

A Case Report on a Female, Open Category, 84kg+, Raw Powerlifter, and Strategy to Excel in the Sport.

Introduction

Previously a sub-division of Olympic Weightlifting, Powerlifting as a competitive sport in its own right first arrived in the USA in 1964, and migrated to the UK shortly thereafter (Ferland et al, 2019). From its inception, Powerlifters were permitted to use knee sleeves, a 10cm supportive belt, and wrist wraps, however over time the apparel worn by competitors became progressively more supportive and more numerous, with the creation of Squat suits, knee wraps, and Bench Shirts (International Powerlifting Federation, 2019). This gradually led to a division between competitors who used such apparel, and competitors who argued that supportive apparel had changed the sport entirely; as a result two separate divisions of Powerlifting now exist – Raw/Classic competitions using International Powerlifting Federation (IPF) approved knee sleeves, wrist wraps and waist belts, and Equipped competitions using these in addition to Squat Suits, Knee Wraps, and Bench Shirts (Ferland et al, 2019, Hackett et al, 2020).

Powerlifting competitions, or ‘meets’, traditionally consist of three lifts; the Squat, the Bench press, and the Deadlift, and whilst some meets can be devoted to purely the bench press, at most meets it is usually the highest combined total of successfully completing all three lifts that determine a win within a competitors age and weight category. Age classes are currently Sub-junior (<18 years), Junior (19-23 years), Open (24-39), Masters (40-49), Masters 2 (50-59), Masters 3 (60-69), and Masters 4 (70+), whilst for women the weight categories are currently 47kg, 52kg, 57kg, 63kg, 69kg, 76kg, 84kg, and 84kg+ (IPF, 2019). At each meet the competitor has 3 attempts at each lift, with weights increasing at increments specified by the lifter following a successful lift; prior to the competition start they will have chosen their ‘opener’ weight, which is usually a weight the competitor is confident they can complete, then using that lift as a reference they decide on the weight of the lift following it (IPF, 2019).

Each lift is a compound movement similarly involving many physiological interactions within the body; success in the lifts depend on the athletes’ anaerobic capabilities, their grip strength, their flexibility and mobility within their joints and skeletal muscle, their predominantly fast-twitch type 2b muscle strength, and their neural functions and motor unit communications (Martel et al, 2006. Bengtsson et al, 2018. Ferrari, 2022. Smith et al, 2022). Despite the current knowledge of what is physiologically required within the sport, and awareness that lack of proper training in these areas can lead to injury in as many as 50% of lifters (Bengtsson, 2018. Dudagoitia, 2021. van de Hoek, 2022), there is still very little research on Powerlifting when compared with other sports (Ferland et al, 2019). Using research and testing methods available, this paper will examine the current physical status of one Female, Open Category, 84kg+, Raw Powerlifter, then identify possible avenues for improvement in order to minimise risk of injury and excel in the sport.

Method

As demonstrated by Gabriel et al, neural functions and interactions with intra- and inter- muscular motor units play a huge role in capabilities in a chosen sport (2006), showing that in essence practice does go a long way to making ‘perfect’ in terms of technique and

form (Austin, 2012. Škarabot et al, 2021). Combined with this, in order to properly evaluate the current physical capabilities of the athlete and help them excel in their chosen sport, many other physiological functions were deemed of high importance and therefore were to be assessed (Ferland et al, 2019. Hackett et al 2020. Ferrari, 2022). Following the completion of a PAR-Q (appendix 1), the following components of health were tested, and results evaluated.

1 Repetition Max Test

The participant is already an amateur competitive powerlifter, who had previously competed at regional level, but competed more recently at a local level. Such competition by its nature represents a 1 Repetition Max test; a test of the maximum weight the lifter can lift, carried out using equipment and apparel approved by the International Powerlifting Federation (IPF, 2019). Whilst to the competitor a 1RM test is a test of their absolute strength, during a competition this is a test of their relative strength – if two competitors in the same age and weight category lift the same amount of Kilograms successfully, it'll be the competitor who weighs less that'll earn more points as they've exerted more pound-for-pound force than their competition (Hackett et al, 2020).

