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Research Article

Covid-19 Lockdown Effects on Body Mass and Fat in French Elite Athletes

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Abstract

Objectives: Quantifying the change in body mass and fat of elite French athletes during the Covid-19 lockdown according to gender, training load, injuries and diet and mass management. **Methods:** Prior returning to training after the Covid-19 lockdown, 122 elite athletes (23.3 ± 5.2 years old; 43% women), from 17 different sports and training at the National Institute of Sport, Expertise, and Performance (INSEP) undergo a medical consultation, anthropometric assessment, and fill out a questionnaire. Body mass and fat data were analyzed and compared to pre-lockdown values. The influence of gender, training load, injuries, and dietary management on these two parameters was investigated. Paired t-tests for variables following a normal distribution and paired Wilcoxon tests in other cases were used. **Results**: Considering all athletes, body mass and fat significantly increased from 71.23 ± 13.75 kg to 72.03 ± 14.50 kg ($p<0.01$) and from 15 ± 6.3% to 15.9 ± 6.4% $p<0.01$) respectively. A decrease in training load and the absence of injuries during the lockdown were significant factors in the increase of body mass and fat mass. However, gender and self-reported difficulties with body mass and/or dietary management only significantly impacted body mass gain. **Conclusion:** Gender, training load management, occurrence of injury and difficulties in managing diet are all factors that influenced body mass and fat of elite athletes. The lockdown is just an example of prolonged training cessation in elite athletes. Our observations suggest the importance of nutritional education, adaptation of training load, and guidance from professionals during these periods.

Keywords: Elite athletes; Body composition; Lockdown; Physical inactivity; Detraining

Introduction

Due to the Covid-19 lockdown, athletes were away from their usual training facilities, with no access to sports structures or sometimes even outdoor physical and sports activities [1,2]. To cope with this unprecedented scenario during the sports season, coaches and sports scientists provided training recommendations to minimize the negative effects of lockdown on physical performance [2,3]. Indeed, such a period of detraining may affect the adaptations associated with sustained training [4], and for example generate mis adaptation [5] and performance decreases [6].

Moreover, the effects of isolation on the anthropometric data of elite athletes have been studied worldwide across different sports and age groups [7-9]. Detrimental lifestyle changes have been observed such as poor nutrition and sleep quality as well as physiological side effects related to isolation: increased body fat, decreased lean mass, immune system disturbances, etc. [3].

In elite athletes, the influence of both gender and the type of sport practiced has been shown to affect parameters such as body mass and fat [10]. Sports can be categorized based on their demand in terms of strength or endurance [10,11]. Alternatively, they can be analyzed in terms of training load, which includes factors such as the number of hours or days spent training [12]. In addition to this variation in training load or the physical demands, the number, type and severity of injuries also varies from sport to sport [13]. Regarding injuries based on gender and sport, men and women are not exposed to the same risks. For example, during the 2016 Olympic Summer Games, women had a higher risk of injury than men in sailing and mountain bike cycling [13].

Injuries may also be due to an inappropriate management of body mass and fat. These parameters and, more generally, body composition, will differ from one sport to another, partly due to specificities related to weight categories and/or emphasis on physical appearance in certain sports [14,15]. It is well-established that athletes commonly experience extreme dieting behaviors and eating problems, including eating disorders and concerns related to perceived body image [16-19]. Indeed, in some sports that emphasize leanness, where weight cycling is common and body mass or body fat reduction are synonymous with performance, the pursuit of weight loss or dieting pressure can lead to eating disorders [20]. Additionally, injury can result in unwanted weight gain and increase the risk of eating disorders. Moreover, the prevalence of disordered eating and eating disorders is higher in female athletes (6-45%) than in male athletes (0-19%) [20].

Managing body composition in elite athletes is crucial and can be affected by factors such as injury status or the management of diet and weight. The period of isolation disrupted the usual environment for managing body composition and its influencing factors.

The purpose of this study was to quantify the change in body mass and fat of elite French athletes during the Covid-19 lockdown according to gender, training load, injuries and diet and mass managing.

