# Harnessing the Athletic Mind
## Pathways to Optimal Mental Performance

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**Abstract**

The intense focus and commitment required for successful sports performance can often be harmful to athletes' well-being, causing burnout and negatively impacting mental health. To optimize performance, athletes must regulate factors that affect their overall quality of life, as well as be able to mitigate the negative side effects that intense commitment to sports performance often brings. They also must understand how different aspects of their mental state, such as resilience, loneliness, and athletic identity, affect each other. In being able to understand and control these factors, athletes will be able to improve their overall mental health and harness their athletic identity, allowing them to push harder and perform better. In this paper, we aim to identify what physical factors impact athletic identity, as well as identify the relationships between different mental performance-affecting factors.

**Introduction**

Athletic performance is affected by mental health ((D. L. Rogers, M. J. Tanaka, A. J. Cosgarea, R. D. Ginsburg, G. M. Dreher. How mental health affects injury risk and outcomes in athletes. *Sports Health a Multidisciplinary Approach*. **16**, 222–229 (2023).)). Mental health has also been shown to be often negatively impacted by intense commitment to performance, which can cause feelings of mental and physical exhaustion, low mood, and even feelings of resentment towards one's own sport ((D. Wilczyńska, W. Qi, J. C. Jaenes, D. Alarcón, M. J. Arenilla, M. Lipowski. Burnout and mental interventions among youth athletes: A systematic review and meta-analysis of the studies. *International Journal of Environmental Research and Public Health*. **19**, 10662 (2022).)). This creates a difficult tradeoff situation for athletes to navigate since while commitment to their sport is the primary way to improve performance, that commitment can harm their mental health, which may throttle performance.

Certain standard measures are used for mental health ((C. L. M. Keyes. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior*. **43**, 207-222 (2002).)), resilience ((B. W. Smith, J. Dalen, K. Wiggins, E. Tooley, P. Christopher, J. Bernard. The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine*. **15**, 194–200 (2008).)), athletic identity ((B. W. Brewer, J. L. Van Raalte, D. E. Linder. Athletic Identity Measurement scale. *PsycTESTS Dataset*. (1993).)), and loneliness ((J. De Jong Gierveld, T. Van Tilburg. A 6-item scale for overall, emotional, and social loneliness. *Research on Aging*. **28**, 582–598 (2006).)). These measures are the Mental Health Continuum-Short Form, the Brief Resilience Scale, the Athletic Identity Measurement Scale, and The Short Loneliness Scale. These measures involve quantitative survey questions that, when summed or averaged, provide a numerical scale of each main trait the given measure is meant to assess. For example, a high score on the Adult Mental Health Continuum-Short Form would mean the respondent has good mental health, while a low score would indicate poor mental health.

The dataset used in our study came from a separate study that surveyed the aforementioned mental and physical factors in athletes and analyzed them ((C. Knowles, S. Shannon, G. Prentice, G. Breslin. Comparing mental health of athletes and non-athletes as they emerge from a COVID-19 pandemic lockdown. *Frontiers in Sports and Active Living*. **3**, 612532 (2021).)). In our study, we performed analyses on this dataset that the original study did not perform.

**Athletic Identity**

Athletes also tend to feel that sport is part of their identity, with more committed athletes tending to feel more strongly so than less committed athletes. Athletic identity is at the core of athletic performance and is the heart of any athlete's relationship with their sport. Athletic identity is how strongly a person feels their sport is tied to their identity. Athletic identity is closely associated with commitment to performance, improvement, and training

((B. R. Edison, M. A. Christino, K. H. Rizzone. Athletic identity in youth athletes: A systematic review of the literature. *International Journal of Environmental Research and Public Health*. **18**, 7331 (2021).)). Athletic identity is measured using the Athletic Identity Measurement Scale ((B. W. Brewer, J. L. Van Raalte, D. E. Linder. Athletic Identity Measurement scale. *PsycTESTS Dataset*. (1993).)), which utilizes ten statements with a numerical answer of 1-7, in which the respondents indicate how strongly they agree with each statement. The mean value of an individual's answers is considered their athletic identity. Athletic identity is a strong indicator of performance-affecting factors, such as motivation and time dedicated to training and competition, as it is the core of an athlete and their sport's relationship.

