






The rates of null and valid movements in parapowerlifting in international competitions

As taxas de movimentos nulos e válidos no *parapowerlifting* em competições internacionais

Tasa de levantamientos validos y nulos en competiciones internacionales de *parapowerlifting*

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Keywords:

Disabled powerlifting 1;
Powerlifting effectiveness 2;
Technical execution 3.

ABSTRACT

The Paralympic system adapted the press modality, allowing the participation of people with physical disabilities called para-powerlifting (PPL). The purpose was to establish the rates of valid and invalid movements; identify if factors such as the weight category, gender, or athletes' country have an influence on the results; A retrospective study was elaborated in which the results of the null and valid movements made in 12 international events of the 2013-2016 Paralympic cycle were recovered from the official page of the international paralympic committee. The results indicate that in these twelve events a total of 6,759 movements were performed, of which 3,264 moves were valid and 2,991 were rated as null, with no significant differences in null movements between men and women. These results indicate the need to review the judging system or the use of visual technologies to reduce the rate of null movements.

Palavras-chave:

Levantamento de peso para deficientes 1;
Eficiência do *powerlifting* 2;
Execução técnica 3.

RESUMO

O sistema paraolímpico adaptou a modalidade de supino, permitindo a participação de pessoas com deficiências físicas, denominada *parapowerlifting* (PPL). O objetivo foi estabelecer as taxas de movimentos válidos e inválidos; identificar se fatores como a categoria de peso, o gênero ou o país dos atletas influenciam os resultados; Foi elaborado um estudo retrospectivo no qual os resultados dos movimentos nulos e válidos realizados em 12 eventos internacionais do ciclo paraolímpico 2013-2016 foram recuperados da página oficial do Comitê Paraolímpico Internacional. Os resultados indicam que nesses doze eventos foi realizado um total de 6.759 movimentos, dos quais 3.264 movimentos foram válidos e 2.991 foram classificados como nulos, sem diferenças significativas nos movimentos nulos entre homens e mulheres. Esses resultados indicam a necessidade de revisar o sistema de julgamento ou o uso de tecnologias visuais para reduzir a taxa de movimentos nulos.

Palabras-clave:

Powerlifting adaptado 1;
Efectividad en *powerlifting* 2;
Ejecución técnica 3.

RESUMEN

El sistema paralímpico, adaptó la modalidad de press plano, para permitir la participación de personas con discapacidad física, denominándola como *para-powerlifting* (PPL). El objetivo de este estudio fue establecer los índices de movimientos válidos y no válidos; identificar si factores como la categoría de peso, el sexo o el país de los atletas influyen en los resultados; se elaboró un estudio retrospectivo en el que se recuperaron de la página oficial del Comité Paralímpico Internacional los resultados de los movimientos nulos y válidos realizados en 12 eventos internacionales del ciclo paralímpico 2013-2016. Los resultados indican que en estos doce eventos se realizaron un total de 6.759 movimientos, de los cuales 3.264 movimientos fueron válidos y 2.991 fueron calificados como nulos, sin diferencias significativas en los movimientos nulos entre hombres y mujeres. Estos resultados demuestran que es necesario revisar el sistema de juzgamiento o implementar el uso de video para reducir la tasa de movimientos nulos.

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Received 24 February 2023; accepted 1 November 2023.

DOI: <https://doi.org/10.1590/rbce.45.e20230008>

INTRODUCTION

Para-powerlifting is an official sport for the Paralympic games in Barcelona 1992. In this sport disabled people participate (amputated, spinal injury, short stature population and cerebral palsy individuals), who are classified into 10 categories according to their body weight without regarding the disability (Comité Paralímpico de Chile, 2017).