The primary hypothesis was that major modifications occurring in this context, particularly regarding training load and nutrition, could lead to an increase in weight and/or fat mass. We also aimed to investigate whether these modifications varied depending on age, gender, and sports discipline.

Methods

Ethics

This study was conducted by the sports medicine department of the National Institute of Sport, Expertise, and Performance (INSEP) in Paris, France. Data collection complied with the General Data Protection Regulation of the European Union. A study declaration was submitted and approved by the Commission Nationale de l'Informatique et des Libertés (CNIL) with the following registration number: 2229646.

Participants

The data were collected from 122 elite athletes (52 females and 70 males) practicing 17 different sports (judo, boxing, wrestling, taekwondo, gymnastics, athletics, fencing, swimming, archery, canoeing, modern pentathlon, table tennis, badminton, water polo, baseball, shooting and football) and training at INSEP during the 2019/2020 season. The study included both adult and minor athletes who accepted to participate in the post-lockdown medical assessment and fully completed the questionnaire. Athletes without the same anthropometric measurements from the pre-COVID period of the same season were excluded.

The mean age for women and men was 22.2 ± 5 years and 24.1 ± 5.2 years, respectively.

Data Collection

During the lockdown lifting and before athletes could return to training, they had to undergo a medical check-up, including the completion of a self-questionnaire and an anthropometric assessment.

The questionnaire addressed training load as well as injury status, both pre-lockdown and during the lockdown, in the following manner:

- The usual number of training hours per week before the lockdown, with the expected response being a number of physical training hours and a number of sport-specific training hours (sport practice). Regarding the training load during the lockdown, participants were additionally asked whether the number of hours spent on cardiovascular training, strength training (both combined under "physical training" for the analysis), and sport-specific training was higher, equal to, or lower than before the lockdown.
- Were you injured before the lockdown (if yes, please specify)?
- Did you report an injury or illness (excluding Covid) during the lockdown?

A specific question was also asked to determine whether the athlete had experienced difficulties managing their diet and weight.

The remainder of the questionnaire explored the current health status during the lockdown, including possible Covid-19 symptoms or infection, as well as the occurrence of sleep disorders and/or psychological issues in the athlete, but these aspects will not be developed in this article

The anthropometric assessment included measuring body mass on an electronic scale (seca 899, seca gmbh & co. kg, Hamburg, Germany), as well as an estimating percentage of body fat using the reference method of 4 skinfold measurements (biceps, triceps, sub-iliac, subscapular) with the Harpenden caliper (Holtain Ltd, Bryberian, Crymmych, Pembrokeshire, UK), according to the Durnin and Womersley equation [21]. These anthropometric data were compared to those obtained before the lockdown during the regular medical monitoring assessments of the same sports season and using the same methods. The medical consultation included an interview with the physician, partly based on the information from the self-questionnaire, and a physical examination tailored to any complaints from the athlete.

Statistical Analysis

The Shapiro-Wilk test was applied to check the normality of the data. Descriptive statistics expressed as mean ± standard deviation (SD) was used to indicate the percentages of weight and body fat before and after the lockdown. Paired t-tests for variables following a normal distribution and paired Wilcoxon tests in other cases were used to compare weight and body fat before and after the lockdown, based on gender, sport, problems with managing diet and weight, injury status (injured or not), and changes in training load during the lockdown compared to baseline values. The significance level was set at $p=0.05$ and $p<0.01$. All statistical analyses were performed using R (version 4.1.3, The R Foundation for Statistical Computing, Vienna, Austria).

Equity, diversity and inclusion statement

The research team included two women and four men, consisting of junior, mid-career and senior researchers and clinicians. All athletes were welcome to participate regardless their gender, ethnicity and socioeconomic backgrounds.

Results

Weight and body fat

During lockdown, athletes body mass increased significantly from 71.23 ± 13.75 kg to 72.03 ± 14.50 kg ($p=0.002$) (Figure 1A). The results varied according to sport: in judo and boxing, weight increased significantly from 76.4 ± 18.8 kg and 73.6 ± 18.7 kg respectively to 77.6 ± 19.3 kg and 77.74 ± 20.35 kg (Figure 1A), with p values of $p=0.017$ and $p=0.012$.

