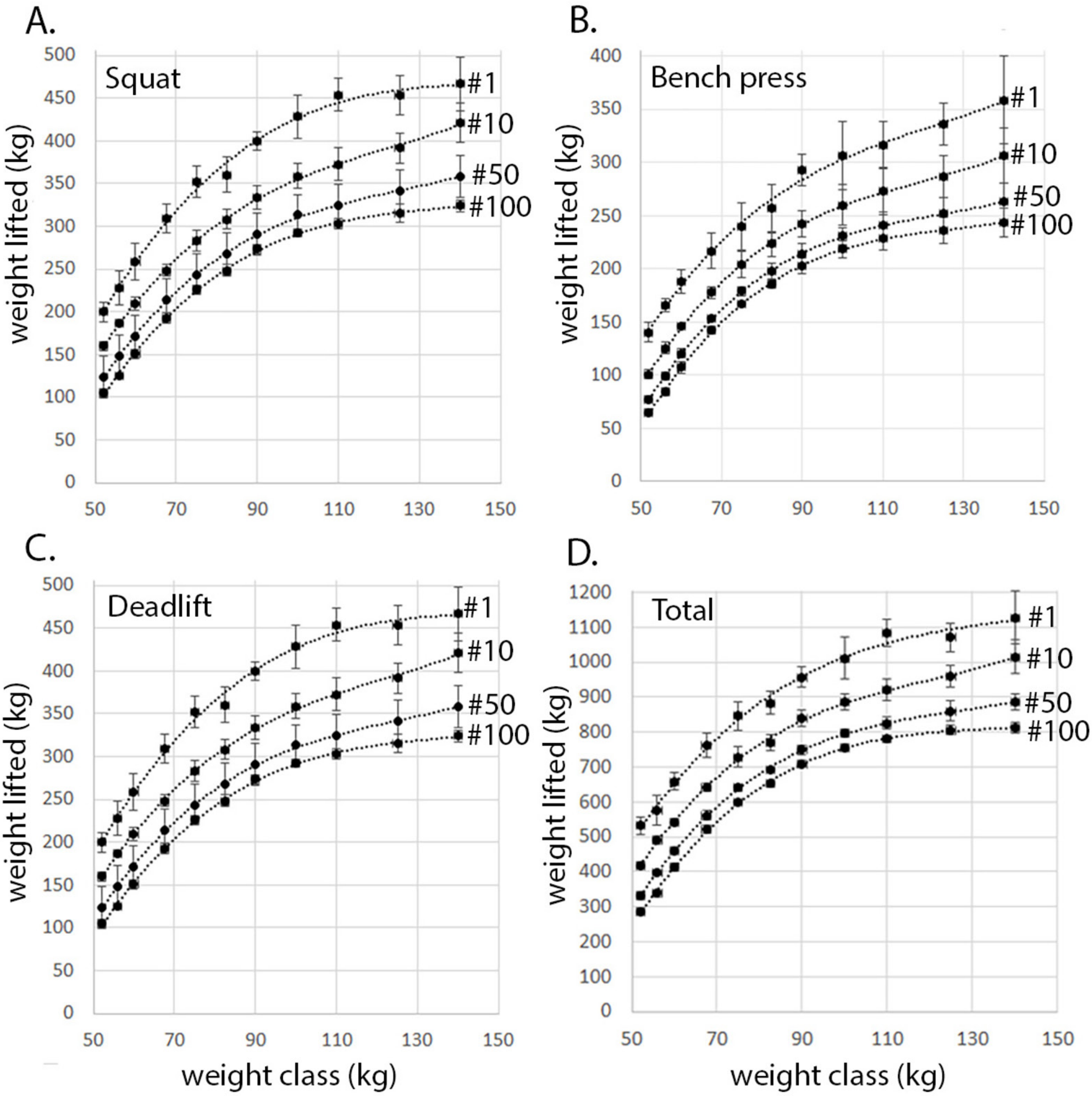

Figure 2. Powerlifting performances as a function of weight class. The three lifts: squat (A), bench press (B), deadlift (C), and total (D) are shown. The different rankings (#1, #10, #50, and #100) are indicated. Each point represents the average for the period 1995 – 2005 and the error bars are ± SD. Curves are regression lines fit with third order polynomial equations. The pattern of each curve is similar, with weight lifted increasing as a function of weight class, but exhibiting a flatter slope as lifter weight increased.

Table 1. Rankings of U.S. Powerlifting Squats (1995 – 2005) – weight in kg

Weight Class	#1	#10	#50	#100
52	199.5 ± 12.1	160.1 ± 5.5	123.7 ± 5.2	105.2 ± 5.0
56	228.2 ± 19.6	187.0 ± 4.3	147.6 ± 2.7	125.4 ± 3.3
60	258.9 ± 21.8	209.6 ± 7.3	171.7 ± 3.9	150.6 ± 5.2
67.5	309.4 ± 17.1	248.2 ± 6.9	213.6 ± 6.7	192.8 ± 6.1
75	352.1 ± 18.5	282.7 ± 12.2	244.0 ± 4.9	226.5 ± 5.0
82.5	360.5 ± 20.9	308.3 ± 10.9	267.5 ± 6.4	248.2 ± 6.7
90	400.1 ± 10.9	334.1 ± 14.1	290.5 ± 6.0	273.2 ± 5.4
100	428.2 ± 25.9	359.0 ± 15.2	313.1 ± 8.0	292.9 ± 4.7
110	453.8 ± 18.9	372.7 ± 18.8	324.2 ± 7.0	302.9 ± 6.2
125	453.3 ± 23.3	391.7 ± 17.4	340.9 ± 13.3	315.6 ± 10.5
SHW	466.8 ± 31.2	420.8 ± 23.3	358.8 ± 12.5	323.8 ± 7.2