The technical gesture used for this modality is similar to bench press, the movement begins with an eccentric phase, which implies a controlled lowering of the bar until it slightly touches the chest keeping the barbell still, for 1 and 2.5 seconds (Without considering the time to decide the movement as valid), immediately, after this pause and as soon as the judge determines, the concentric phase begins, taking the bar up, the bar ascent must be performed considering a constant speed maintaining the bar level finishing totally symmetric having the elbows extended and locked (Evangelista et al., 2015). During the movement execution, the sportsperson lifts the rib cage to reduce the displacement the bar must do (International Powerlifting Federation, 2020), at the time the upper back, gluteus and the inner thighs edges press the bench while the feet press the floor. The bandwidth used to grab the bar varies according to the weightlifter biotype, however, the regulations limit the bandwidth to 81 cm between the two hands.

Each sportsperson has three attempts to succeed in the maximum weightlifting. To validate the movement, two or three judges must raise the white flag. The judges (3) from different positions observe the movement the sportsperson performs taking into consideration these technical criteria concluding the validity or not of the movement.

In recent decades, there has been an increase in the number of investigations concerning this sport, some studies focus on the prevalence of sports injuries, in athletes participating in the London 2012 and Rio 2016 Paralympics (Willick et al., 2016; Ona Ayala et al., 2019).

Other studies center on analyzing the effects of dietary supplementation or drug intake on physiological variables such as maximal strength, muscle power, cardiovascular responses during training, fatigue index, or body temperature of athletes (Sampaio et al., 2020; Fraga et al., 2020; Paz et al., 2020). Other studies were interested in establishing relationships between chronological age, and the performance of athletes who participated in the World Championships and Paralympic Games (Lopes-Silva et al., 2023; Severin et al., 2023; Latella et al., 2018).

On the other hand, the technique used in parapowerlifting competitions, has been studied from several aspects; (a) the phases of the movement, relying on electromyographic and kinematic parameters (Silva et al., 2022). (b), In recent decades at an international

level, studies have been developed, focused on body composition, physical aptitude and the movement technique are high incidence factors dealing with the sportive performance, (Ryguła et al., 2016), (c) the study carried by Tovstonoh et al. (2015) developed a training program based on the algorithmizing teaching to improve the lifting technical implementing, which concluded: the experimental athletes group made substantially less errors in comparison with the control group. This research employed as method; the record of the mistakes made by the youth athletes during competing. (d) Seidel and Zurowska (2014), devised a study performed by 29 athletes of the Polish national Para- powerlifting team which, evaluated the arms symmetry, based on a strength test at 40-50-60-70-80-95% of 1RM by using uniaxial potentiometric goniometers located on each arm, significant differences were not identified in any of the arms, as conclusion, it was established how this was not the null movements' cause. (e) The study by Ribeiro et al. (2022), There were no significant differences for all analyzed outcomes comparing the arched and flat techniques.

The research developed about Powerlifting is few, in fact, very limited analyze the null movements subject. Tavera et al. (2017) conduct a biomechanical analysis of the Sportive Para- powerlifting gesture (try) and observed a higher number of null movements than valid movements having as reference the four examined athletes.

Studies about incidental facts related to the large null movements number in Para- powerlifting have not been conducted (Puce et al., 2022). The present study has the aim to examine the null movements magnitude during 12 international events and to investigate if variables such as weight category, gender, or country of origin, are related to lifting efficiency. In concordance with our knowledge, this is the first study which seeks these inquiries.

MATERIALS AND METHOD

This is a retrospective study that collects and analyzes the null and valid movements in 12 PPL official international competitions. The PPL is supported by the international paralympic committee (IPC). The events were: Alexin 2013, Kuala Lumpur 2013, Dubai 2014, Mexico 2015. Almaty 2015. Eger 2015, Dubai 2016, Rio 2016, Berck Sur Mer 2018, Colombia 2018, Kitakyushu 2018 and Argelia 2018. The obtained data of each one of the events was taken from the international official Paralympic web page.

To obtain the information, we accessed the official IPC website (International Paralympic Committee, 2023) and downloaded the information referring to the results of each of the twelve events, which was registered in a database for later analysis. The following information was recorded for each event: name of the athlete, sex, category in which he/she was competing, country, and

total number of movements of null and valid movements reported by the judges in the official registration forms of each event.

