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Martins W[1], Fernandes VAR[1,2,3,5], Conte M[1,3,4]

1. SCHOOL OF PHYSICAL EDUCATION OF JUNDIAÍ, *Jundiaí/SP, Brazil*
2. JUNDIAÍ MEDICAL SCHOOL, *Jundiaí/SP – Brazil*
3. STUDY GROUP ON MOTOR SPORTS AND PHYSICAL PERFORMANCE (GEMPEF / ESEF), *Jundiaí/SP – Brazil*
4. CONTE FIT SPORTS SCIENCE
5. UNIVERSITY CENTER N. SRA. DO PATROCÍNIO, *Itu/SP – Brazil*

Changes in Lactacidemia and Glycemia of Automobilism Race Car Drivers after Old Stock Race Category Racing

Änderungen von Laktazidämie und Glykämie der Auto-Piloten nach dem Rennen der Rennkategorie

Summary

- **Introduction:** Few studies are available on the acute effects of motor racing on race driver´s lactacidemia and blood glucose. Objective: To verify changes in lactacidemia and glycemia of race car drivers in the Old Stock Race category.
- **Method:** The concentrations of plasma lactate and glycemia of eight male race car drivers in the Old Stock Race category (OSR) were recorded thirty minutes before the start and ten minutes after the start of the race. The data were obtained during the 4th round of the 2018 Season of the OSR held at the José Carlos Pace race track (Interlagos / São Paulo-Brazil). For comparison between moments, paired Student's t-test paired on variables with normal distribution was used, with Bonferroni's post-test, adopting a 5% significance level, for all analyses. Descriptively the data were compared using the Percentage Delta and presented in graphical and tabular form.
- **Results:** It was found that the lactate concentration increased significantly after the race (2.26 + 0.76 vs. 3.56 + 0.97 mmol / L, p = 0.0101). On the other hand, there was no change in blood glucose (122 +15.3 vs. 123 + 19.8 mg / dl, p = 0.8828).
- **Conclusion:** The significant increase in lactacidemia after the race indicates that there was an anaerobic muscle requirement during the race. On the other hand, there was no change in the mean blood glucose after the race.

KEY WORDS:
Motor Racing, Human Performance, Exercise, Experimental Research

Zusammenfassung

- **Einleitung:** Zu den akuten Auswirkungen des Motorsports auf die Laktazidämie und den Blutzucker der Fahrer liegen nur wenige Studien vor.
- **Ziel:** Feststellung eventueller Veränderungen von Laktazidämie und Glykämie bei Old Stock Car Race Fahrern.
- **Methode:** Die Konzentrationen von Plasma-Laktat und Glukose von acht männlichen Fahrern wurden 30 Minuten vor dem Start und zehn Minuten nach dem Start des Rennens der 4. Etappe der OSR-Saison 2018 auf der Rennstrecke von Interlagos (São Paulo) gemessen. Die normal verteilten Variablen wurden mittels des gepaarten t-Tests verglichen (p = 5%; Bonferroni-Post-Test). Die Daten wurden per Percentage Delta verglichen und in grafischer und tabellarischer Form dargestellt.
- **Ergebnisse:** Die Laktatkonzentration nach dem Rennen war signifikant höher (2,26 + 0,76 gegenüber 3,56 + 0,97 mmol/l, p = 0,0101), wohingegen der Blutzucker konstant blieb (122 + 15,3 gegenüber 123 + 19,8 mg / dl, p = 0,8828).
- **Schlussfolgerung:** Der signifikante Anstieg der Laktazidämie nach dem Rennen weist auf eine Muskelbelastung während des Rennens hin. Der mittlere Blutzuckerswert blieb unverändert.

SCHLÜSSELWÖRTER:
Motorsport, menschliche Leistung, Bewegung, experimentelle Forschung

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CORRESPONDING ADDRESS:
R. Rodrigo Soares de Oliveira, Anhangabaú, Jundiaí, SP. Postal Code: 13208-120 Jundiaí/SP, Brazil
: marcelo.conte@esef.br

Introduction

Motor racing is one of the most popular sports in the world, in which it requires great physical and mental performance from the race drivers. However, the physiological changes of race drivers during and after races are little explored (14).