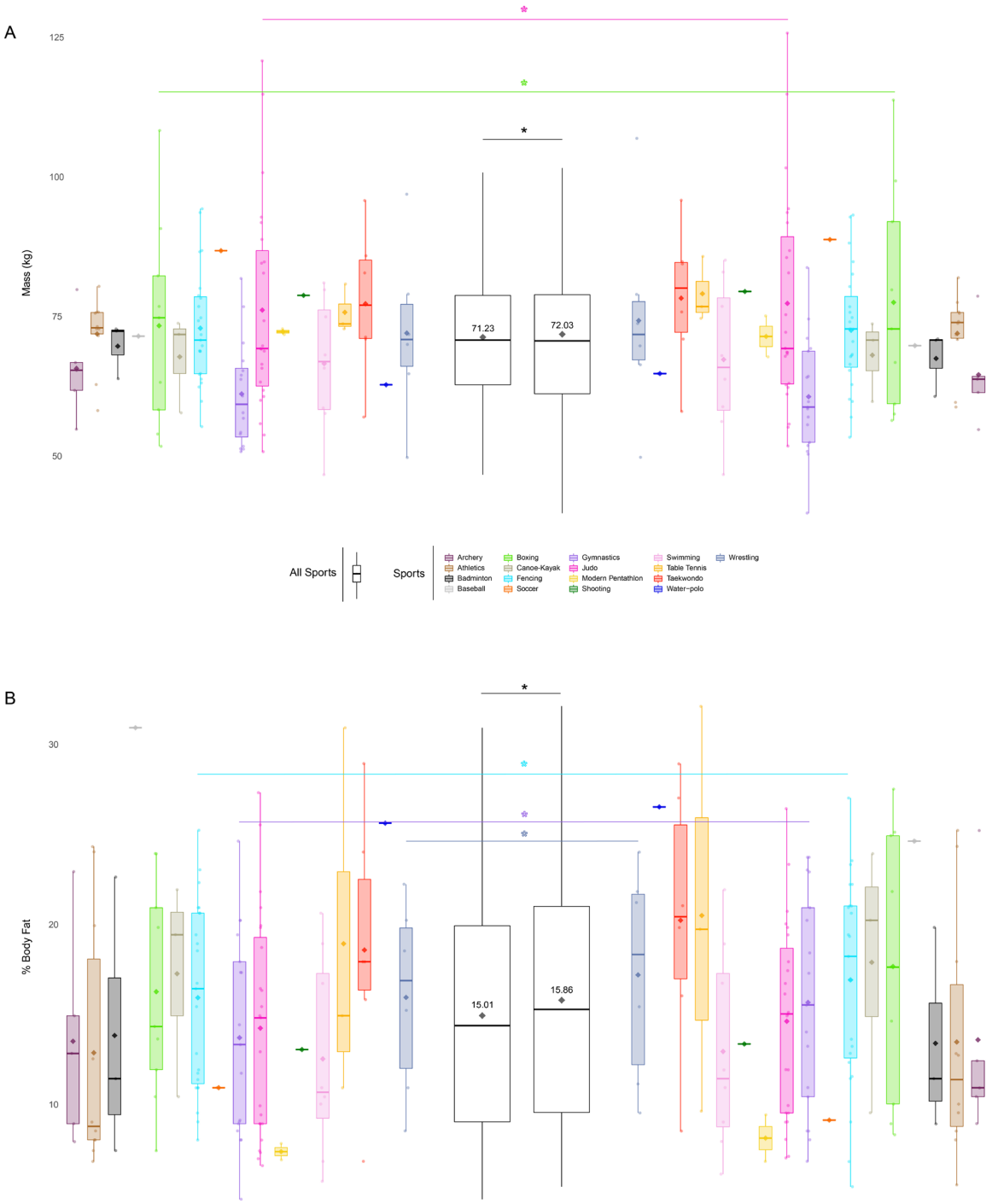

Figure 1A: Variations in body mass (kg) among elite athletes between before and after lockdown, according to sport.

Figure 1B: Variations in body fat (%) among elite athletes between before and after lockdown, according to sport.