At the commencement of each lift there is one central and two side referees, of which two must agree that the lift met the defined form guidelines for it to be deemed a 'good' lift. To judge a 'good' lift the definitions are given as such; Firstly a Squat is defined as the lifter holding a weighted barbell across the top of their back/shoulders, then at the 'SQUAT' command from central referee lowering their body by flexing at the hip, knee, and ankle joints until the hip crease is lower than the top of the knee, The lifter then returns to the upright position to complete the lift (Bengtsson, 2018. IPF, 2019). Secondly, during a bench press the lifter must lift the barbell from the rack perpendicularly to their body whilst lying in the supine position. They must then at the 'START' command lower the barbell to their chest, ensuring their elbow joint finishes lower than their shoulder at anterior view, and wait for the 'PRESS' command before returning the bar to its start position (Bengtsson, 2018, IPF, 2019). Lastly, the Deadlift is conducted by lifting the barbell from a 'dead' position on the floor, until the lifter is stood erect. The movement, be it in classic or sumo stance, is completed by initially flexing the ankles, knees, and hips until the lifter is in position to grasp the barbell with straight arms, then using the hip, knee, and back extensors to pull the weight until the lifter has return to the erect position. The lifter then waits for the 'DOWN' command to return the barbell to the floor in a controlled manner (IPF, 2019. Ferrari, 2022). Following calculation of combined total score across all three lifts, the athletes are then ranked based on their strength in proportion to their body weight, giving values of both relative and absolute strength.

Grip Strength

For the general population, a test of hand grip strength can be indicative of overall bodily strength (Hackett et al, 2020). Additionally, in this instance strong hand grip strength can be of vital importance when conducting exercises such as the deadlift, where the ability to hold grip on the weight the lifter is attempting to lift is vital to the lift's success (Ferrari, 2022).

To measure hand grip strength a dynamometer is used. To begin the test the participant is to hold the dynamometer so that their middle finger digits rest on the mobile inner section of the handle, with their palm facing upwards and their elbow at 90 degrees. They are then to squeeze the handle to the best of their ability for 3 seconds. At this point a reading should be taken from the dynamometer scale. The test is then to be conducted on

the other hand, with each hand taking it in turn until they have both conducted the test thrice. The highest values from both hands are added together and divided by 2 to give the final number (Montoye, 1964. Housh et al, 2016).

Upper Body Strength

In order to assess the absolute and relative upper body strength of the athlete, and yield results more relevant to powerlifting than purely grip hand strength, the Keiser A420 machine was used in chest press format. After sitting in the seat and inserting the data recording chip into the screen panel, the participant is to press the yellow handle buttons either side of their seat until the message 'CLER' appears on the screen, then with both hands grip the handles at shoulder height (Keiser Equipment, 2023). At that point the machine will use compressed dry air to push resistance similar to a defined weight against the force exerted by the participant, in order to generate a force result from the participants efforts (Keiser Equipment, 2023). Repetitions will happen following a countdown displayed on the screen reaching '0', with 'weight' increasing as the number of repetitions increases (Keiser Equipment, 2023). After each rep the screen will display the force generated by the participant, and whilst initially this number will increase with every rep, at the point which the number starts to decrease is the point where the test ends. After finishing the test the data recording chip is to be removed from the screen panel, which then prompts the data to migrate to the computer programme for analysis (Keiser Equipment, 2023). The highest values from the left and right arms are combined to show the final value of absolute strength to be recorded.

Lower Body Strength

Similar to the test for upper body strength, the Keiser A420 machine was also used to determine the participants level of lower body strength, in leg press format. After sitting in the seat and inserting the data recording chip into the screen panel, the participant is to press the yellow handle buttons either side of their seat until the message 'CLER' appears on the screen, however for this test the participant is then to place their feet flat on the panels in front of them, adjusting the seat so that their knees are at 90 degrees prior to test commencement (Keiser Equipment, 2023). This test then follows the same procedure as for upper body, with resistance increasing at each rep to a point where the participant can no longer exert the force required to complete the rep. After test completion and removal of the data chip the values generated for the left and right legs are combined to give a final value of absolute strength.