According to Potkanowicz & Mendel (19), the racing driver (athlete) is exposed to extreme conditions, with high physical and mental demands, such as high speed and multitasking nature of driving the racing car (acceleration, braking, changes driving, attention to mirrors, gear shifting), prolonged and continuous periods of maximum performance, persistent thermal stress, repetitive exposure to G-Force, physiological, psychological and emotional stress in addition to the constant risk of accidents, serious injuries, and death.

According to Durand et al. (10) in motorsports, due to the physical restrictions of access to the driver during races, associated with the use of safety equipment, very little is known about biological adaptations during competitions and training. However, Ebben and Suchomel (11) claim that in recent decades, racing drivers have recognized the importance of physical training, and recent studies have shown that some skills and physical requirements of racing drivers, such as maximum oxygen consumption (VO_2max) and ventilatory volumes are similar to those of athletes in other sports, such as boxing, basketball, football and medium distance running.

It is recognized that motor racing drivers are subject to high risk in sport, in this sense, Mansfield and Marshal (16) determine that the specific

vibrations of the racing car, cause injuries from overuse and result in musculoskeletal disorders. Backman et al. (2) affirm that it is common for racing drivers to suffer musculoskeletal injuries, caused by vibrations and / or shocks from the car, however with the training of musculoskeletal resistance these injuries can be minimized.

Currently, it is considered very important to work on the physical capacity of racing drivers for performance in driving cars. Some authors consider that racing drivers are extremely physically fit athletes, and have excellent physical and mental fitness (15). However, Ebben and Suchomel (11) affirm that a wide analysis of the needs of each athlete is necessary to develop strength and physical conditioning programs and that to develop specific training, the specific demands of each category must be considered, such for example, predominant energy system, biomechanics of movement, the most frequent injuries, and finally the training levels of each athlete. In this sense, it is justified to know the physiological responses of motor racing drivers, specifically from specific categories, aiming to establish appropriate physical training strategies for preparing for the races thus, lactacidemia and blood glucose are markers of the intensity of exercise widely used to monitor physiological responses in different sports (19, 20).

In this sense, the objective of this study was to verify the changes in lactacidemia and glycemia of race car drivers in the Old Stock Race category.

Material and Method

Sample Characteristics

Eight professional racing car drivers in the Old Stock Race (OSR) category, affiliated to the São Paulo Federation of Motorsport, were followed. The sample was constituted by the accessibility criterion. The starting grid of the respective race was composed of 18 drivers, our sample was 8 drivers. In this sense, adopting a 95% confidence level, we obtain a 26.57% confidence interval for the sample of this study. However, it is worth noting that traditionally accessibility to pilots during races to obtain physiological data is difficult since all team members and even the race driver are extremely concentrated with the preparation for the start and/or analysis of the results of the race right after the end of the race.

Inclusion Criteria

Motor racing drivers from the São Paulo Motoring Federation; Old Stock category; male; age over 18 years; signing the Free and Informed Consent Form (ICF).

Exclusion Criteria

Race car drivers with any type of injury; who reported having practiced physical exercise the day before in addition to drive; who have consumed medication; Diabetics and do not accept to participate in the research.

Ethical Aspects

The research project was submitted approved (protocol number: 2, 848, 416) by the Research Ethics Committee Escola Superior de Educação Fisica de Jundiaí and all the volunteer of the study agreed and signed the Informed Consent Form. The study strictly followed the protocols of the Declaration of Helsinki, preserving at all times the physical, mental, psychological, and spiritual health of the participants.

Experimental Procedures

Plasma lactate and glycemia were obtained by collecting blood from the digital pulp, using disposable lancets (Accu-Chek Softclix® Pro), applying a drop of blood over a specific area of the reactive strip BM-lactate and another on the Accu reactive strip-Chek, and the samples respectively measured on the Accutrend® Lactate Lactimeter and the Accu-Chek® Pro meter. Both procedures were performed in two moments, that is, thirty minutes before the start and ten minutes after the arrival of the 4th round of the Old Stock Race held at the Autódromo José Carlos Pace (Interlagos, São Paulo, Brazil), with a length of 4,309 meters, on June 16, 2018. The race that lasted 30 minutes, where the drivers traveled approximately a total of 65 km at an average speed of around 130 km/h. The race was held at 9 pm, with an ambient temperature around 17oC, the car used by the drivers in the race was the Opala Old Stock Race model, with a power of 300 hp.