Table 2. Rankings of U.S. Powerlifting Bench Press (1995 – 2005) – weight in kg

Weight Class	#1	#10	#50	#100
52	140.3 ± 9.0	100.7 ± 4.7	77.3 ± 3.4	64.7 ± 3.1
56	165.7 ± 6.5	125.2 ± 5.6	99.1 ± 3.4	84.5 ± 3.8
60	188.0 ± 10.8	146.0 ± 2.5	120.3 ± 4.5	107.1 ± 5.4
67.5	216.7 ± 16.5	177.5 ± 5.9	153.5 ± 2.8	142.1 ± 3.8
75	240.0 ± 21.9	204.2 ± 12.5	178.9 ± 4.5	167.2 ± 2.2
82.5	256.6 ± 22.7	223.2 ± 12.2	197.8 ± 7.5	185.5 ± 4.1
90	292.6 ± 15.3	242.3 ± 12.2	214.1 ± 9.7	202.3 ± 7.5
100	306.2 ± 31.8	259.7 ± 19.3	230.7 ± 8.3	218.5 ± 8.2
110	316.1 ± 21.9	272.9 ± 22.8	240.7 ± 12.6	228.6 ± 11.4
125	335.4 ± 19.7	286.1 ± 19.7	251.8 ± 14.8	235.9 ± 12.3
SHW	358.5 ± 41.7	306.3 ± 26.2	262.8 ± 17.3	243.5 ± 13.1

Table 3. Rankings of U.S. Powerlifting Deadlifts (1995 – 2005) – weight in kg

Weight Class	#1	#10	#50	#100
52	222.8 ± 10.0	176.5 ± 5.3	143.2 ± 3.0	125.5 ± 3.0
56	237.6 ± 14.7	201.4 ± 5.7	166.1 ± 1.9	147.0 ± 2.7
60	264.1 ± 9.2	219.2 ± 5.3	190.5 ± 2.8	173.3 ± 4.6
67.5	289.1 ± 14.4	253.1 ± 6.7	227.5 ± 1.9	211.3 ± 4.0
75	317.1 ± 14.5	280.9 ± 6.1	252.9 ± 2.5	238.5 ± 2.7
82.5	331.3 ± 7.8	298.8 ± 3.6	272.4 ± 3.1	258.1 ± 3.8
90	345.9 ± 5.2	315.2 ± 4.1	288.0 ± 3.3	275.3 ± 2.9
100	361.5 ± 9.0	326.2 ± 5.8	300.1 ± 2.4	288.9 ± 2.4
110	380.4 ± 13.7	337.1 ± 4.2	307.5 ± 2.0	294.2 ± 1.8
125	379.8 ± 9.7	345.4 ± 7.3	317.1 ± 4.1	300.0 ± 5.1
SHW	395.1 ± 14.3	353.4 ± 7.3	318.3 ± 4.9	297.3 ± 5.7

Table 4. Rankings of U.S. Powerlifting Totals (1995 – 2005) – weight in kg

Weight Class	#1	#10	#50	#100
52	532.6 ± 25.3	418.4 ± 10.7	332.3 ± 12.0	285.9 ± 10.2
56	574.5 ± 42.2	490.7 ± 12.1	396.7 ± 6.8	339.0 ± 9.3
60	659.1 ± 25.7	542.7 ± 9.9	460.2 ± 9.6	413.4 ± 12.9
67.5	762.4 ± 34.8	641.2 ± 11.2	562.2 ± 12.6	520.9 ± 10.6
75	845.9 ± 41.4	727.9 ± 28.8	639.9 ± 10.1	598.5 ± 9.1
82.5	883.3 ± 33.6	770.8 ± 23.7	692.2 ± 9.1	652.9 ± 9.3
90	957.3 ± 29.7	839.5 ± 23.1	748.8 ± 13.0	708.3 ± 10.2
100	1011.4 ± 61.2	885.1 ± 24.0	796.1 ± 11.9	756.6 ± 9.2
110	1084.5 ± 38.0	919.9 ± 31.4	825.2 ± 18.6	779.4 ± 10.0
125	1071.9 ± 40.7	959.8 ± 31.0	859.3 ± 28.8	806.1 ± 14.8
SHW	1127.3 ± 75.3	1015.5 ± 47.1	886.2 ± 24.9	812.4 ± 14.9