POPULATION

The population from which the information was obtained consisted of the total number of 2084 athletes of all categories who participated in the twelve events. The athletes' data who did not execute the three movements were not included in the present study.

A statistical descriptive analysis to determine frequencies, average and percentage was made as well as an inferential one to determine the relations among the analyzing variables: null lifts, gender, category, and null movements tendency per country. The data was processed by the program SPSS19.

RESULTS AND DISCUSSION

The purpose of this study was to identify the rate of invalid and valid movements in various international PPL competitions. To our knowledge this is the first study addressing this issue, this is confirmed by the review of the literature on paralympic powerlifting conducted by [Puce et al. \(2022\)](#) where it is indicated that the areas studied are as follows: warm-up strategies; aspects of training; physiological aspects and responses; psychological aspects and responses; biomechanics of bench press; recovery strategy; impact of the disability and type of disability; epidemiology of PP; and new analytical/statistical approaches for kinematics assessments, internal load monitoring, and predictions of mechanical outputs in strength exercises and in PP.

The present study analyzes a total of 6759 movements, which were revised along the 12 sportive events. A total of 100 countries participated, and 2252 athletes (1.442 men 64% and 810 women 36%). 4329 of the total number of movements were carried out by men and 2430 by women. The quantity of 3.535 movements were catalogued as valid and 3225 as null, to shape an average of $51,8 \pm 6.4\%$ valid movements along the twelve competitions, a fact which is strongly homogeneous as the standard deviation indicates. These initial data may indicate a high presence of null movement throughout all the events.

Table 1 shows the number of countries and the distribution of athletes participating in the 12 events. It is observed a large dispersion in the number of participants and countries in each one of the events. The information is presented as the whole number of participants, and it is arranged by gender.

A comparison of participation classified by gender was depicted for all events by means of the T-Student statistic with homogeneous variances, considering that the variables meet the homoscedasticity assumption ($F_{11}=2.29$; $p=0.183$). The relevant participation of men corresponds to 120.16 (± 13.64), while in women 67.5 (± 9.006). Significant differences were found in participation ($T_{22}=3.22$; $p=0.0039$), with greater participation of men in all events.

Table 2 shows the total number of movements performed by the athletes in each of the 12 events and the distribution of their scores (null or valid) given by the judges.

When analyzing the important number of null and valid movements, a large dispersion is observed

Table 1. Countries and total number of athletes participating by gender in the twelve international PPL events.

Contest	Country	Men participants	Women participants	Total participants
Aleksin 2013 ¹	24	81	42	123
Kuala Lumpur 2013 ²	34	127	65	192
Dubai 2014 ³	55	214	102	316
México 2015 ⁴	20	77	26	103
Almaty 2015 ⁵	28	125	62	187
Eger 2015 ⁶	41	136	70	206
Dubai 2016 ⁷	42	121	71	192
Rio 2016 ⁸	29	102	74	176
Berck Sur Mer 2018 ⁹	33	97	71	168
Colombia 2018 ¹⁰	27	93	46	139
Kitakyushu 2018 ¹¹	30	126	74	200
Argelia 2018 ¹²	15	46	36	82

Aleksin 2013: IPC powerlifting Open European Championship; ²Kuala Lumpur 2013: IPC Open Asian championship; ³Dubai 2014: IPC Worldwide powerlifting championship; ⁴México 2015: Americas open powerlifting Championship; ⁵Almaty 2015: Asian open powerlifting championship; ⁶Eger 2015: IPC European open powerlifting championship; ⁷Dubai 2016: World cup; ⁸Rio 2016: Paralympic games; ⁹Berck Sur-Mer 2018: IPC open European championship; ¹⁰Colombia 2018: IPC America's powerlifting cup; ¹¹Kitakyushu 2018: IPC Asian open powerlifting championship; ¹²Argelia 2018: IPC African powerlifting worldwide championship.

Table 2. Rate description of the movements in twelve events.