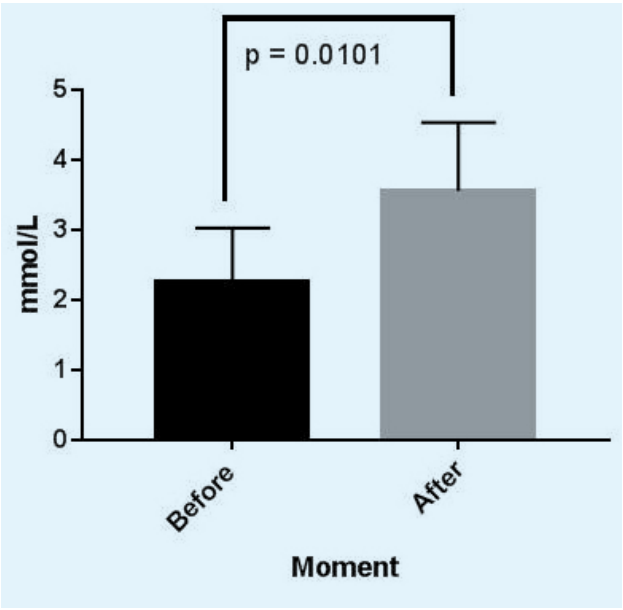

Figure 1

Comparison of lactate levels before and after of race.

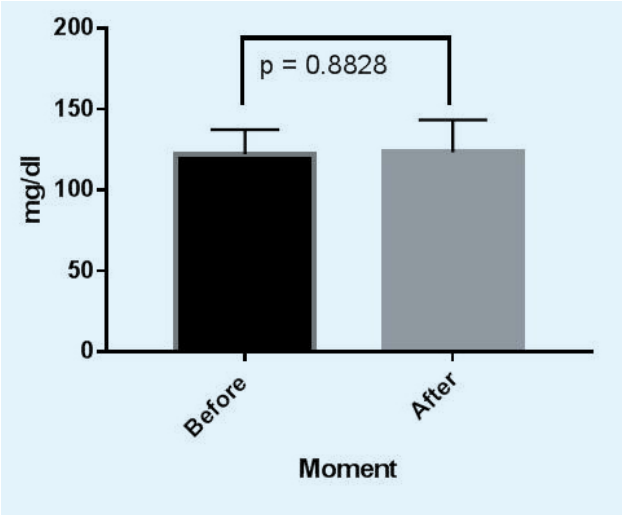

Figure 2

Comparison of glycemia levels before and after of race.

Data Analysis

For comparison between moments, Student's t-test paired on variables with normal distribution was used, with Bonferroni's post-test, adopting a 5% significance level, ›

Table 1

Race driver's age and anthropometric characteristics.

LACTATE AND BLOOD GLUCOSE CONCENTRATIONS	
AGE (YEARS)	39.4+5
BODY MASS (KG)	78+8.4
HEIGHT (CM)	172+8

Table 2

Mean and standard deviation of lactate and blood glucose concentrations.

	BLOOD LEVELS	
MOMENT	LACTATE (MMOL/L)	GLYCEMIA (MG/DL)
Before Race	2.26+0.76	122+15.3
After Race	3.56+0.97	123+19.8
Percent Delta	57.52%	0.81%
p value	0.0101	0.8828

for all analyzes. Descriptively the data were and compared through the Percent Delta and presented in graphical and tabular form.

Results

After the period of data collection, analysis, and statistical treatment, their planning was prepared for better visualization. Table 1 shows the characteristics of the sample of eight race car drivers. Table 2 and graphs 1 and 2 show the comparisons of lactacidemia and glycemia, before and after the OSR race. In this sense, it is observed that the lactate concentration of the riders before the race (2.26 + 0.76 mmol/l) was above the value considered normal for baseline conditions between 0.3 to 1.3 mmol/l.

However, at the end of the race, the verified average was 3.56 + 0.97 mmol/L slightly lower than 4 mmol/l, traditionally considered as a reference for the OBLA (3, 13).

On the other hand, blood glucose both before (122 +15.3 mg/dl) and after (123 + 19.8 mg/dl) the run was shown to be under normal casual blood glucose values up to 140 mg/dl (17).

Discussion

Regarding lactacidemia, there was a descriptive increase of 57.52%, which was similar to those observed in the case study, carried out by Gobatto et al. (13) with a driver of the Formula Corsa category at the same Interlagos Circuit. These authors found a 53.84% increase in plasma lactate concentrations. On the other hand, Del Rosso et al. (8) registered an increase of 395% in Rally racing drivers, this great difference between the delta of this study can be explained by the expressive difference between the events in categories such as Rally and Tourism (as is the case OSR and Formula Corsa) such as, for example, type of surface and the layout of the track where the race is held, duration of the race, power and characteristics of the race cars, differences between the technical level and the physical fitness of the race car drivers, among others aspects.

