



## EFFECT OF CLIMATE CHANGE TRAINING, ADAPTATION, AND PERFORMANCE OF ATHLETE IN LAGOS, NIGERIA

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### Abstract

Climate change is a global burden that has far-reaching effects on almost every aspect of human life and the world of sport has also had its own share of this burden, from disruption of sports events to training rescheduling, athlete adaptation, and performance due to climate change. The study examined the effect of climate change on athletes' training, adaptation, and performance in Lagos State. One hundred (100) university athletes, professional athletes, and coaches were purposively selected to participate in the study. Data were collected through validated Climate Change and Athletes, Training, Adaptation and Performance Questionnaire (CCATAPQ) with a reliability coefficient of 0.69. The questionnaire was structured to assess athletes' and coaches' experience of how climate change has affected athlete management in terms of, training, preparation, and performance. The first section of the questionnaire elicits the demographic information of the respondents such as gender, age, and type of sport, while the second section focuses on how climate change affects athletes' training, preparation, and performance. Data collected was analysed using descriptive statistics of frequency count, simple percentage, and mean for demographic data and inferential statistics of one sample goodness-of-fit test at 0.05 level of significance. Results reveal that climate change has a significant effect  $\chi^2(2) = 40.820$ ,  $p < .05$ . athletes' training, athletes' adaptation  $\chi^2(3) = 12.00$ ,  $p < .05$  and athletes' performance  $\chi^2(4) = 48.100$ ,  $p < .05$  at 0.05 level of significance. The study concludes that climate change has negative effects on athlete's training, adaptation and performance. The study recommends that coaches, athletes, and other stakeholders in sports should use sports platforms to advocate for behaviour change to reduce global warming also exercise physiologists and athlete managers should design acclimatization programmes to make athletes adapt to the extreme climatic conditions.

### Keywords:

Climate change,  
Athlete, Training,  
Adaptation,  
Performance

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## Introduction

Climate change is a global burden and one of the most pressing issues of our time that has far-reaching impacts on various aspects of human endeavor, and the world of sports is no exception. According to the World Health Organization, the heat stress linked to climate change effects is likely to cause 38,000 extra deaths a year worldwide between 2030 and 2050, as it worsens existing health problems and provokes heat stroke and exhaustion (World Economic Forum, 2019).

Across the globe, climate change has profound effects on the world of sports, impacting directly or indirectly on athletes, events, infrastructure, and the overall sports industry. The changing climate introduces various challenges that can disrupt sports activities, alter training routines, and necessitate adaptations to ensure the safety and sustainability of the sports sector. Thus, athletes' preparation and performance can be significantly influenced by changing climatic conditions.

The effect of climate change on sports in recent times is becoming more glaring, there are instances where the effect of climate change disrupted sports events, for instance, in 2019, the Rugby World Cup was disrupted by unprecedented Pacific typhoons, and in 2020, the Australian Tennis Open was disrupted by the smoke blowing in from the country's devastating bushfires. Also, the Tokyo 2020 Olympics were forced to move long-distance running events north of the capital due to the city's sweltering summer weather which makes it impossible for athletes to run. The 2022 World Cup in Qatar was moved to the winter season due to concerns over extreme temperatures in the country during the summer (World Bank Group, 2022).

Apart from the disruption of sports events, climate change has a direct physiological effect on athletes in many ways. From heat stress and dehydration to altered competition conditions and psychological stress, the effects of climate change on athletes are complex. Rising temperatures due to climate change expose athletes to higher heat stress levels during training and competitions. Heat stress can lead to increased sweating and dehydration, which in turn have devastating effects on an athlete's physical endurance, cardiovascular function, and overall performance (Kenefick et al., 2019). Similarly, extreme weather conditions, such as heat waves, heavy rainfall, and storms, can disrupt training schedules and limit outdoor training opportunities. With this, athletes may need to adapt their training routines or find alternative training facilities, which affect their preparation and readiness for competitions (Cleather et al., 2017).