Over the same period, the percentage of body fat increased significantly from 15 ± 6.3% to 15.9 ± 6.4% (p<0.001) (Figure 1B). The results varied according to sporting discipline: in wrestling, gymnastics and fencing, the percentages of body fat increased significantly, from 16 ± 5.39% to 17.3 ± 6.1% (p=0.036), 13.8 ± 5.7 to 15.7 ± 6.1% (p=0.032) and 16 ± 5.2% to 17 ± 5.8% (p=0.027) respectively (Figure 1B).

Variations by gender

During lockdown, weight gain was significant only in male athletes, increasing from 77.6 ± 12.9 kg to 78.8 ± 13.9 kg (p=0.002) (Figure 2). In contrast, over the same period, the percentage of body fat increased significantly in both men and women, from 10.7 ± 3.5% and 20.7 ± 4.3% to 11.6 ± 4.1% and 21.6 ± 4%, respectively, with p values of p<0.001 and p=0.032 (Figure 2).

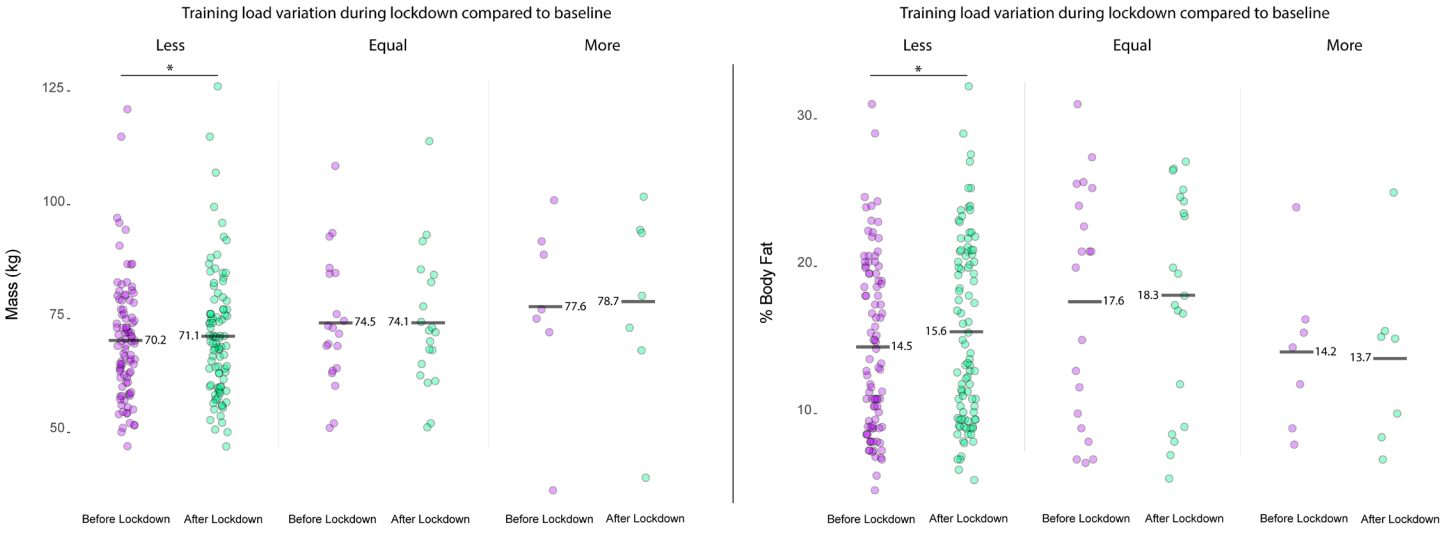

Figure 2: Changes in weight (kg) and body fat (%) among elite athletes before and after lockdown, according to gender.

Influence of training load

Athletes who reduced their training load during lockdown compared with their pre-lockdown load experienced a significant increase in body mass, from 70.2 ± 13 kg to 71.1 ± 13.8 kg (p=0.002) (Figure 3). Their body fat percentage also increased, from 14.5 ± 5.9% to 15.6 ± 6.2% (p<0.001) (Figure 3). On the other hand, the weight and fat mass of elite athletes who were able to maintain or increase their training volume during lockdown did not vary significantly (p=NS).