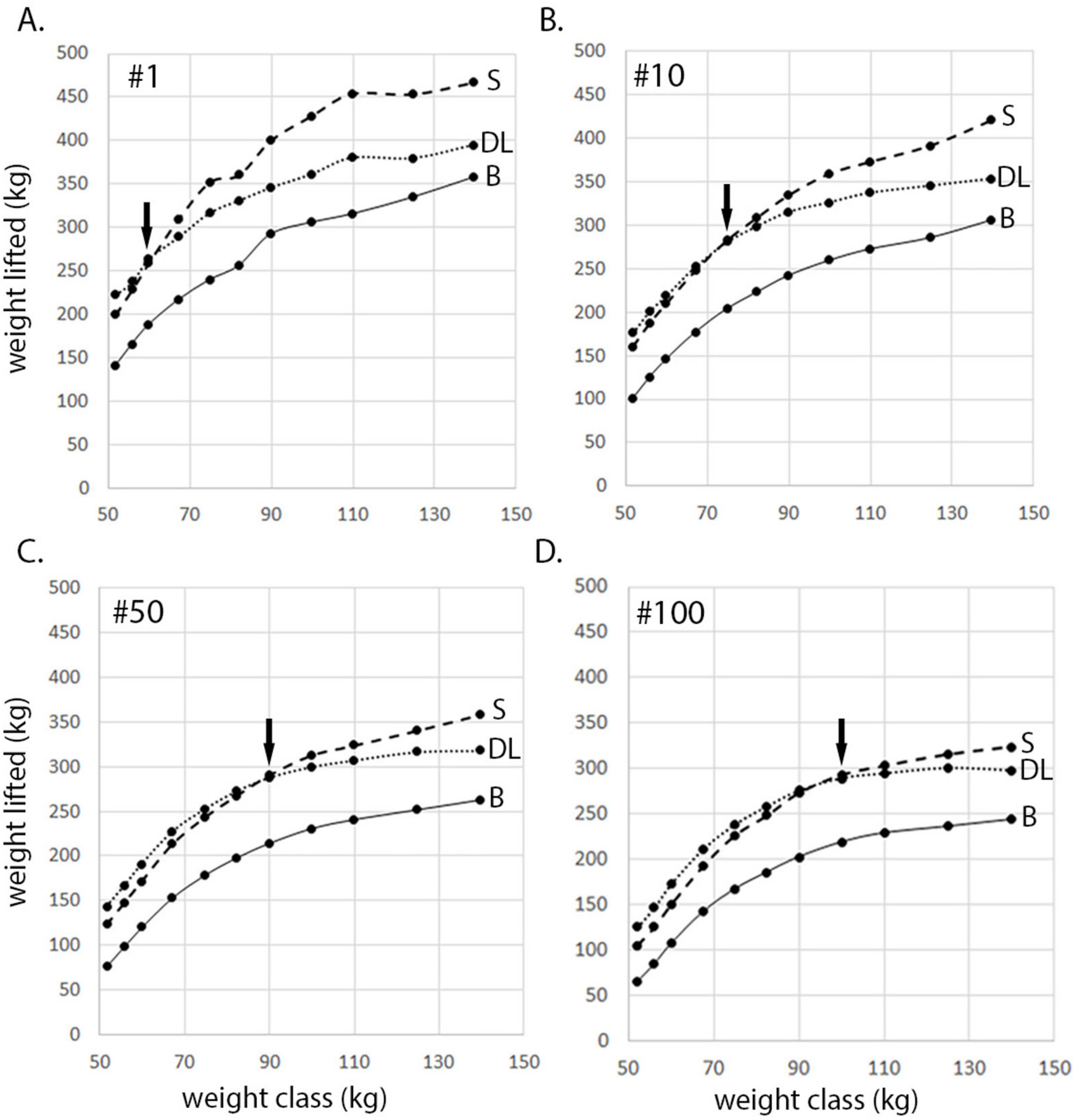

Figure 3. Powerlifting performances as a function of weight class. Each of the three lifts: squat (S), bench press (B), and deadlift (DL) are plotted together to show their relative values. The three lifts are split according to rank: #1 (A), #10 (B), #50 (C), and #100 (D). Each curve is a line graph connecting points, rather than regression curves. Note that in each set of curves, the deadlift is greater than the squat in the lighter weight classes, but the squat becomes greater as the weight classes increase. Vertical arrows denote the crossover point beyond which the squat is greater than the deadlift. Note that this crossover point occurs at lighter weight classes in the #1 ranked lifters than in the lower ranks. The weight lifted at which the squat surpassed the deadlift for all ranks was between 250 and 300 kg.

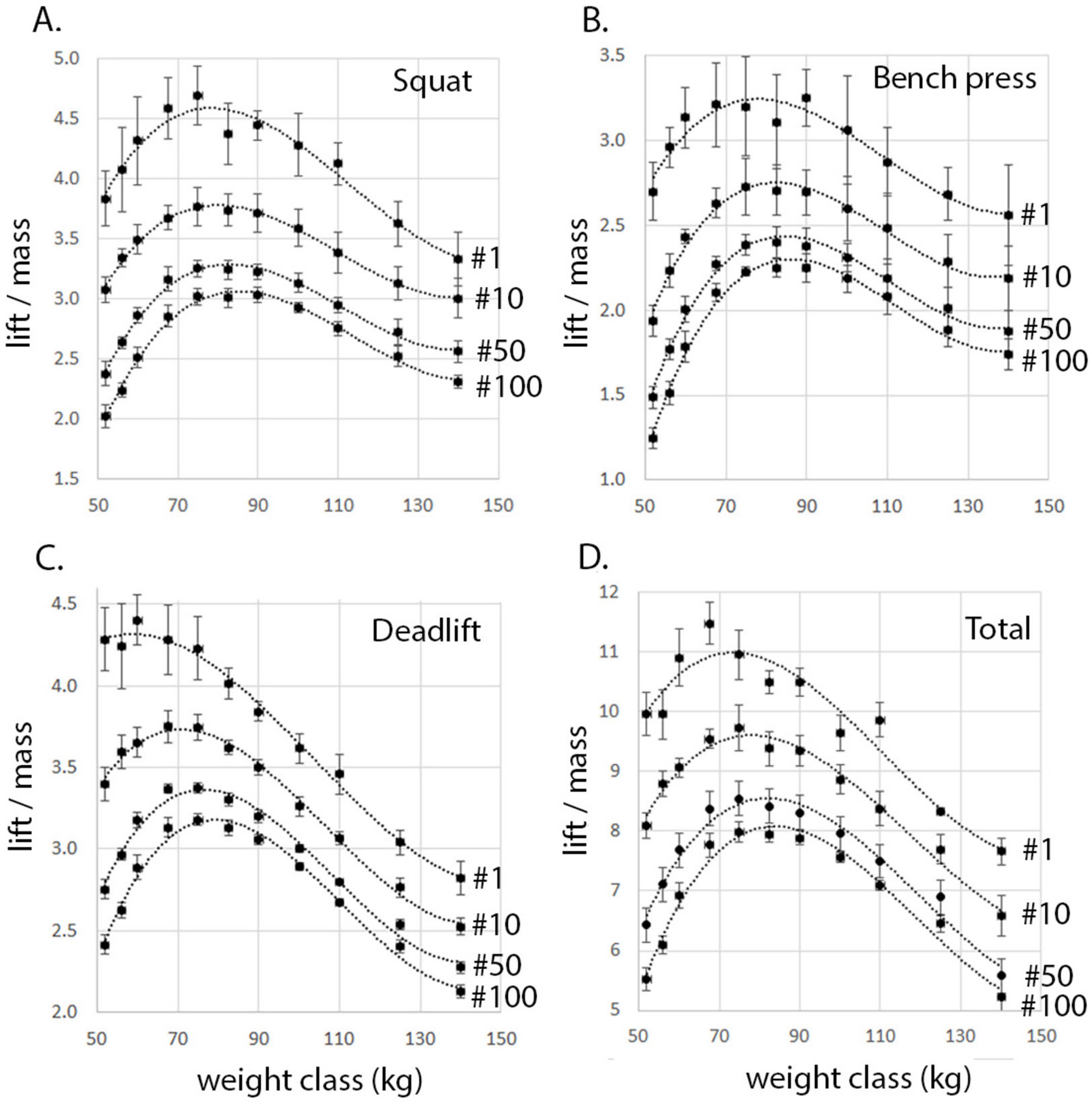

Figure 4. Relative powerlifting performances (weight lifted/weight class) as a function of weight class. The three lifts: squat (A), bench press (B), deadlift (C), and total (D) are shown. The different rankings (#1, #10, #50, and #100) are indicated. Each point represents the average for the period 1995 – 2005 and the error bars are ± SD. Curves are regression lines fit with third order polynomial equations. Overall, the curves are unimodal, with the greatest relative performances corresponding to the middle weight classes. For each set of curves, the relative performance steadily declines beyond the 90 kg weight class.