Extreme temperatures as a result of climate change, can also impact an athlete's ability to perform at their peak due to increased fatigue, reduced muscle strength, and impaired cognitive function. This can lead to decreased athletic performance and increase the risk of injuries (Périard et al., 2015). Also, climate change can contribute to worsened ambient air quality, particularly in urban areas. Poor air quality especially in indoor sports can lead to respiratory issues for athletes, affecting their lung function, oxygen uptake, and overall performance, especially during outdoor endurance events (Rundell, 2013).



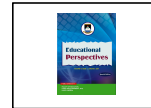
Changes in climate patterns can lead to altered competition conditions, such as unexpected rainfall, wind patterns, or extreme temperatures. Athletes may need to adjust their strategies and techniques to adapt to these changing conditions, affecting their performance outcomes (Kenefick et al., 2019). Moreso, as temperatures rise, altitude training for certain sports might become more difficult due to increased heat stress at higher altitudes. Athletes training at high altitudes for improved performance might face additional physiological stresses, requiring careful planning and acclimatization strategies (Chapman et al., 2019).

In recent years, the warming of the Earth's climate has led to shifts in weather patterns, more frequent extreme weather events, and alterations in the frequency and intensity of temperature-related phenomena. Athletes, coaches, and sports organizations are encountering new challenges as they strive to optimize training regimens and achieve consistent performance outcomes in the face of these climate-related changes. Whether it is adapting to higher temperatures during endurance activities, navigating altered competition conditions due to unexpected weather events, or planning for shifts in training locations, the effects of climate change are increasingly becoming a prominent consideration in the world of sports.

In regions experiencing more frequent and intense heat waves due to climate change, athletes engaging in endurance sports like long-distance running or cycling may face challenges. Extreme heat can lead to an increased risk of heat-related illnesses, dehydration, and heat stress, impacting training schedules and requiring athletes to adopt new strategies for hydration and cooling during workouts (Kenefick et al., 2019). Winter sports like skiing and snowboarding rely on consistent snowfall. Climate change's impact on reduced snowfall and shortened snow seasons can limit athletes' training opportunities and disrupt competition schedules. Athletes in regions affected by snow scarcity may need to travel longer distances to find suitable training conditions (Erdogan et al., 2019).

Altitude training, commonly used to enhance endurance performance, can be affected by climate change. Rising temperatures at higher altitudes can impact the physiological responses that athletes expect from altitude training. Athletes may need to adapt training programs to account for changing climate dynamics (Chapman et al., 2019). Athletes participating in coastal sports such as surfing, sailing, and beach volleyball may face challenges from sea-level rise and increased coastal erosion due to climate change. Changing beach conditions and unpredictable tidal patterns can impact training and competition venues (Erdogan et al., 2019).

Poor ambient air quality resulting from climate change-related factors, such as increased air pollution and wildfires, can affect outdoor endurance sports. Athletes may experience reduced lung function, respiratory discomfort, and decreased oxygen uptake during training, impacting performance (Rundell, 2013). Athletes and sports events can be directly impacted by extreme weather events, such as storms and heavy rainfall. These events can disrupt training sessions,



delay competitions, and even cause venue changes, requiring athletes to adapt their preparation and strategies on short notice (Cleather et al., 2017).

In conclusion, climate change presents athletes and sports organizations with a range of challenges that directly influence training, preparation, and overall performance. In spite of the devastating effect of climate change on athletes' preparation and performance, it is observed that this area has not been fully explored in Nigeria, there is a paucity of empirical studies on how climate change affects athletes' training and performance, creating a knowledge gap in this area. To optimize athletes' performance, efforts must be geared toward understanding how climate change affects athletes in Nigeria. Therefore, this study explores the effect of climate change on athletes', training, adaptation and performance in Lagos, Nigeria.

## **Methods**

### **Participants of the Study**

The participants of the study are coaches and athletes in Lagos State, Nigeria. A total of 100 coaches and amateur and professional athletes from different sports were purposively selected to participate in the study. The criteria for inclusion were that the athlete must have represented his/her institution at competitions outside the school or must be a professional athlete representing the State or an athlete of a club within Lagos State.