Event	Total of movement	Valid movements	Null movements	Valid %	Null %
Dubai 2014	369	188	181	49.3%	50.7%
Eger 2015	576	376	200	50.2%	49.8%
Kitakyushu 2018	938	467	471	58.7%	41.3%
Kuala Lumpur 2013	312	140	172	65.3%	34.7%
Dubai 2016	561	319	242	52.3%	47.7%
Almaty 2015	618	310	308	56.9%	43.1%
Rio 2016	576	301	275	41.5%	58.5%
Berck Sur Mer 2018	528	219	309	53.8%	46.2%
Colombia 2018	504	271	233	47.5%	52.5%
Alexin 2013	417	198	219	50.9%	49.1%
Mexico 2015	600	352	248	44.9%	55.1%
Argelia 2018	240	123	117	50.0%	50.0%

Total of movements made in the 12 events. The information has been arranged by frequency, and valid and null movements percentage.

Table 3. Differences of null and valid movements in each event.

Event	Assessment of movement				P value
	Valid		Null		
	Mean	SD	Mean	SD	
Alexin 2013	1.53±	0.90	1.47±	0.90	0.620
Kuala Lumpur 2013	1.96±	0.87	1.04±	0.87	<0.001*
Dubai 2014	1.48±	0.93	1.52±	0.93	0.549
Mexico 2015	1.36±	0.98	1.67±	0.91	0.019*
Almaty 2015	1.71±	0.81	1.29±	0.81	<0.001*
Eger 2015	1.50±	0.86	1.50±	0.86	0.908
Dubai 2016	1.57±	0.86	1.43±	0.86	0.123
Rio 2016	1.24±	0.83	1.76±	0.83	<0.001*
Berck sur mer 2018	1.61±	0.88	1.39±	0.88	<0.001*
Colombia 2018	1.42±	0.90	1.58±	0.91	0.145
Kitakyushu 2018	1.76±	0.89	1.24±	0.89	<0.001*
Argelia 2018	1.50±	1.08	1.50±	1.08	1.000

*Significant differences between valid and invalid movements.

in the twelve events (Table 3). In six events, significant differences between the notable number of null and valid movements are identified, while remaining, the differences are not significant. No association of these results with the number of participants or countries in each event was identified.

Regarding gender, no relevant differences between the valid and null movements were identified (Table 4).

However, this incidence of the rate of null movements can be influenced by several factors. When analyzing the effect that the number of participants per event may have on the rate of valid movements in each test, a low relationship is observed ($r=0.20$), which means that regardless of the number of participants in each event, the rate of valid movements is still low. Figure 1 shows this correlation disaggregated by gender.

Another aspect that modifies the incidence of valid movements is the number of participations of each country in the twelve events. A low relationship $r=0.09$ in men (Figure 2) and $r=0.1$ in women (Figure 3) was identified between the number of times the countries participated in the twelve events and the percentage of valid movements. This could indicate that the experience of both coaches and athletes is not related to the execution technique of the PPL movement. However, this behavior shows large variations. In the case of the United Kingdom, for instance, whose representatives participated in 10 of the 12 events, the effectiveness rate of valid movements was 70% in both men and women, while Chile, whose delegation participated in 9 events, evidenced an effectiveness rate of 52%, closer to Thailand's results (56%), whose sportspeople only

Table 4. Differences of null and valid movements according to gender.

Movements	Sex	Mean	SD	P value
Valid	Men	1.55±	0.918	0.152
	Women	1.61±	0.879	
Null	Men	1.45±	0.915	0.132
	Women	1.39±	0.879	

participated in four events. Table 5 shows the countries' distribution of participants in the events.

When analyzing the efficiency of movements according to the competence category, it is observed a weak association ($r=0.20$) within these, in men as well as in women, which indicates how the high null movements does not differ substantially in relation to the variety of weight categories where it is competed. In Table 6 it is described the competition categories and the efficiency percentage in movements.

Table 6. Evidences the efficiency percentage achieved in each gender weight category developed in the 12 events. When observing the null movements behavior per country, it is identified a high dispersion regarding the results which shifts from having 71% of valid movements as it is the Great Britain case, to 24% in United States of America. For this study, countries which participated at least with 10 athletes between men and women were taken into consideration, due to in many cases, one representative participated per country and whose three movements were evaluated as null. These results indicate that on certain countries, the training system has allowed to improve the efficiency of movements however, this would be valid only for the 7% of the countries which are the unique which exceed the 60% of valid movements.