For most of the lifters, the squat and deadlift were close to the same weight for the #10, #50, and #100 ranked lifts (Fig. 3). However, the squats for the #1 ranked lifts were substantially greater than the deadlifts, across all but the lightest weight classes (Fig. 3A). In each rank category, the squat and deadlifts were very close to one another in the lightest weight classes, but the squat surpassed the deadlift as lifter weight increased (Fig. 3). The weight class at which the squat surpassed the deadlift increased as the lifter rank decreased (see arrows in Fig. 3). For example, the squats were greater than the deadlifts for each weight class heavier than 60 kg for the #1 ranked lifters. The points at which the squats surpassed the deadlifts for lower ranked lifters were 75 kg, 90 kg, and 100 kg for the #10, #50, and #100 ranks, respectively. Foreach rank, the weight at which the squat surpassed the deadlift was between 250 and 300 kg (Fig. 3). The average bench press was lower than the average squat and deadlift in all weight classes and ranks (Fig. 3 and Tables 1, 2, and 3).

The mass-specific lifts (weight lifted / lifter weight) exhibited a more complex, unimodal distribution for all lifts (Fig. 4). Each of these curves was described by a 3rd degree polynomial equation that significantly fit the data ($p < 0.0001$ for each curve except for the #1 bench and total. The p-value for regression fitting the #1 bench was $p < 0.002$

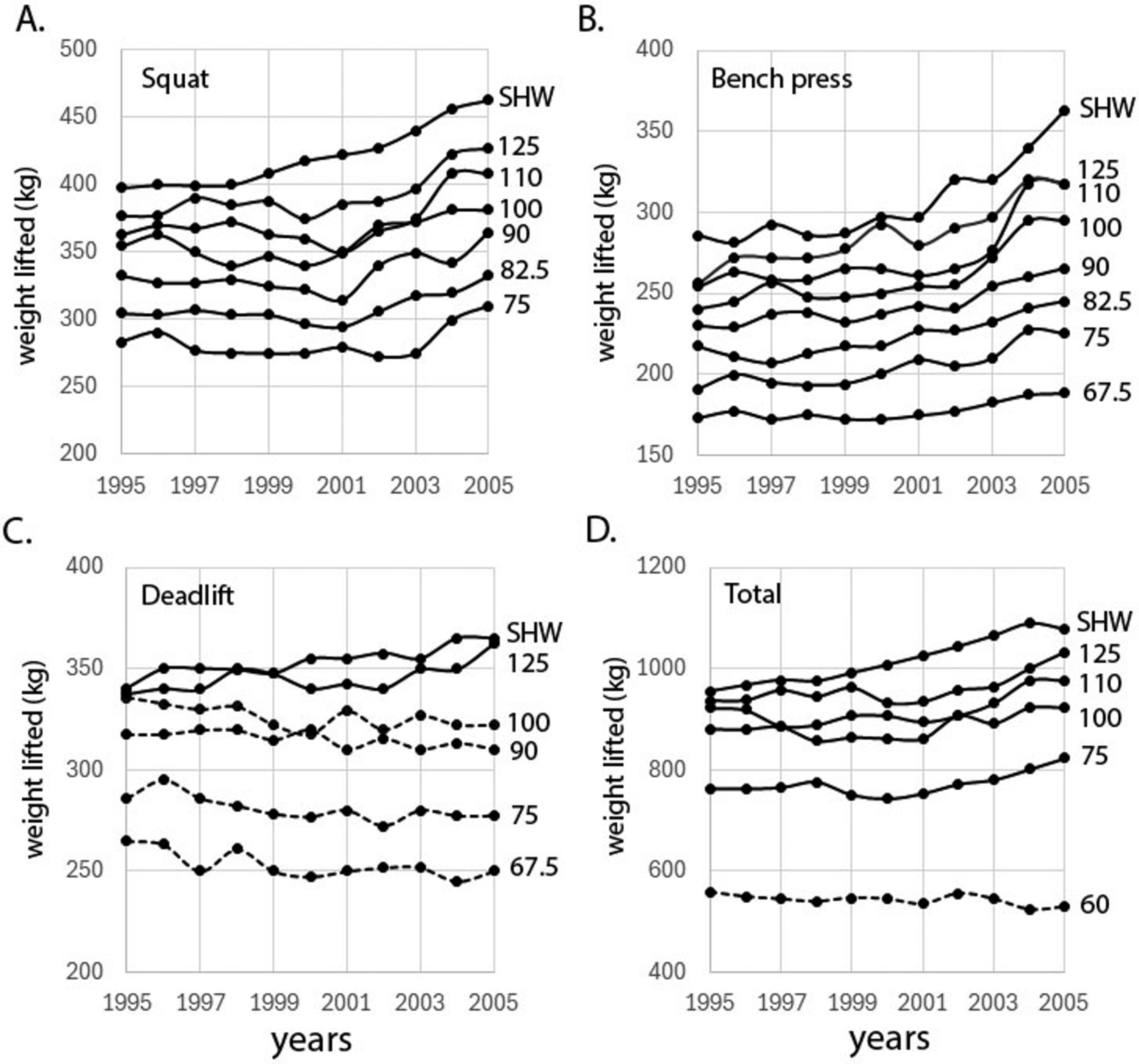

Figure 5. Changes in lifting performance for the #10 ranked lifts. Weight classes are shown on the right of each line. Only statistically significant changes over time are shown ($p < 0.05$). Increases in performance are indicated by a solid line, whereas decreases are indicated with a dashed line. A. Squat performance improved over time for all weight classes at 75 kg and heavier. B. Performances in the bench press also improved for weight classes 67.5 kg and above. C. Performance in the deadlift only improved in the two heaviest weight classes. For the 67.5, 75, 90, and 100 kg weight classes deadlift performance declined significantly. D. Totals increased over time in the 75, 100, 110, 125 kg, and SHW classes. Totals for the 60 kg weight class decreased over time.

and was $p < 0.004$ for the #1 total ; r^2 ranged from 0.917 – 0.994, with an average of 0.976). Overall, the middle weight classes (67, 75, 82.5, and 90 kg) posted the greatest mass-specific lifts for all of the lifts. These values decreased systematically as weight classes decreased below this peak, with the lightest weight classes showing systematic decline in the lowest classes (Fig. 4). One exception was for the #1 ranked deadlifters, for which the lightest weight classes were at least as competitive as the middle weight classes (Fig. 4C). In the heavier weight classes (about 90 kg), there was an inverse relationship between mass-specific performance and increasing body mass (Fig. 4). These patterns were observed consistently for the individual lifts and totals.