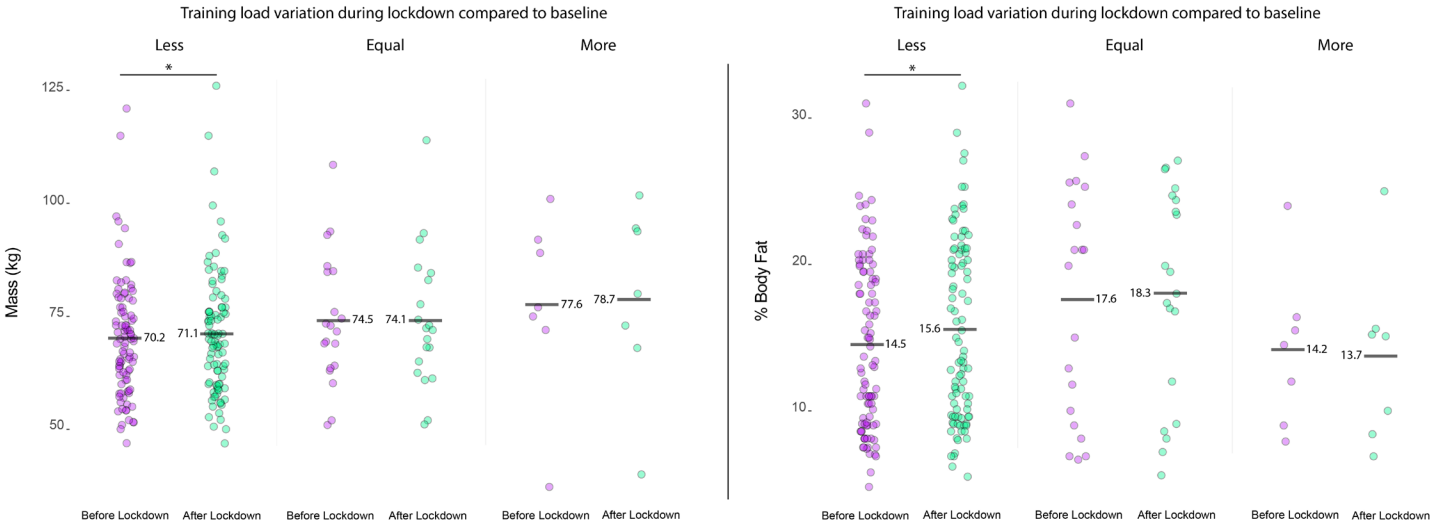

Figure 3: Changes in weight (kg) and body fat (%) among elite athletes between before and after lockdown, according to changes in training load during lockdown.

Influence of injuries

In non-injured athletes prior to lockdown, a significant increase in weight was measured, rising from 70.7 ± 14.4 kg to 71.4 ± 14.8 kg (p=0.01) (Figure 4). Their body fat percentage also increased significantly, from 14.8 ± 6.6% to 15.8 ± 6.6% (p<0.001) (Figure 4). For athletes who were already injured prior to lockdown, no significant change in weight or body fat was observed (p=NS).