Anaerobic Capabilities

Despite its name, *Powerlifting* exerts less explosive power than sports such as Olympic Weightlifting, instead excellence is achieved here through the generation of the slower force needed to perform a lift. With that being said, the lifts as they're performed take mere seconds to complete (Hackett et al, 2020), and so the predominant energy source to complete the lift would be the ATP-PC cycle, providing around 5 seconds of all-out energy, making it the perfect energy system for powerlifters. Anaerobic capabilities were assessed here by the use of the Monark Bike Wingate test, which used resistance to determine the anaerobic output of the participant (Monark Exercise AB, 2010). To conduct the test, following a short warm up, the participant must remain seated on the saddle, adjusted for their own height. The linked computer will then calculate the required weight to be applied to the bike, based on the weight of the participant. In order to begin the test, the participant must then peddle with all their might for 30 seconds, against the resistant force applied by the bike. At the end of the 30 seconds, the participant may stop the test and dismount, at

which point the linked computer will determine both average and peak power for the participant (Monark Exercise AB, 2010).

Flexibility

Flexibility is the measure of range of motion within a joint, and just because a person has flexible wrists it does not necessarily mean they have flexible knees (van de Hoek, 2022. Smith et al, 2022). Because of this, in order to get a complete picture of an athletes' flexibility you would need to test every single body part in isolation; there is no one test that would examine the entire body at once. Due to the fact that most injuries suffered by powerlifters are injuries of the lower and back and hamstrings (Dudagoitia, 2021), it was deemed appropriate to use the sit-and-reach test to measure flexibility of the lower body.

Following a brief warm-up, the participant is to sit on the floor with their feet planted flat against the front of a sit-and-reach box, under the measured scale on top, with their knees at full extension. They are then to reach forward along the measuring scale with their arms straight, hands on top each other, palms down. The point at which they can no longer push their hands forward along the measure scale is the point at which the reading will be taken. The test was conducted thrice, and the highest number taken as the final result.

Body Composition

Unlike body building, which uses non-functional cytoplasmic hypertrophy to grow the muscle fibres, Powerlifting uses functional myofibrillar hypertrophy to grow the muscle protein filaments (Austin, 2012. Abe, 2018). These different approaches to muscle growth yield differing aesthetics, as well as differing body compositions (Keogh et al, 2009). Whilst the nature of body building demands a lower body fat percentage of its athletes, Powerlifting places more importance on strength and muscle mass, the only importance of Fat mass is the affect it has on an athletes score at the end of the competition (Keogh et al, 2009. Abe, 2018). The test used here to determine muscle mass was the Tanita body composition scale, which is to be stood on with bare feet, holding the attached handles in the corresponding hand. At the commencement of the test, the participant is to stand still whilst the equipment uses small electrical pulses to determine the participants body composition, including levels of Fat Mass, Muscle Mass, and Muscle Mass Balance (Tanita Health Equipment, 2010).

Results

Following the completion of tests detailed above, the following table (1) has been generated, showing the participant results.

Table 1 showing participant results.

Sex m/f	Age (Years)	Stature (m)	Body Mass (KG)	BMI	Grip (KG)	Keiser Chest (W)	Keiser Leg (W)	WAnTAP (W)	WAnTPP (W)	Sit and Reach (CM)
f	28	1.76	101.5	32.8	39.5	163	664	780	955	27

Not included within the table are the 1RM results for the participant, whose current squat was recorded at 107.5kg, her bench at 52.5kg, and her deadlift at 135kg, giving a total of 295kg. Whilst these are ultimately the things that the participant is aiming to improve, these were not included in the table as they are not being compared to those within the

cohort (Table 2) due to lack of comparative results. When compared to current champions within this age and weight category, the most recent result shows totals around 500kg.