According to our knowledge, this is the first study which addresses the issue and revises the results of twelve international Para- powerlifting events. The results of the present research indicate that regardless of gender, category, or country, a high percentage (48.2% of the movements performed by athletes, are considered as null per judges.

The PPL motion requires a high maximum component of strength, power and technique which are intertwined with the disabled athletes anatomical and physiological features. The lifting efficiency depends on diverse factors as the sportsperson capacity to generate strength, combined with a correct technical implementation, which implies a symmetric arms action, a grasping hands position to the bar and the movement range motion at elbow and shoulder articulation level (Seidel and Zurowska, 2014).

The research developed by Briskin et al. (2008) whose participants were Ukrainian athletes, evidences the technical component as one of the determining factors in Para- Powerlifting. The investigation also identified a strong negative correlation between the maximum strength results obtained in tests during

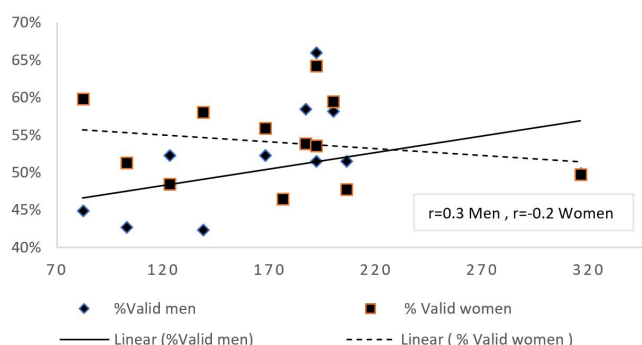


Figure 1. Relationship between the rate of valid movements and the total number of men and women who participated in each event.

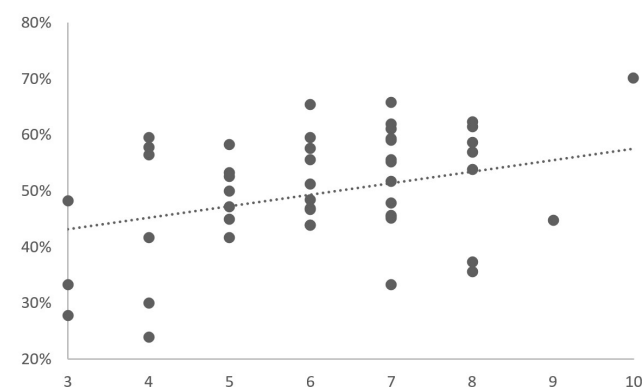


Figure 2. Relationship between men's rate of valid movements and their participation in number of times.

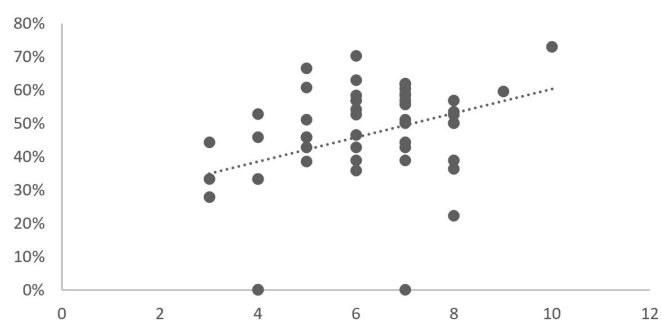


Figure 3. Relationship between women's rate of valid movements and their participation in number of times.

training and those obtained by the same athletes in official competences. During the maximum strength evaluations during the training period, athletes achieved higher maximum strength levels than the obtained ones during competing. Authors stated that this could have

Table 5. Valid movements and countries' participation in 12 happenings.

