

## BLOOD LACTATE CONCENTRATION AT SELECTED OF OLYMPIC MODES WEIGHTLIFTING

SUBIR GUPTA\* AND ASIS GOSWAMI\*\*

\*Department of Physiology,  
P.S Medical College,  
Karamsad - 388 325

and

\*\*Sports Authority of India  
Netaji Subhas Western Centre, Sector 15,  
Gandhinagar - 382 016

( Received on February 3, 2000 )

**Abstract :** This study highlights the blood lactate response of weightlifters (N = 5) in two modes of olympic lifts: Snatch (SN) and Clean & Jerk (CJ), during three types of training namely (1) **one repetition lift (ORL)**, (2) **Multiple set session (MSS)** and (3) **one set session (OSS)**. In ORL, 30, 40, 50, and 60 kg, each of one repetition only, were lifted with an interval of 5 min between two consecutive loads. Both MSS and OSS consisted of 6 sets of lift: 50% × 6 (i.e 50% of 1 Repetition Maximum × 6 repetitions), 60% × 5, 70% × 4, 80% × 3, 90% × 2, and 100% × 1. In MSS, 3 to 3.5 min interval was given between two successive sets whereas in OSS the interval was ~24 hours. Lactate levels were very low (<3.5 mM) in ORL. In MSS, lactate reached peak at an intermediate set, but, it was maximum at the first set and then declined gradually in OSS. In **most of the cases, however, lactate were significantly higher in CJ than SN**. The study concludes that : (a) **anaerobic glycolysis is not stimulated considerably when the lifting time is only 4-5 sec**, (b) **repetition of lift plays more important role, than intensity, in lactate production**, (c) CJ is more strenuous than SN for a given %RM.

**Key words :** blood lactate      repetition maximum      one set session  
multiple set session      anaerobic glycolysis

### INTRODUCTION

Blood lactate levels may be the estimates of physical stress and fatigue resulting from

weightlifting (WL) exercise. Typical WL is characterised by high rate of energy use, phosphagen breakdown, and accumulation of glycogenolytic intermediates like lactate.

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\*Corresponding Author

Few studies (1, 2) are available which evaluate the acute physiological responses to competitive weightlifters during heavy resistance exercise utilising very short rest periods. It was opining that acute physiology response in WL depends to some extent on the length of the rest pauses (1). Although studies (1, 2, 3) have been conducted to evaluate cardiovascular and metabolic responses in assisted weight training programmes but investigations on olympic lifts are regrettably scanty.

The present study was aimed to :

- (a) Compare metabolic response in two modes of olympic lift at identical relative loads,
- (b) Show the effects of various intensities of lifts on glycolytic pathway and
- (c) Compare lactate response of olympic lifts during two different training modes.

#### METHODS

Five trained weightlifters (age=25.6 ± 2.6 years, body weight = 71.8 ± 7.6 kg) served as volunteers in this investigation. Two tests, on separate days, were given to evaluate each subjects one repetition maximum (1RM) for each mode of lift: Snatch (SN) and Clean and Jerk (CJ). This score served as a basis for calculating percentage of weight lifted during the exercise sessions. The whole experimental protocol was conducted in three stages in an indoor weightlifting hall.

#### Stage I: One repetition lift (ORL)

Volunteers performed a standardised bout of four different intensities: 30, 40, 50, and 60 kg, each of one repetition only. SN and CJ were performed on two different days, but each more was completed in a day. A five minute interval was given between successive loads. The duration of lift, in all the cases, was maintained fairly unchanged (4-5 sec). Blood samples were collected 2.5 to 3 min following the completion of each lift.

#### Stage II: Multiple set session (MSS)

This was completed on two days. In the first day the lifting type was SN, while CJ was done in another day. In each mode of lift, six sets were done that were composed of various loads and repetitions. An interval of 3 to 3.5 min was given between two subsequent sets. From the beginning the sets were 50% × 6 (i.e. 50% of 1RM × 6 repetitions), 60% × 5, 70% × 4, 80% × 3, 90% × 2 and 100% × 1.

Blood samples were collected within 1 min after the end of warm up (preceding the first set) and between 2.5 to 3 min after the completion of each set.

#### Stage III: One set session (OSS)

In this stage the sets were similar to that of MSS but the volunteers performed on set in a day. Blood samples were collected after warm up (within 1 min), and 2.5 to 3 min after the completion of each set.

Collection of blood samples

Blood samples were collected from capillarised fingertips. Precautions were taken not to dilute blood samples by perspiration or tissue fluids (4). Lactate levels were measured by an automated lactate analyser (1500 Sport, YSL, USA).

Statistical analysis of the data

In order to estimate the differences among the mean values, repeated measures of ANOVA were applied followed by Schaffe's post-hoc analysis. The acceptance level of significance, in all the cases, was set at  $P < 0.05$ .

RESULTS

1-RM of the volunteers, for SN and CJ, were  $81 \pm 5.6$  and  $95.4 \pm 6$  kg respectively.

Stage I

Post-lift blood lactate levels were higher, only marginally, with increased load in both SN and CJ (Table I).

Stage II

The duration of reach set of lift declined with decrease in repetition. Lactate levels increased, in both lifting modes, from the first set, reached highest at an intermediate set and then declined gradually (Table II). CJ shows significantly higher lactate than SN for any given set.

Stage III

In both the lifting modes, the highest lactate level (post-lift) was recorded in the first set ( $50\% \times 6$ ) and decreased gradually in the subsequent sets (Table III). Lactate

TABLE I: Blood lactate levels following various loads of ORL.