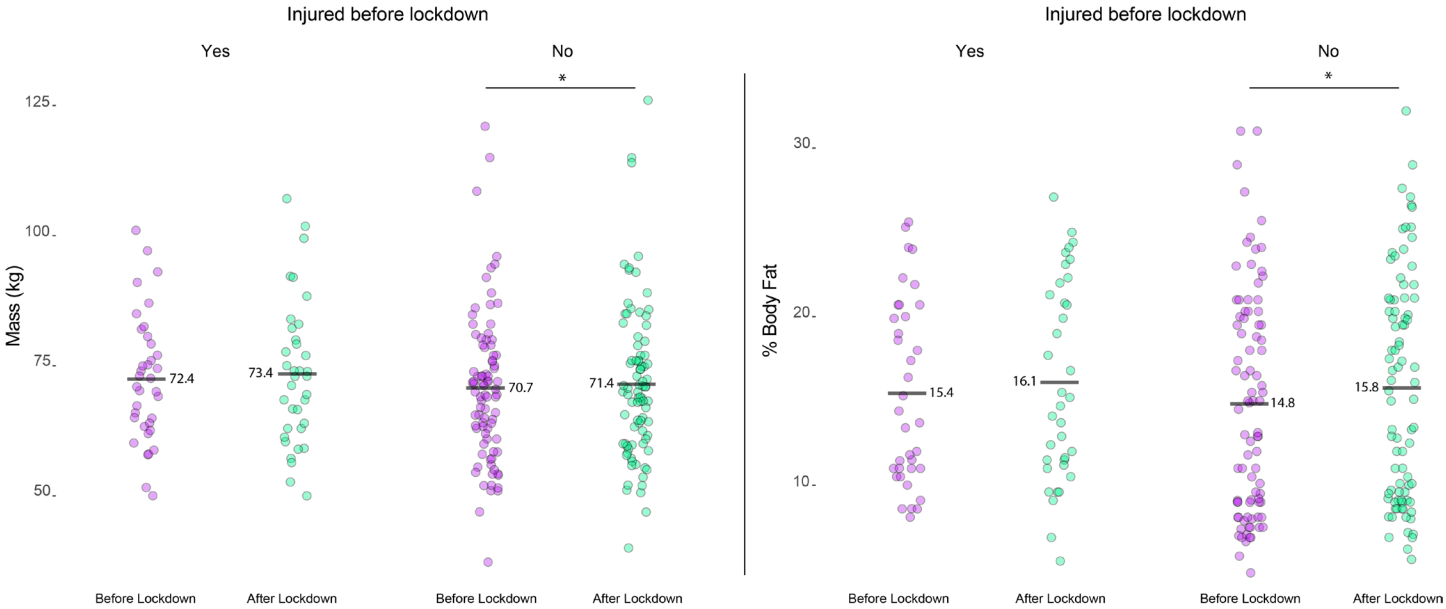

Figure 4: Changes in weight (kg) and body fat (%) among elite athletes between before and after lockdown, according to their injury status before lockdown.

Influence of difficulties in managing food and weight

Athletes who reported difficulties in managing their diet and/or weight during lockdown increase significantly their body mass from 70.4 ± 15.8 kg to 71.8 ± 16.6 kg (p=0.005) (Figure 5). Over the same period, there was also a significant increase in body fat in all the athletes, whether or not they reported these difficulties. Those who reported such difficulties increased their body fat from 16.12 ± 5.66% to 17.61 ± 5.56%, while those who did not report such difficulties increased their body fat from 14.54 ± 6.62% to 15.07 ± 6.67%, with respective p-values of p=0.009 and p=0.003 (Figure 5).