**Resilience: The Tool Used to Overcome Challenges**

Resilience is the process and outcome of successfully adapting to difficult or challenging life experiences, especially through mental, emotional, and behavioral flexibility and adjustment to external and internal demands ((S. M. Southwick, G. A. Bonanno, A. S. Masten, C. Panter-Brick, R. Yehuda. Resilience definitions, theory, and challenges: interdisciplinary perspectives. *European Journal of Psychotraumatology*. **5**, 25338 (2014).)). Resilience is important to athletes since successful athletes regularly must learn from failures, adapt to challenges, and bounce back from setbacks ((M. Sarkar, D. Fletcher. Psychological resilience in sport performers: A review of stressors and protective factors. *Journal of Sports Sciences*. **32**, 1419-1434 (2014).)). Resilience is measured using the Brief Resilience Scale[4], which involves six questions that the respondent scores from 1-5. Additionally, resilience has been shown to mediate the effects of burnout ((M. Yıldırım, Ö. Kaynar, F. Chirico, N. Magnavita. Resilience and extrinsic motivation as mediators in the relationship between fear of failure and burnout. *International Journal of Environmental Research and Public Health*. **20**, 5895 (2023).)). Therefore, resilience positively impacts athletic performance, making it a key mental performance factor ((M. Yıldırım, Ö. Kaynar, F. Chirico, N. Magnavita. Resilience and extrinsic motivation as mediators in the relationship between fear of failure and burnout. *International Journal of Environmental Research and Public Health*. **20**, 5895 (2023).)).

**Sleep: Vital to the Mind and Body**

Sleep is highly regarded as essential to physical and mental health. Poor sleep quality is associated with reduced mental health ((A. J. Scott, T. L. Webb, M. M.-S. James, G. Rowse, S. Weich. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. *Sleep Medicine Reviews*. **60**, 101556 (2021).)) and reduced resilience ((M. Breus. How sleep helps build resilience. *Sleep Doctor*. (2024).)). Sleep is both a physical and mental factor in performance since it affects both the body and the mind, and lack of sleep is detrimental to athletes' physical and mental performance.

Sleep is also incredibly important to rest and recovery, both mental and physical, in all athletes ((R. Doherty, S. M. Madigan, A. Nevill, G. Warrington, J. G. Ellis. The sleep and recovery practices of athletes. *Nutrients*. **13**, 1330 (2021).)) since sleep difficulty and sleep deprivation have been shown to have many negative effects on athletic performance, including increased injury risk, reduced recovery from exercise and stress, and adversely impacted reaction times ((J. Charest, M. A. Grandner. Sleep and athletic performance. *Sleep Medicine Clinics*. **15**, 41–57 (2020).)).

**Mental Health: Important to Performance**

Mental Health is measured using The Mental Health Continuum Short-Form (MHC-SF). This mental health scale involves a combination of questionnaire categories that assess emotional, psychological, and social well-being. Emotional well-being is scored 0-15, psychological well-being 0-30, and social well-being 0-25. These three factors are then summed to produce a score from 0-70. The questionnaire involves three items for emotional,

five for social, and six for psychological. Each item is scored on a 6-point Likert scale that ranges from 0 "never" to 5 "every day" ((C. L. M. Keyes. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior.* **43**, 207-222 (2002).)). An example of a question is, "How often during the past month did you feel confident to think or express your own ideas and opinions?" ((C. L. M. Keyes. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior.* **43**, 207-222 (2002).)). Psychological well-being values within the dataset are simply the sum of the psychological items that contribute to the MHC-SF total. Existing research shows that poor mental health can lead to poor outcomes in athletic performance, meaning maintaining good mental health is vital for athletes who want to perform well ((D. L. Rogers, M. J. Tanaka, A. J. Cosgarea, R. D. Ginsburg, G. M. Dreher. How mental health affects injury risk and outcomes in athletes. *Sports Health a Multidisciplinary Approach.* **16**, 222–229 (2023).)).