Changes in lifting performance over time

A total of 176 regressions were performed (4 lifts x 4 ranks x 11 weight classes) to determine if significant changes in performance could be identified. Of these, 65 (37%) were improvements in performance over time, 31 (18%) were declines in performance, and 80 (45%) did not change significantly during the 11-year period. The significant changes over time were not evenly distributed throughout the ranks. Within the #1 ranked lifts, 18 significant improvements were noted, with the remaining 26 showing no change over time. The #10 ranked lifts showed the greatest changes over time (Fig. 5). In that group, 22 lifts improved over time, 4 lifts declined, and 18 showed no change. In the #50 ranked lifts, 14 improved, 11 declined, and 19 did not change. In that group 64% of the declining lifts were within the lighter weight classes (56, 60, and 67.5). In the #100 ranked lifts, 11 improvements over time were noted, 16 lifts declined, and 17 remained unchanged. In that rank, 62.5% of the declines were also in the lighter weight classes (56, 60, and 67.5). Overall, the greatest number of improvements in lifts were observed in the #1 and #10 ranks, whereas the greatest number of declines were in the #50 and #100 ranks.

The majority of improvements (41.5%) were seen in the bench press. These improvements were primarily in the heavier weight classes (67.5 and up) (Fig. 5). In the squat, a total of 14 improvements were observed, primarily in the #10 ranked lifts (Fig. 5). A total of 8 improvements were observed for the deadlift, whereas 12 of these lifts significantly declined over time. In the totals, 16 were observed to increase significantly, while 9 declined. About 81% of declining trends for the deadlift and total were within the #50 and #100 ranks.

The magnitude of change was greatest for the bench press and the squat (Fig. 5). For both of these lifts, the biggest improvements of during this time period were in the range of 15% to 25%. Improvements in the deadlift were uncommon and typically amounted to about 5% increases. The majority of significant improvements in the deadlift were within the heaviest two weight classes.

Comparison to World Champion Lifters

The totals for the U.S. lifters during this 11-year time period were compared with International Powerlifting Federation (IPF) world champion lifters during the same years (Fig. 6). Wilk's coefficients were used to compare totals across weight classes and U.S. ranked lifters (Fig. 6A). This comparison shows that among all but the lightest weight classes, the IPF world champion totals were intermediate between the #1 and #10 U.S. totals. The U.S. competed in each of the IPF world championships during these years and many of the lifters ranked on the Powerlifting USA top 100 lifts represented the U.S. in these meets. A review of the lifters competing at the IPF world championships revealed that 77% of the lifters representing the U.S. posted totals within the top 10 in that year. The Wilk's coefficients for the U.S. lifters demonstrates a clear trend for each rank, where the 3-4 lightest weight classes were less competitive than the heavier classes. A similar pattern is shown in Fig. 6B, where the average mass-specific totals of the IPF world champions are compared with the average U.S. #10 ranked totals.

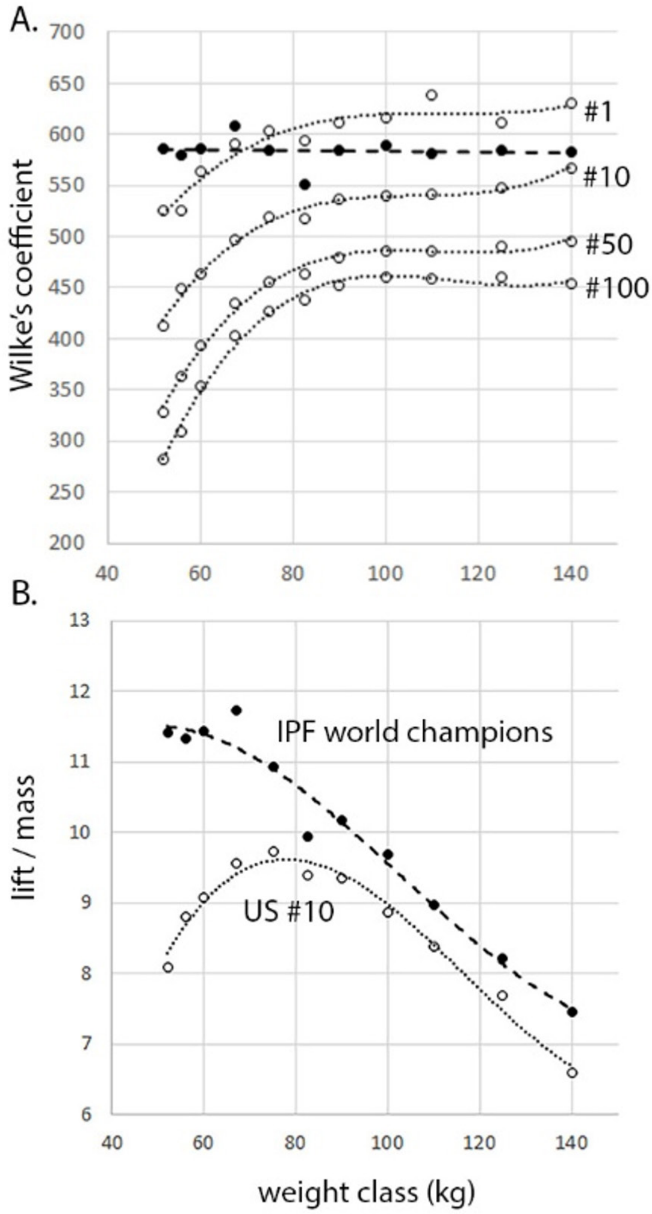

Figure 6. U.S. powerlifting performances compared with International Powerlifting Federation (IPF) world champion performances. Wilk's coefficients (A) for totals by U.S. lifters (open circles) and IPF champions (closed circles). Note that the lighter weight classes (52, 56, and 60 kg) were less competitive than the rest of the classes for U.S. lifters. In general, the IPF world champion totals were intermediate between the #1 and #10 U.S. ranks. (B) Relative performance (total/weight class) for the IPF world champions (closed circles) vs. U.S. #10 ranked lifters. Note again that the lighter weight classes of U.S. lifters were less competitive by this measure, whereas the lightest IPF champions posted the highest mass-specific lifts. For the heavier weight classes, the IPF champions and #10 ranked U.S. lifters declined with increasing weight class in parallel with one another.