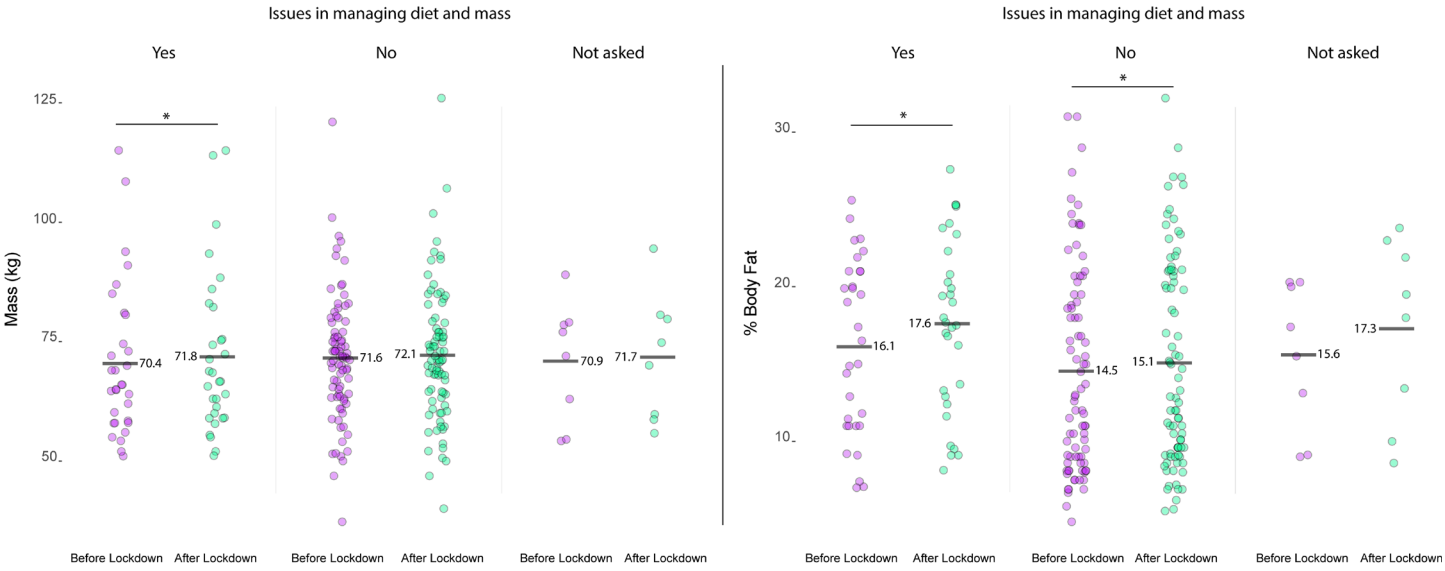

Figure 5: Changes in weight (kg) and body fat (%) among elite athletes between before and after lockdown, according to the difficulties reported in managing their diet and/or weight during lockdown.

Discussion

Weight and body fat Overall, we observed a significant increase in weight and body fat among athletes during the lockdown.

The consequences of online training on body composition have been explored in 51 young basketball players [8]. Authors found a significant body mass gain in all three age groups (U14, U16, and U18) and a significant increase in body mass index (BMI) among the U14 and U18 groups. A study on 201 endurance athletes (cyclists, runners, triathletes) showed significant weight and BMI gains across all three groups [9].

In the present study, there was no significant increase in body mass and body fat among endurance athletes (athletics, modern pentathlon), possibly due to a small sample size. Same results were observed regarding team sports (soccer, water polo). Similarly, a stable body fat percentage was found among 29 first-division footballers [7], as well as no significant change in body mass and body fat among 10 elite futsal players [2]. It seems that changes in body composition are related to the type of sport. In fact, athletes had more difficulty maintaining these anthropometric parameters in weight-category sports such as judo, wrestling, and boxing, where body mass and fat fluctuations are common [14,22,23].

Influence of gender

According to gender, weight gain was significant only for men, while an increase in body fat was observed in both sexes. Some of these results differ from another study on body composition changes in 77 college athletes (43 male). Body fat had significantly decreased in men, while it had significantly increased in women. There were no statistical changes in BMI or muscle mass regardless of gender [24].

A study on 43 elite fencing athletes (22 male) highlighted an increase in body fat mass among women but not among men, with no weight gain observed in either group [25]. However, the three studies highlighted a significant increase in body fat among women during this period of reduced activity. A possible explanation for these discordant results across the three studies among men, could be that other factors, such as the type of sport, play a more significant role. In relation to the type of sport, the variability in training load and access to appropriate facilities or

training programs could also explain these differences.

Influence of training load

In this study, athletes with less training load during the lockdown compared to their pre-lockdown training load, across all disciplines, increased significantly their weight and body fat. This trend was also observed on 23 male professional footballers after the 63 days without training imposed by the Covid-19 lockdown [26]. The results were compared to data obtained upon returning to training after the annual 24-day break preceding the pandemic. Body mass and body fat were significantly higher after the lockdown-related break where training load decrease [26].

Variations in training load may also be related to the injury profile of athletes. A study on the variations in body composition between injured and non-injured professional soccer players highlighted an average of 15.6 days of absence (training or match) per injury [27]. Additionally, they observed a greater variability in body composition among injured athletes compared to non-injured athletes [27].