Countries	Events	Men				Women			
		Participants	Total of Movements	Valid	%	Participants	Total of Movements	Valid	%
22	1	32	96	25	23.6±18.2	9	27	13	50±18.2
12	2	31	93	29	27.7±19.4	31	93	29	27.7±19.3
13	3	68	204	78	37.9±18.8	68	204	78	37.9±18.7
9	4	95	285	125	48.7±15.2	36	108	60	49.3±15.7
11	5	154	462	234	54.3±12.1	111	333	170	47.2±12.5
10	6	256	768	409	51.9±7.3	218	654	347	51.9±10.9
13	7	481	1443	805	52.8±9.1	249	747	434	53.4±7.9
8	8	249	747	396	48.1%±14.7	126	378	186	45±11.9
1	9	38	114	51	44.7%	14	42	25	59.5%
1	10	39	117	82	70.1%	16	48	35	72.9%

Relation of valid movements classified by gender according to number of countries' participants per contest.

been done due to the focus of importance athletes made in technical aspects of performance instead of concentrating on lifting higher weights.

Another important but less examined element according to our knowledge, is the effect the type of disability may have on the results. Unlike some other sports, Para- powerlifting classifies athletes in categories according to the weight without considering the type or degree of disability, fact which admits short stature competitors, spinal cord injury contestants or athletes with malformations who have the same weight condition may compete in the same category. Based on our knowledge, thus far, it has not been conceived any study which seeks if the type of disability could be a factor of incidence related to Para- powerlifting performance.

In this sense, some reports indicate the need to take into consideration the type of disability. [Allegretti João et al. \(2017\)](#) suggest the idea to consider the athletes' particularities, this fact is crucial in physical disabled athletes training process given the major morpho functional differences the competitors present, considering disability factors as result determinant. [Ortiz \(2006\)](#) centered on intervene contestants through an arms strength training program to improve the sportive lifters performance, concluding although it is true the suggested exercises contributed to enhance the physical disabled contestants' results, it is imperative to reflect on the anatomical and physiological characteristics lifters may present to plan the strength training program. [Ryguła et al. \(2016\)](#), [Ocampo et al. \(2010\)](#) suggest preparation must be segmented and specific due to the type of disability and its particularities according to the type of injury and the moment it took place, factors which may be reflected in the high level of technical movements performed in Para- powerlifting.

According to scientific evidence ([Van den Hoek et al., 2023](#)) there is no difference in absolute strength between disabled and conventional athletes in powerlifting. The physical deficiencies suffered by PPL world record

Table 6. Competence categories and movements efficiency.

Category kg	Total men	% Valid movements
49	127	59.1%
54	131	54.5%
59	150	46.7%
65	160	50.0%
72	172	45.8%
80	176	48.1%
88	167	48.7%
97	153	58.2%
107	99	53.9%
>107	102	57.8%
Category kg	Total women	% Valid movements
41	72	51.4%
45	80	50.8%
50	97	51.2%
55	102	56.2%
61	103	50.8%
67	81	55.6%
73	68	54.9%
79	66	56.6%
86	72	53.7%
>86	57	57.9%

holders do not appear to compromise bench press strength. In fact, PPL world record holders often possess greater relative and absolute strength than their conventional counterparts and it seems to be the only sport where this situation occurs.

Based on the results the current research establishes, it emerges a series of inquiries which must be approached in other studies; the method how contenders are trained in technical aspects of movements performance, the disability, it is necessary to design and implement

technological video devices to support judges' decision making as in other sports; athletes' classification according to weight is appropriate given the large morphological differences and limitations the type and level of disability may cause.

CONCLUSION

It is presented a high null movements rate in international Para- powerlifting competences regardless gender, country, or participants category. This also may indicate that the rules in the PPL should be reviewed as well as be more flexible for these are more restrictive than in conventional powerlifting.

FUNDING

This research had the financial support of the Cenda University Corporation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

ACKNOWLEDGEMENTS

Special acknowledgement to Corporación Universitaria Cenda, to Professor Carlos Barbosa and to the International Paralympic committee for providing the information to develop the present study.

Special thanks to the methodologist of the Colombian Paralympic Committee Carlos Barbosa.

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