### **Procedure for Data Collection**

Self-developed Climate Change and Athletes, Training, Adaptation and Performance Questionnaire validated by three experts in Exercise Physiology, Sports Management, and Geography and Planning with a reliability coefficient of 0.69 was used to collect data from the respondents. The questionnaire was structured to assess athletes' and coaches' experience of how climate change has affected athlete management, training, preparation, and performance. The first section of the questionnaire elicits the demographic information of the respondents such as gender, age, and type of sport, while the second section focuses on how climate change affects athletes' training, preparation, and performance. The athletes and coaches were briefed on the objectives of the study and the selection was made from those who volunteered to participate in the study. To ensure 100% retrieval of the questionnaire, the researcher administered and collected the questionnaire on the spot.

### **Data Analysis**

Data collected was analysed after coding using descriptive statistics of frequency count, simple percentage, mean, and standard deviation for demographic data and inferential statistics of one sample goodness-of-fit test at 0.05 level of significance.



## Results

**Table 1: Demographic Characteristics of the Respondents**

Demographic	Variables	Percentage
Gender	Male	68
	Female	32
Respondents	Coach	23
	Athlete	77
Type of Sport	Indoor	43
	Outdoor	57

Table 1 presents the demographic characteristics of the respondents, from the tables, 68% of the respondents were male while 32% were female. Also, 23% of the respondents were coaches while 77% were amateur and professional athletes. On the type of sport engaged in, 43% of the respondents participated in indoor sports while 57% were outdoor sport athletes and coaches.

**Table 2: Chi-square Result of Effect of Climate on Athletes' Training**

	Training
Chi-Square	40.820 <sup>a</sup>
Df	2
Asymp. Sig.	.002

Table 2, presents the result of chi-square goodness of fit on the perceived effect of climate change on athletes' training. The result indicated that the observed distribution of climate change perceptions significantly deviated from the expected distribution,  $\chi^2(2) = 40.820$ ,  $p < .05$ . Athletes' perceptions of climate change were not in line with the expected distribution, suggesting that climate change may have an effect on their training.

**Table 3: Chi-square Result of Effect of Climate on Athletes' Adaptation**

	Adaptation
Chi-Square	12.000 <sup>a</sup>
df	3
Asymp. Sig.	.007

Table 3, presents the result of chi-square goodness of fit on the perceived effect of climate change on athletes' adaptation. The chi-square test indicated that there is a significant association



between athletes' perception of climate change and their reported performance,  $\chi^2(3) = 12.00$ ,  $p < .05$ .

**Table 4: Chi-square Result of Effect of Climate on Athletes' Performance**

	Performance
Chi-Square	48.100 <sup>a</sup>
df	4
Asymp. Sig.	.045

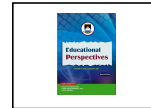
Table 4, presents the result of chi-square goodness of fit on the perceived effect of climate change on athletes' performance. The result indicated that the observed distribution of climate change perceptions significantly deviated from the expected distribution,  $\chi^2(4) = 48.100$ ,  $p < .05$ . Athletes' perceptions of climate change were not in line with the expected distribution, suggesting that climate change may have an effect on athletes' performance.

## Discussion

The chi-square goodness-of-fit test was employed to investigate the hypothesis that there would be no significant difference in the opinion of athletes on the effect of climate change on athletes training. The chi-square goodness-of-fit test revealed a statistically significant deviation from the expected distribution (assuming no difference) in athletes' responses.

The result of the study reveals that athletes opined that climate change has a profound effect on athletes' training. One of the most direct impacts of climate change on athletes is the rise in extreme temperatures. The high temperature exposed athletes to higher levels of heat stress during training, which can lead to heat-related illnesses and dehydration during training sessions and competitions. Climate change has direct and indirect effects on athletes. Direct consequences are primarily caused by extreme temperature and other weather conditions such as heatwaves, extreme weather events, and ultraviolet (UV) radiation, while indirect consequences are a result of climate-induced changes to the ecosystem such as air pollutants, allergens, viruses, and bacteria as well as the associated vectors and natural reservoirs (Mücke & Matzarakis, 2019). Extreme heatwaves can force athletes to limit their outdoor training or even cancel training sessions altogether. This reduction in training time can have a negative impact on performance. Moreover, the direct consequence of climate change can disrupt competition schedules due to unpredictable weather conditions. This can affect an athlete's preparation and performance. Unpredictable weather can make it difficult to plan outdoor training sessions or take part in specific seasonal sports.