Influence of Injuries

Regarding injury status, this study did not highlight any changes in body mass and body fat, either in athletes who were injured before the lockdown or in those who reported an injury or illness during the lockdown. However, in athletes without an injury before the lockdown, a significant increase in weight and body fat was measured. We hypothesize that the lack of change in body composition among athletes who were injured before the lockdown is related to their reduced training load. Thus, being already deconditioned, the lockdown and the reduction in physical activity had a lesser effect on their body mass and fat. In fact, it has been generally observed, outside of any lockdown context, that an injury affecting a limb not only results in a decrease in muscle mass of that limb but also a local fat mass deposit [28]. Deficiencies in muscle function, as well as an increase in body fat, have been documented from 5 days to 3 weeks following reduced muscle demand [29]. In cases of injury requiring prolonged rest from sports activity, such as in the post-operative period, a loss of overall muscle mass has been observed by the 8th week of rehabilitation [30]. In these situations of prolonged rest from sports activity, the challenge is to find adequate nutritional intake to maintain sufficient muscle mass and body fat in line with the sporting discipline, to ensure good recovery of performance and a rapid return to training [31]. From this perspective, this 8-week lockdown period, similar to a post-surgical rest period, may have compromised the nutritional status of the athletes.

Influence of difficulties in managing diet

This study highlights that athletes with difficulties in managing their diet and/or weight during lockdown showed a significant increase in body mass unlike those who did not experiencing these difficulties. Indeed, it has been observed that the fatigue or stress experienced by athletes during the lockdown may have altered their eating habits, sometimes leading to overeating and snacking, particularly on high-sugar, high-fat, and ultra-processed foods [32]. However, some study observed the maintenance of good eating habits with appropriate adjustments to their diet during the lockdown period [33]. This implies that athletes are educated about nutrition and supported by dietitians. They should be encouraged to eat healthily to optimize their health status and to adjust their meals according to their needs, with possible calorie restrictions. The beneficial effects of a training "bubble" camp were also observed: improvement in eating habits, training routines, and relaxation sessions reduced the stress experienced by athletes during the lockdown [34].

A limitation of the present study is that not all athletes received the same training recommendations during COVID. Although this is mitigated by the question on variations in training load, it may amplify the "sport-dependent" effect found as a factor influencing body composition. The pre/post-lockdown measurement of muscle mass was not conducted, but this parameter must also be considered in managing periods of reduced physical activity or immobilization, to maintain muscle mass without an increase in body fat [31]. In addition to the nutritional aspects previously mentioned, adjusting training load should be implemented during these periods, with tools that have even proven effective in limiting muscle loss and strength in an immobilized limb [35].

Conclusion

This study highlighted the impact of 57 days of lockdown on the body mass and body fat of a large number of elite French athletes competing in 17 different disciplines. Gender, training load, injury status and diet and weight management were all factors that influenced the body composition of these athletes.

The study highlights body mass gain with variations by sport and gender, where only men experienced significant increases in weight. Body fat increase was also influenced by the sport, but both men and women experienced significant gains. Additionally, a reduction in training load, as well as difficulties in managing diet or weight, are factors that contribute to greater body mass and body fat gain. Finally, those who were already injured before the lockdown did not show significant changes in body composition. These observations suggest that during periods of prolonged training reduction or cessation, such as experienced during the lockdown, an adapted approach to training load, nutrition, and injury status is necessary, as highlighted in the literature [27]. Additionally, the importance of factors such as gender, type of

sport, and difficulties in managing diet or weight should also be considered.

Competing Interests

None declared.

Contributors

SNG: concept/design, data collection, data analysis, manuscript draft, critical revision and guarantor. MDC: concept/design, data analysis, critical revision CF: data analysis, critical revision. AS: data analysis, critical revision. SLG: concept/design, data collection, critical revision. AR: concept/design, data analysis, manuscript draft, critical revision

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Ethics Approval

This study involves human participants and was submitted and approved by the Commission Nationale de l'Informatique et des Libertés (CNIL) with the following registration number: 2229646. Data collection complied with the General Data Protection Regulation of the European Union. Participants gave informed consent to participate in the study before taking part.

Data Availability Statement

Data are available on reasonable request.

Patient and Public Involvement

Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

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