For the IPF champions, an inverse correlation exists between the mass-specific total and increasing weight class, whereas the U.S. #10 mass-specific totals were dramatically lower in the lightest weight classes.

DISCUSSION

Powerlifting USA was published from 1977 – 2012 (Warpeha, 2015). The magazine was unique in its expressed focus on the sport of powerlifting, which it covered both in the U.S. and internationally. Mike Lambert was the driving force behind the publication. Lambert founded the magazine and served as sports reporter, publisher, and editor-in-chief throughout its 35 years of publication. Prior to the development of the internet, Powerlifting USA was the principal resource for keeping up with the sport of powerlifting. In addition to covering the sport of powerlifting, Powerlifting USA was the main source of news for lifters seeking information about upcoming meets long before the development of the internet. The top 100 lists were compiled from the reports of meet directors submitted to Mike Lambert throughout the year. These lists are valuable because they document the best performances in the U.S. from formally judged competitions. The top 100 lists captured the best performances over each year and distilled them into class-specific rankings from across the many powerlifting organizations.

The data compiled from the top 100 lists (Tables 1 - 4) present a number of notable trends. First, even the #100 ranked lifters are remarkable for each weight class. For example, the majority of the #50 - #100 ranked totals have Wilks scores of between 450 and 500. Roughly speaking, those lifters ranked from #50 - #100 would have been competitive at the state level, whereas those in the top 10 were national and world class lifters. Indeed, most of the U.S. lifters that competed in the IPF world championships for a given year were within the top 10 on the lists. Another pattern is that within a weight class and rank, the lifts were highly consistent during this 11-year period. On average, the coefficient of variation was generally only 1 – 5% over this 11-year period. Variability was greatest for the #1 and #10 ranked lifts (3-5%) but was much smaller for the #50 and #100 lifts (1-2%) (Tables 1 – 4; Fig. 2). A likely source of variability, particularly within the top ranks of these lifters, was the use of performance enhancing drugs during this period. The PL USA top 100 lists were compiled from all powerlifting associations, some of which were drug-tested while others were not. Another factor was the use of lifting gear, which also differed from organization to organization. Performances in the squat and bench press were significantly increased by lifters who took advantage of these lifting aids. Major advances in the DL were much less dramatic, probably because this lift is not enhanced by tight-fitting gear like the squat and bench press are (Warpeha, 2015; Wilk et al., 2020).

Overall, improvements in the bench press and squat were noted across all ranks, for many of the weight classes above 67.5 kg. These significant increases in weight contributed to the greater variability observed for these lifts, particularly within the #1 and #10 ranks (Tables 1 -4; Figs. 2 and 5). Although several factors may have contributed to these improvements, it seems likely that advances in lifting gear were involved in increased performances. In particular, highly engineered bench press shirts and squat suits can produce significant increases in the amount of weight moved in these lifts (Todd et al., 2015; Wilk et al., 2020). Supporting this interpretation, systematic improvements in the deadlift were not observed. Retrospective analyses of the impacts of lifting gear have shown that the squat and bench press are improved much more than the deadlift (Todd et al., 2015; Wilk et al., 2020). Another potential factor is an increase in the total number of lifters entering the sport, as the popularity of powerlifting grew.

It is difficult to know what the records represent as a percentile ranking of competitive powerlifters during this time period, because it is difficult to determine how many lifters were actively competing. A recent retrospective study of global drug-tested, unequipped powerlifting performances from 1968 – 2022 calculated percentile rankings based on mass-specific performances (van den Hoek et al., 2024). The data from that report provide an interesting comparison with the U.S. records presented in the current study. For example, the #100 squat records in the current study are very close to the 90th percentile of the mass-specific lifts for 18 – 35-year-old male lifters reported in that recent study (van den Hoek et al., 2024). The #100 bench press records for U.S. lifters exceeded the 90th percentile for the same male age group by about 10%, except in the two lightest weight classes. For the deadlift, the male 18 – 35-year-old 90th percentile lifts were generally about 10% greater than those posted by the #100 ranked lifters in the U.S. from 1995 – 2005. Overall, these comparisons suggest that most of the top 100 lifters in the U.S. during this time period were performing close to or greater than the 90th percentile of lifters broadly. Comparison of these records with IPF world champions (Fig.6) support the conclusion that most the #1 - #10 lifters were world class lifters. When evaluating these data, it is important to recognize that the U.S. records reported here included equipped lifters, some of whom were using performance enhancing drugs.

Observers of competitive lifting have long recognized the pattern that heavier competitors lift less weight in relation to their body mass. Thus, the increase in weight lifted with increased body mass is curvilinear, flattening out in the heaviest weight classes (Figures 1 - 3). Some researchers have applied allometric scaling patterns to explain this systematic trend (Batterham & George, 1997; Cleather, 2006). Allometric scaling relationships following a logarithmic scaling pattern are defined by the general relationship: $Y = A*mass^B$, where B represents the slope of the relationship. When this equation is log transformed, the result is the equation for a straight line ($\log y = \log A + B*\log mass$) (Calder, 1996). Allometric scaling relationships define many physiological trends such as the higher mass-specific metabolic rate in smaller animals (Calder, 1996). Indeed, there are allometric relationships that clearly define skeletal muscle function, such as the faster shortening velocities in smaller animals (Medler, 2002; Pellegrino et al., 2003). Another well-recognized pattern is that smaller animals exhibit greater mass-specific muscle force and power. This trend follows the basic principle that force is proportional to physiological cross sectional area (linear dimension^2), whereas mass is scales as linear dimension^3 (Biewener, 1989; Bishop et al., 2021). This pattern would suggest that mass specific force should scale as mass to the 2/3 power, or 0.66 (Cleather, 2006). This type of allometric scaling does not explain the size related differences powerlifting performance. In the current analyses, log transforming the axes failed to produce a straight line, as would result with allometric scaling patterns (Figure 1). In a similar assessment, Batterham and George (Batterham & George, 1997) demonstrated that allometric modeling did not predict Olympic weightlifting performance for the same reason. Cleather analyzed performances from International Powerlifting Federation World Championships from 1995 – 2004 as a function of body mass in both male and female lifters (Cleather, 2006). The results of that analysis demonstrated similar results, leading the author to conclude that allometric scaling relationships do not accurately fit the trend.