Nigeria, like many other regions, is experiencing high rainfall due to climate change. There is a historic rise in sea level, making many states in Nigeria flood-prone. Heavy rainfall can disrupt training sessions, especially for outdoor sports. The training pitch may be flooded making it



inaccessible for training, also training in the cold weather may have a negative effect on the health of the athletes. The result of this study aligns with previous studies such as Ogunbode et al., (2020), Adedoyin, et al., (2018) and Scott, and Scott, (2018). They concluded that climate change which leads to a rise in temperature, heavy rainfall, and poor air quality has a negative impact on athletes' training and preparation for competitions.

Results also show that climate change has a significant effect on athletes' adaptation. Climate change affects athletes' adaptation in various ways, including through heat stress, changes in training environments, air quality, travel disruptions, and sport-specific challenges. Climate change is causing shifts in weather patterns and extreme weather events in many parts of the world. These changes have direct and indirect effects on athletes and their ability to adapt to the evolving conditions. Athlete adaptation is the physiological, psychological, and lifestyle adjustments that athletes make in response to the effects of climate change. To adjust to the devastating effect of climate change athlete may have to change their training schedule. For instance, due to extreme heat during the day, athletes had to adjust their training schedules to early morning or late evening sessions. And sometimes the athletes are left with no option but to train in extreme weather conditions. In this case, athletes had to engage in acclimatization programs to adapt their bodies to perform better in extreme weather conditions. To cope with the challenges posed by climate change, athletes and sports organizations are forced to implement various adaptation strategies. These include adjusting training schedules, modifying equipment, and incorporating heat acclimatization protocols (Racinais et al., 2015; Wilber, 2007).

The result also reveals that climate change has a significant effect on athletes' performance. When training is altered, and adaptation is negatively affected by climate change, it is expected that this will have an overall effect on athletes' performance. Almost all the athletes and coaches reported that climate change has a negative effect on athletes' performance. Rising temperatures due to climate change can lead to increased heat stress during sporting events, especially in outdoor sports. High heat and humidity can negatively impact an athlete's performance by causing dehydration, heat exhaustion, and even heatstroke. Casa et al. (2015) and Périard et al. (2017), highlighted the physiological challenges athletes face in extreme heat conditions. High levels of humidity impede perspiration thereby causing the retention of heat in the body which eventually increases core body temperature. The high body temperature can lead to increased sweating, causing the loss of essential fluids and electrolytes. Dehydration can result in reduced blood volume, which affects the heart's ability to pump blood to muscles, leading to potential cramping and reduced cardiorespiratory fitness.

## Conclusion

Climate change is a global burden that negatively affects almost every aspect of human life directly or indirectly. The world of sport also has a share of the misfortune climate change poses





on humanity. Climate change has a devastating effect on every aspect of sports in particular athlete training, adaptation, and performance.

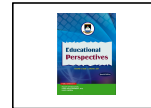
Due to the effect of climate change such as heavy rainfall that led to flooding, extreme ambient temperature, and dangerous windstorms that have been experienced recently in Nigeria, training schedules are canceled. Athletes are not able to train and prepare properly for competitions, even in some cases the competitions are canceled as a result of the effect of climate change. Climate change also has far-reaching implications for athletes' performance, affecting them physically, logistically, and mentally. Athletes are not able to perform optimally due to heat stress, extreme cold, and poor air quality among others.

### **Recommendations**

The result of the study established that climate change has a negative effect on athletes' training, adaptation, and performance. Based on this result, it is recommended that:

- i. Coaches, athletes, and other stakeholders in sports should use sports as a platform to educate and advocate through campaigns, and billboards, within and outside the stadium for behavioral change that will reduce global warming and environmental pollution.
- ii. Exercise physiologists and coaches should design acclimatization programmes that will help athletes adapt to the changing climatic conditions in order to optimize their performance.
- iii. Sports nutritionists should emphasize proper hydration and nutrition, especially in hot and humid conditions. Athletes should be educated on maintaining adequate fluid balance and adjusting their dietary intake to match their training needs.
- iv. Coaches should develop flexible training schedules that can adapt to changing climate conditions. Have indoor training options available for outdoor sports during extreme weather events.





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