Lifting mode	Blood lactate (mM)					
	Rest	Warm up	30 kg	40 kg	50 kg	60 kg
Snatch	1.78±0.37	2.97±0.41	2.42±0.53	2.81±0.33	2.9±0.46	3.3±0.68
Clean and Jerk	1.83±0.3	3.1±0.49	2.39±0.71	2.93±0.45	3.05±0.62	3.19±0.44

(Values are in Mean±SD)

TABLE II: Duration of lift and blood lactate levels following each set of MSS.

Lifting mode		Sets						
		Warm up	50 %×6	60 %×5	70 %×4	80 %×3	90%×2	100%×1
Time (Second)	Snatch		21.16±1.6	19.2±1.3	18±1.7	14.8±1.6	11.4±1.5	6.6±0.8
	Clean & Jerk		33.2±5.3	27.7±3.8	23±1.8	21.4±2.1	13.8±1.6	9.4±1
Blood lactate (mM)	Snatch	5.08±0.98	10.37±1.41	11.35±1.23	13.72±2.59	13.61±3.31	11.23±3.09	9.66±2.52
	Clean & Jerk	4.77±0.12	14.8±1.35	16.5±1.19	18.11±2.34	19.8±2	18.78±3.09	15.17±2.52

(Values are in Mean ± SD)

TABLE III: Blood lactate levels before and after each set of OSS.

Lifting mode		Blood lactate (mM)					
		50%×6	60%×5	70%×4	80%×3	90%×2	100%×1
Snatch	Warm up	6.08±1.04	6.69±1.68	6.73±1.44	7.34±1	7.43±0.85	7.9±0.84
	After lift	10.8±1.59	9.68±0.87	9.41±0.88	9.08±1.12	7.1±1.22	6.56±1.25
Clean & Jerk	Warm up	4.8±0.83	6.06±1.19	6.95±1.13	7.33±0.94	7.73±0.64	8.49±1.72
	After lift	14.29±0.23	12.41±1.38	11.61±1.76	9.36±1.41	8.41±2.05	6.47±0.88

(Values are in Mean±SD)

was higher in CJ than SN for all the sets except at 100% × 1. However, the difference was significant in the first two sets only. Warm up lactate (preceding each set) were higher with increased load. Thus lowest lactate was found before 50% × 6, and highest before 100% × 1. However, the difference was not significant.

#### DISCUSSION

Majority of the WL programmes is based on specific training. It involves repeated lifting at different percentages of 1-RM besides techniques of lift. Normally, they start a general warm up that follows specific warm up with the bar. The weight of the bar is 29 kg. So, before reaching the higher load, they obviously go through the repetitions of lower loads. It is considered that gradual warm up to the 90% level is required for giving a 100% effort. Gradual rise in warming up lactate also suggest that irrespective of the models of lift, more intense warm up is required with increased load so that muscles can achieve favourable conditions.

Lower lactate in ORL suggests that WL exercise, irrespective of its intensity, does not stimulate the anaerobic glycolytic system considerably when the lifting time is only 4–5 sec. The energy source, for such activities, is probably the phosphagen storage. Hakkinen et al (5) suggested that alactic process, i.e. ATP and CP splitting might be sufficient to make a major contribution in the first 15 sec of WL. Intramuscular lactate accumulation may occur as early as 10 sec after the start of maximal exercise, but when the working time is longer, ATP synthesis is also derived from glycolytic process. The neuromuscular factors and the phosphagen component of energy production are expected to become less important during longer work for determining the maximal power produced.

Higher lactate in MSS is probably due to the cumulative activation of the glycolytic pathway or already enhanced kinetics of the anaerobic glycolytic system resulting from earlier sets. In MSS, the interval between two subsequent sets is not adequate to remove lactate. Studies (4, 6) indicate that

lactate reaches its peak level about 2 to 4 min after the end of short bursts of supramaximal exercise. This is because diffusion of lactate from muscle to blood, although oxidation of lactate takes place to some extent in muscles before it comes in systemic circulation (7, 8). Hence, gradual accumulation of lactate takes place, causing higher lactate build up in blood. But at higher workloads, where the number of repetitions are few and lifting time is less, the glycolytic pathway remains active for a shorter period and thus its contribution becomes insignificant.

Lactate levels during MSS were higher than those reported by Collins et al (1989). Many other studies (2, 9, 10) have also shown lower lactate levels than the present study. Kraemer et al (1) shown higher lactate which went to 20 mM. Such differences may have come because of experimental protocol. Higher metabolic response in CJ may happen because of the following reasons:

- (a) the absolute load was higher in CJ due to higher 1-RM,
- (b) longer duration of load holding in CJ and
- (c) technical differences between the two lifting procedures.

No significant difference between SN and CJ at 80, 90, and 100% loads, during OSS, may suggest the existence of a threshold point of weight after which there

is a significant lactate production. In dynamic work, existence of such a threshold point has been established (11, 12). Existing literatures, however, do not describe such a possibility in static work. It could be an enticing work for the future.

- (a) Irrespective of the intensity of lift, anaerobic glycolysis is not stimulated considerably, when the lifting time is short.
- (b) For an identical relative intensity the anaerobic demand is more in CJ than SN.
- (c) The present study has found the possibility of a threshold point of accelerated lactate production. This area needs further detailed investigation.
- (d) A typical weight-training programme for WL is normally based on 70–80% of 1-RM. The presence of higher La level at this load confirms the effectiveness of such conventional training programmes.

#### ACKNOWLEDGEMENTS

The authors are greatly indebted to Mr. S.S Mokha, Weightlifting Coach, SAI, NSNIS, Patiala, for planning training programmes. Thanks are also due to Dr. Manish Bajpai, Asst Prof, P.S. Medical College, Karamsad, for revising the manuscript.

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