Table 2 showing results of the rest of the cohort.

Sex (M/F)	Age (Years)	Stature (m)	Body Mass (kg)	BMI	Grip (Kg)	Keiser Chest (w)	Keiser Leg (w)	WAnTAP (W)	WAnTPP(W)	Sit and Reach (CM)
f	20	1.55	55.4	23.1	27.6	93	324	231	407	43
f	20	1.55	60.0	25.0	34.4	122	453	325	502	32
f	26	1.77	72.6	23.2	36.6	129	604.5	404	616	33
f	26	1.65	88.6	32.5	42	160	698.5	433	688	24
f	21	1.65	57.4	21.1	45	129	654	380	513	36
f	21	1.51	53.8	23.6	20.1	121	550	340	458	30
f	23	1.65	97.5	35.8	43.3	155	764	587	757	36
f	38	1.67	61.0	21.9	33	176	647	447	718	36

Also not included in the tables is the participant's Tanita data, as comparable data was unavailable within the cohort. The data collected by the Tanita is shown in Table 3.

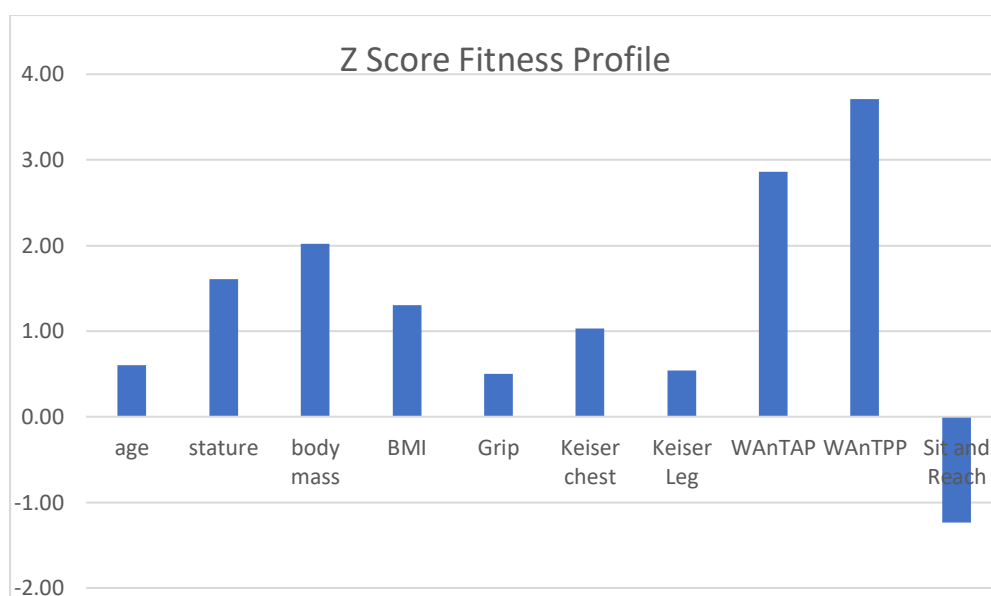
Table 3 showing data collected by Tanita

Measure	Result	Average
Body weight	101.5kg	57.3kg – 77.1kg
Muscle Mass	59.2kg	42.7 – 54.1kg
Fat Mass	39.2kg	16.6kg – 30.5kg
BMI	32.8	18.5 – 24.9

Following the collection of all relevant data, the participant scores were compared to those within the cohort using a Z-score. These were calculated by using the following calculation:

$$Z = (\text{Participant result} - \text{Mean result}) / \text{Standard deviation}$$

Once this calculation was applied to each participant test result, the following graph was generated to show how the participant compared to those within the cohort.



Graph 1 showing Z-scores of the participants scores vs the cohort.

Conclusions

Using Z scoring to more easily view comparable results, it is immediately shown that whilst anaerobic capabilities of the participant far exceed those exhibited by the rest of cohort, and therefore indicates that the participant's ATP-PC cycle efficiency would cope well with the demands of powerlifting (Abe, 2018), values such as the sit-and-reach test result are visibly inferior to the rest of the group, potentially indicating a higher risk of injury in the sport (Bengtsson et al, 2018. Dudagoitia et al, 2021).