A simpler explanation for the systematic underperformance of larger lifters is that these athletes have lower a proportion of muscle mass relative to fat mass. Since skeletal muscle is the only force generating component of the body, increases in body mass from adipose tissue should not contribute to lifting performance. Male competitors from the U.S. Men's National Powerlifting Championships in 1997 exhibited significantly increasing percent body fat (%BF) with increasing weight classes (Brechue & Abe, 2002). The lifters from that study were grouped into light weight (67.5 kg and lower), middle weight classes (70 – 100 kg), and heavy weight classes (110 kg and greater). The %BF from each category were 13.7%, 14.4%, and 26.7%, respectively. Similar patterns in %BF have been reported for American football players from Division I colleges and the National Football League (Kraemer et al., 2005; Melvin et al., 2014; Noel et al., 2003). Although the precise %BF reported in these studies varies, in part because of the assessment methods used, they all show similar patterns. Running backs, receivers, and defensive backs possess the lowest %BF (~6% - 15%), linebackers and quarterback have intermediate %BF (~15% - 20%), and linemen exhibit the highest %BF (~18% - 24%) (Kraemer et al., 2005; Melvin et al., 2014; Noel et al., 2003).

The idea that powerlifting performance is a direct function of fat-free mass (FFM) is appealing, because it provides a simple, mechanistic explanation of functional strength. Although FFM is not only comprised of skeletal muscle, it does represent a very significant proportion. On average, about 50% of FFM in non-obese men is skeletal muscle, while women possess slightly less muscle (Heymsfield et al., 2002). However, individuals exhibit significant differences in their degree of muscular development (Heymsfield et al., 2022). For mammals broadly, skeletal muscle represents approximately 40 – 50% of total mass in a scale independent fashion (Bishop et al., 2021; Calder, 1996; Muchlinski et al., 2012). Studies of body composition in competitive powerlifters have demonstrated a direct linear correlation between absolute strength and lean body mass, as measured by dual X-ray absorptiometry (DEXA) (Ferland et al., 2023; Ferland, St-Jean Miron, et al., 2020). Another study of elite powerlifters using ultrasound to estimate fat free mass also demonstrated a linear relationship between lifting performance and lean mass (Brechue & Abe, 2002). Long-term gains in strength follow increased muscle thickness and lifters can accrue additional muscle mass and strength through years of lifting (Abe et al., 2000; Latella, C et al., 2020; Latella et al., 2022, 2024). Lifters using performance enhancing drugs enjoy an unfair advantage not only because these compounds increase muscle mass, but also because they reduce body fat. These combined effects lead to an overall increase in FFM for lifters within a given weight class. Further empirical studies that assess the connections between fat-free mass and the amount of weight lifted are needed to provide a better understanding of the relationship between weight class and mass-specific performance.

The data presented in the current report have a number of limitations, some of which have already been noted. The records did not include information about age or even sex, but simply included the name and date of the lift. In fact, some of the records, particularly in the lighter weight classes, were achieved by women. These records were compiled from meet reports from many different powerlifting organizations. As noted, powerlifting in the U.S. has long been fractured into federations along the lines of drug use and testing. For example, the American Powerlifting Federation (APF) was formed with the explicit principle that they opposed drug testing, whereas the American Drug Free Powerlifting Federation (ADFPA) was formed in opposition to drug use (Hunt & Todd, 2007; Warpeha, 2015). It is impossible to know how these records were impacted by drug use, although it seems a safe assumption that the highest ranks were most impacted. In addition, some of the lifts were performed with assistance from heavy duty gear that would not be permitted in all lifting organizations (Hunt & Todd, 2007; Warpeha, 2015). During this period, the majority of lifters were using single ply lifting gear, knee wraps, and a lifting belt. Unequipped, or 'raw', lifting competitions were uncommon. Furthermore, perceived differences in judging among lifting federations have led to disagreements over the validity of records. Comparison of powerlifting performance has long been wrought with controversy because of these many factors. Nevertheless, these records, contemporaneously published by PL USA, document the best powerlifting performances in the U.S. from the end of the 20th Century to the beginning of the current century. Since that time, powerlifting has continued to grow as an international sport, with more than 100 member nations participating in the International Powerlifting Federation (Warpeha, 2015). In response to the perceived unfair advantages of heavy-duty lifting gear, unequipped or 'raw' powerlifting began to gain popularity beginning sometime after the time frame of the current study (Todd et al., 2015; Warpeha, 2015). As with performances in any sport, it is difficult to make direct comparisons of the powerlifting records set from 1995 – 2005 with those being set in the current day.

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CONFLICTS OF INTEREST

The authors have no conflicts to declare.

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ETHICAL APPROVAL

The Institutional Review Board (IRB) at St. Bonaventure University determined this protocol to be exempt from review, because it involves only deidentified secondary data.