**Loneliness: Risk Factor for Mental Struggles**

Loneliness is affective and cognitive discomfort or uneasiness from being or perceiving oneself to be alone or otherwise solitary ((L. C. Hawkley J. T. Cacioppo. Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Annals of Behavioral Medicine.* **40**, 218–227 (2010).)). Loneliness was measured using the Short Loneliness Scale ((J. De Jong Gierveld, T. Van Tilburg. A 6-item scale for overall, emotional, and social loneliness. *Research on Aging.* **28**, 582–598 (2006).)), which includes 6 statements, each yielding a numerical answer from 1-5 based on how strongly the respondent agrees with each statement. The answers were then averaged to produce a number 1-5, which indicates total loneliness. Loneliness is often, but not always, associated with a higher risk of psychiatric disorders, such as depression and anxiety ((R. Mushtaq, S. Shoib, T. Shah, S. Mushtaq. Relationship between loneliness, psychiatric disorders and physical health ? A review on the psychological aspects of loneliness. *Journal of Clinical and Diagnostic Research.* **8**, WE01-WE04 (2014).)). Loneliness in athletes is associated with more difficulty coping with stress, burnout, and other psychological problems athletes experience that impact their performance ((British Psychological Society (BPS). The loneliness of the individual athlete. *ScienceDaily.* (2016).)).

**Total Weekly Hours: Path to Improvement That Can Risk Burnout**

Total weekly hours are the sum of an athlete's weekly training, competing, and playing hours. Training hours include scheduled practice and training sessions and any extra training (strength training, conditioning, stretching, skills work, etc.). Competing hours are hours spent at competitions, including active and resting periods. Playing hours are the hours the athlete spends playing their sport outside of organized practices. When these three items are summed, they produce the total weekly hours value. The number of hours per week an athlete dedicated to their sport, whether it's training or competition, tells us how many hours per week that athlete is willing to dedicate to improving performance. Training too hard with too much volume such that it exceeds what the body is capable of recovering from often results in decreased performance, increased risk of injury, and derangement of the cardiovascular, neurologic, and psychological systems in the body ((J. S. Brenner, A. Watson, A. Watson, M. A. Brooks, R. L. Carl, S. M. Briskin, G. Canty, S. Cuff, N. M. Edwards, S. Kinsella, P. J. Lang, C. L. Master, S. M. Miller, A. Peterson, F. J. Silva, P. Stricker, K. D. Walter, A. Faigenbaum, A. B. Diamond, P. C. Elder, A. Emanuel. Overuse injuries, overtraining, and burnout in young athletes. *American Academy of Pediatrics.* **153**, (2024).)). An athlete's total weekly hours dedicated to their sport can give a rough indication of their risk of burnout and exhaustion, and thus, it is important to the understanding of other factors that can affect athletes' mental health ((J. S. Brenner, A. Watson, A. Watson, M. A. Brooks, R. L. Carl, S. M. Briskin, G. Canty, S. Cuff, N. M. Edwards, S. Kinsella, P. J. Lang, C. L.

Master, S. M. Miller, A. Peterson, F. J. Silva, P. Stricker, K. D. Walter, A. Faigenbaum, A. B. Diamond, P. C. Elder, A. Emanuel. Overuse injuries, overtraining, and burnout in young athletes. *American Academy of Pediatrics*.**153**, (2024).)).

**Sport Level: Athletes are Categorized Based on Performance**

Another measure we used was sport level, which indicated the highest level of sport that a given athlete regularly participated in. There are three levels, ordered from lowest to highest: "non-elite," "semi-elite," and "elite," respectively. "Non-elite" is designated as "1," "semi-elite" as "2," and "elite" as "3" to signify the three different levels of sport[7]. These numerical designations are not universal but rather just used for the study from which we are pulling our dataset ((C. Knowles, S. Shannon, G. Prentice, G. Breslin. Comparing mental health of athletes and non-athletes as they emerge from a COVID-19 pandemic lockdown. *Frontiers in Sports and Active Living*. **3**, 612532 (2021).)).

"Non-elite" means an athlete that doesn't compete or competes at a low level, typically locally or regionally. Regardless of performance, anyone who regularly participates in a sport can be considered at least a non-elite athlete.

"Semi-elite" means an athlete may be semi-professional or compete at the national level but has not necessarily achieved highly notable results in those leagues. In basketball, for example, division 3, division 2, and most division 1 players qualify as semi-elite athletes. However, for example, players on a team that makes it to the final four of March Madness, the most-watched NCAA basketball tournament, would certainly be considered a step above the "semi-elite" and could be considered elite.