In addition to this, whilst the participant's Body mass and BMI are higher than those within the cohort, and within in the general population this body mass would be recommended to reduce (Nuttal, 2015), within the sport of powerlifting the level of fat mass matters little, if only in the deciding of ranking (Keogh, 2009. Ferrari et al, 2022). Using the data generated by the Tanita, it is shown that the participant is surpassing general population levels on all counts. Whilst this is arguably negative in the aspects of fat mass, their level of muscle mass is certainly positive for their chosen sport.

In order to excel in Powerlifting, it is certainly worth adding mobility and flexibility training into this participants regimen. With as many as 50% of lifters experiencing lower back and hamstring injury (Dudagoitia, 2021. van de Hoek, 2022), and the sit-and-reach test focusing on those areas, it is certainly an aspect worth exploring in order to limit injury and ensure training efficiency.

Along with flexibility and mobility movement practices, in order to increase the load the lifter is able to bear it is recommended they follow a programme incorporating progressive overload, whilst following the Specific Adaptations to Imposed Demands (SAID) principle (Austin et al, 2012. Bengtsson et al, 2018). Such a programme should certainly increase myofibrillar muscle growth, whilst adding in flexibility practices would limit the risk of injury during the regimen.

In addition to training in this way, it is recommended that the participant decrease their fat mass. Whilst performing a lift it is of high importance that the muscles and their associated mass be able to cope with performing it correctly, however once the competitor reaches levels where they could arguably win a competition it is potentially their body weight that may scupper their chances at gold (van de Hoek, 2022).

Above all else, in order to excel in Powerlifting the competitor must Powerlift. Progressive overload and flexibility work will help, but if the competitor is not repeatedly performing the Squat, Bench, and Deadlift movements needed to train their motor unit synchronisation and decrease antagonist muscle response, they will be hampering their own abilities, and potentially not reaching their full potential in their chosen sport (Gabriel, 2006. Austin et al, 2012. Ferrari, 2022).

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Appendix

Appendix 1 showing the completed PAR-Q prior to testing.

Physical activity readiness questionnaire (PAR-Q)

Name: Laura Mowlam Age: 28 Gender: F
Contact number: 07875429734 Email: laura.mowlam@gmail.com
Next of kin: Neil Mowlam Contact number: 07876267894

This PAR-Q is designed to help you to help yourself. Many benefits are associated with regular exercise, and completion of the PAR-Q form is a sensible first step to take if you are planning to increase the amount of physical activity in your life.
For most people, physical activity should not pose a problem or hazard.

The PAR-Q has been designed to identify the small number of people for whom physical activity might be inappropriate or for those who should seek medical advice concerning the type of activity most suitable for them. Common sense is your best guide for answering these questions.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor? YES/NO ☒
2. Do you feel pain in your chest when you do physical activity? YES/NO ☒
3. In the past month, have you had chest pain when you were not doing physical activity? YES/NO ☒
4. Do you lose your balance because of dizziness or do you ever lose consciousness? YES/NO ☒
5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in physical activity? YES/NO ☒
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition? YES/NO ☒
7. Do you know of any other reason why you should not do physical activity? YES/NO ☒

If you have answered YES to any of the above questions, then you are required to gain consent from your doctor before participating in the gym-based exercise programme.

If you have answered NO to all of the above questions and you have reasonable assurance of your suitability for:

A gym-based exercise programme – which will include; a warm up, cardiovascular training using equipment, fixed weights, using resistance machines, free weights, using dumbbells and barbells, body weight exercises and cool down stretches.

You are advised to postpone entry into the programme if you feel unwell or have a temporary illness. You must inform your gym instructor of any changes to your health status, whilst engaged in your training programme.

Client signature: [Signature] Date: 23/3/23
Witness signature: [Signature] Date: 23/3/23

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