However, there is an agreement in the literature that there is a significant increase in the plasma lactate concentration of the drivers after the races. In this sense, the average of the absolute values of lactacidemia of the ORS racing drivers (3. 56 + 0.97 mmol/l) was similar to that found by Barthel et al. (4) in North American amateur race drivers (3.3 ± 1, 7 mmol / l). Schwaberger (20) observed that lactate concentration went from 1.6 mmol/l before to 3.3 mmol/l after the race. Both Sperlich et al. (21) and Conte (7) also observed a significant increase in lactacidemia after kart racing and Rally respectively, as well as agreeing Schwaberger (20) that lactate is an important metabolic marker of physical stress.

The study by Ohkuwa et al. (4) shows that during an extreme exercise, the individual's temperature causes changes in the lactate concentration, the higher the heat, the greater the use of muscle glycogen, increasing the lactate levels, this may be one of the reasons the increase in lactacidemia in the drivers after the race, as the racing driver's clothing and the internal car heat, associated with the physical effort of the driver can raise the body temperature of the drivers. Carlson et al. (6) found a significant increase in body temperature in North American Stock-Car race drivers, that is, before the race the core intestinal temperature was 38.1 ± 0.1 °C, increasing to 38.6 ± 0.2 °C after the race (p = 0.001). The skin temperature increased from 36.1 ± 0.2 °C to 37.3 ± 0.3 °C (p = 0.001), while the gradient between core intestinal temperature vs. that of the skin decreased from 2.0 ± 0.3 °C to 1.3 ± 0.3 °C after running (p=0.005). In addition to body temperature, the increase in race car drivers lactacidemia is related to high emotional stress, as well as the dynamic and static muscle requirements for driving (7).

It is important to note that we were unable to perform a feeding control before the race. The recorded mean of blood glucose both before and after the race remained very similar. In a study by Burr (5), it was found that glycemic values did not obtain significant differences after a race in both all terrein vehicle and off-road motorcyclists. Del Rosso et al. (8) also did not observe changes in blood glucose in Rally drivers after the end of the race. On the other hand, an activity with high intensity and a volume of 50 minutes can promote an increase in blood glucose levels (1). It is possible that the racing time, just 30 minutes, was not enough to promote a significant increase in blood glucose (9).

Practical Applications

The increase in lactacidemia corroborates, as in other motoring categories, that the muscular demand in the OSR category is significant, suggesting that the characteristics of cars in this category, such as gear shifts by a manual transmission, constant activation of brakes and clutches, maintenance body posture in the seat, the temperature inside the car, CO inhalation and car vibrations can cumulatively cause a lot of muscle strain. The average values of lactacidemia found in this study can contribute towards providing parameters that must be considered during physical training off the track and in the monitoring of other drivers of the category during the races. On the other hand, recovery strategies should be considered between free and qualifying exercises that are performed the day before and a few hours before the races and that can influence the baseline levels of lactate concentrations. In general, we can consider that high levels of lactate can interfere with driving, leading to early muscle fatigue and less efficiency in the motor actions necessary to practice the sport.

Conclusion

The significant increase in lactacidemia after the race indicates that there was an muscle requirement during the race, the concentrations observed were similar to the findings in studies with race drivers of North American categories. On the other hand, there was no change in the mean blood glucose after the race. However, there is a need to research with the monitoring of the respective variables involving a greater number of race car drivers and different categories for the establishment of specific strategies for the physical training of race car of the modality.

Study Limitations

Classificatory training and free training performed during the day of the competition, as well as training on the track, performed the day before data collection, may have contributed to the observation of baseline lactacidemia values (2.26 mmol/l), relatively high before the race. On the other hand, it was not possible to evaluate and know the IAT of the race drivers, for a possible comparison of the lactate concentration obtained at the anaerobic threshold with the lactacidemia after the race. Although, due to the specificity of the IAT test on a treadmill or cycle ergometer and the muscular actions that occur during driving, we consider that the respective lactacidemia values may not be optimal parameters for comparison.

Conflict of Interest

The authors have no conflict of interest.

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