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REFERENCES

1. Abe, T., DeHoyos, D. V., Pollock, M. L., & Garzarella, L. (2000). Time course for strength and muscle thickness changes following upper and lower body resistance training in men and women. European Journal of Applied Physiology, 81, 174–180.
2. American College of Sports Medicine. (2009). American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. Medicine and Science in Sports and Exercise, 41(3), 687–708.
3. Batterham, A. M., & George, K. P. (1997). Allometric modeling does not determine a dimensionless power function ratio for maximal muscular function. Journal of Applied Physiology, 83(6), 2158–2166.
4. Biewener, A. A. (1989). Scaling body support in mammals:

Limb posture and muscle mechanics. Science, 245(4913), 45–48.
5. Bishop, P. J., Wright, M. A., & Pierce, S. E. (2021). Whole-limb scaling of muscle mass and force-generating capacity in amniotes. PeerJ, 9, e12574.
6. Brechue, W. F., & Abe, T. (2002). The role of FFM accumulation and skeletal muscle architecture in powerlifting performance. European Journal of Applied Physiology, 86, 327–336.
7. Brill, P. A., Macera, C. A., Davis, D. R., Blair, S. N., & Gordon, N. (2000). Muscular strength and physical function. Medicine & Science in Sports & Exercise, 32(2), 412.
8. Calder, W. A. (1996). Size, Function, and Life History. Dover Publications, Inc.
9. Cleather, D. J. (2006). Adjusting powerlifting performances for differences in body mass. Journal of Strength & Conditioning Research, 20(2), 412–421.
10. Ferland, P.-M., Allard, M.-O., & Comtois, A. S. (2020). Efficiency of the Wilks and IPF formulas at comparing maximal strength regardless of bodyweight through analysis of the open powerlifting database. International Journal of Exercise Science, 13(4), 567.
11. Ferland, P.-M., Charron, J., Brisebois-Boies, M., Miron, F. S.-J., & Comtois, A. S. (2023). Body composition and maximal strength of powerlifters: A descriptive quantitative and longitudinal study. International Journal of Exercise Science, 16(4), 828.
12. Ferland, P.-M., St-Jean Miron, F., Laurier, A., & Comtois, A. S. (2020). The relationship between body composition measured by dual-energy x-ray absorptiometry (DEXA) and maximal strength in classic powerlifting. J Sport Med Phys Fitness, 60(3), 407–416.
13. Glossbrenner, H. (1996). The First Seniors. Reviewing the Historic Occasion—Powerlifting's Maiden Voyage. Powerlifting USA, 19(8), 48–49.
14. Heymsfield, S. B., Gallagher, D., Kotler, D. P., Wang, Z., Allison, D. B., & Heshka, S. (2002). Body-size dependence of resting energy expenditure can be attributed to nonenergetic homogeneity of fat-free mass. American Journal of Physiology-Endocrinology and Metabolism, 282(1), E132–E138.
15. Heymsfield, S. B., Smith, B., Chung, E. A., Watts, K. L., Gonzalez, M. C., Yang, S., Heo, M., Thomas, D. M., Turner, D., & Bosy-Westphal, A. (2022). Phenotypic differences between people varying in muscularity. Journal of Cachexia, Sarcopenia and Muscle, 13(2), 1100–1112.
16. Hunt, T. M., & Todd, J. (2007). Powerlifting's Watershed: Frantz v. United States Powerlifting Federation: The Legal Case that Changed the Nature of a Sport. Iron Game History, 9(3).
17. Kraemer, W. J., Torine, J. C., Silvestre, R., French, D. N., Ratamess, N. A., Spiering, B. A., Hatfield, D. L., Vingren, J. L., & Volek, J. S. (2005). Body size and composition of National Football League players. The Journal of Strength & Conditioning Research, 19(3), 485–489.
18. Latella, C., Owen, P. J., Davies, T., Spathis, J., & Mallard, A. (2022). Long-term adaptations in the squat, bench press, and deadlift: Assessing strength gain in powerlifting athletes. Medicine and Science in Sports and Exercise, 54(5), 841–850.
19. Latella, C, Teo, W-P, Spathis, J, & van den Hoek, D. (2020). Long-term strength adaptation: A 15-Year analysis of powerlifting athletes. Journal of Strength and Conditioning Research, 34(9), 2412–2418.
20. Latella, C., van den Hoek, D., Wolf, M., Androulakis-Korakakis, P., Fisher, J. P., & Steele, J. (2024). Using powerlifting athletes to determine strength adaptations across ages in males and females: A longitudinal growth modelling approach. Sports Medicine, 54(3), 753–774.
21. Medler, S. (2002). Comparative trends in shortening velocity and force production in skeletal muscles. American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 283(2), R368–R378.
22. Melvin, M. N., Smith-Ryan, A. E., Wingfield, H. L., Ryan, E. D., Trexler, E. T., & Roelofs, E. J. (2014). Muscle characteristics and body composition of NCAA division I football players. Journal of Strength & Conditioning Research, 28(12), 3320–3329.
23. Muchlinski, M. N., Snodgrass, J. J., & Terranova, C. J. (2012). Muscle mass scaling in primates: An energetic and ecological perspective. American Journal of Primatology, 74(5), 395–407.
24. Noel, M. B., VanHeest, J. L., Zaneteas, P., & Rodgers, C. D. (2003). Body composition in Division I football players. The Journal of Strength & Conditioning Research, 17(2), 228–237.
25. Pellegrino, M. A., Canepari, M., Rossi, R., D'Antona, G., Reggiani, C., & Bottinelli, R. (2003). Orthologous myosin isoforms and scaling of shortening velocity with body size in mouse, rat, rabbit and human muscles. The Journal of Physiology, 546(3), 677–689.
26. Suchomel, T. J., Nimphius, S., & Stone, M. H. (2016). The importance of muscular strength in athletic performance. Sports Medicine, 46, 1419–1449.
27. Todd, J., Morais, D. G., Pollack, B., & Todd, T. (2015). Shifting gear: A historical analysis of the use of supportive apparel in powerlifting. Iron Game History, 13(2–3), 37.
28. van den Hoek, D. J., Beaumont, P. L., van den Hoek, A. K., Owen, P. J., Garrett, J. M., Buhmann, R., & Latella, C. (2024). Normative data for the squat, bench press and deadlift exercises in powerlifting: Data from 809,986 competition entries. Journal of Science and Medicine in Sport.
29. Vanderburgh, P. M., & Batterham, A. M. (1999). Validation of the Wilks powerlifting formula. Medicine and Science in Sports and Exercise, 31(12), 1869–1875.
30. Warpeha, J. (2015). A History of Powerlifting in the United States: 50 Years after York. USA Powerlifting Minnesota. https://www.usaplmn.com/wp-content/uploads/2014/04/History-of-Powerlifting-Warpeha-9-4-15.pdf
31. Wilk, M., Krzysztofik, M., & Bialas, M. (2020). The influence of compressive gear on maximal load lifted in competitive powerlifting. Biology of Sport, 37(4), 437–441.