"Elite" means an athlete competes at or near the professional or international level and thus has achieved highly notable results, at least within their own country, and likely has been selected to play professionally or represent their country's national team. To qualify as an elite athlete, an athlete must compete at or near the highest level of their sport. This may vary by sport, but, for example, all professional, national team, and Olympic athletes qualify as elite athletes. Athletes nearly at the highest level may also be considered elite athletes. For example, division 1 American football players close to the performance level necessary to be drafted into the NFL can be considered elite athletes. In contrast, players at a lower performance level in their same league would be considered semi-elite athletes.

Existing research shows that a higher sport level is typically associated with a greater athletic identity, where three levels of sport level were defined as "elite," "recreational," and "non-participation." Although these sport-level designations differ from the ones used in our study, the designations of "elite" and "recreational" are comparable to "elite" and "non-elite" as used in our dataset ((A. Lamont-Mills, S. A. Christensen. Athletic identity and its relationship to sport participation levels. *Journal of Science and Medicine in Sport*. **9**, 472–478 (2006).)).

**Gaps In Prior Research**

The relationship between resilience and mental health has been studied heavily in general but not as much in semi-elite and elite athletes ((S. A. Vella, C. Swann, M. Batterham, K. M. Boydell, S. Eckermann, H. Ferguson, A. Fogarty, D. Hurley, S. K. Liddle, C. Lonsdale, A. Miller, M. Noetel, A. D. Okely, T. Sanders, M. J. Schweickle, J. Telenta, F. P. Deane. An intervention for mental health literacy and resilience in organized sports. *Medicine & Science in Sports & Exercise*. **53**, 139–149 (2020).)). This presents a gap in prior research, where it has not been extensively shown whether this adolescent-prevalent relationship applies to elite and semi-elite athletes that we aim to fill. Since resilience correlates positively with mental health in most people ((S. A. Vella, C. Swann, M. Batterham, K. M. Boydell, S. Eckermann, H. Ferguson, A. Fogarty, D. Hurley, S. K. Liddle, C. Lonsdale, A. Miller, M. Noetel, A. D. Okely, T. Sanders, M. J. Schweickle, J. Telenta, F. P. Deane. An intervention for mental health literacy and resilience in organized sports. *Medicine & Science in Sports &*

*Exercise*. **53**, 139–149 (2020).)), we hypothesize that resilience will also correlate positively with mental health in semi-elite and elite athletes.

There is extensive research on athletic identity and even more so on sleep, but research on the relationship between the two is limited. The only identified relationship we found in our search of prior studies focused on retired athletes: the greater an individual's athletic identity, the greater their risk of sleep difficulty following retirement ((A. Montero, J. Baranoff, R. Adams, M. Drummond. Athletic retirement: Factors contributing to sleep and mental health problems. *Frontiers in Psychology*. **15**, (2024).)). However, prior research only examines this relationship specifically on retired athletes. It appears that no prior research has examined the relationship between sleep and athletic identity in currently-competing athletes. This is a gap in existing research that we aim to fill. Since sleep correlates negatively with athletic identity in retired athletes, we hypothesize that sleep will also correlate negatively with athletic identity in actively competing athletes.

Studies on the relationship between loneliness and resilience have largely focused on categories of people more applicable to the general population, such as men, women, students, the elderly, and teens ((I. S. Jakobsen, L. M. R. Madsen, M. Mau, O. Hjemdal, O. Friborg. The relationship between resilience and loneliness elucidated by a Danish version of the resilience scale for adults. *BMC Psychology*. **8**, (2020).)). Prior research does not appear to specifically cover this relationship, in a direct form, on semi-elite and elite athletes. This is a gap in prior research that we aim to fill. Loneliness is correlated with more difficulty coping with burnout ((British Psychological Society (BPS). The loneliness of the individual athlete. *ScienceDaily*. (2016).)), while resilience has been shown to mediate burnout ((M. Yıldırım, Ö. Kaynar, F. Chirico, N. Magnavita. Resilience and extrinsic motivation as mediators in the relationship between fear of failure and burnout. *International Journal of Environmental Research and Public Health*. **20**, 5895 (2023).)), so resilience and loneliness have opposite effects on burnout in athletes. Since loneliness and resilience have opposite effects on burnout, we hypothesize that loneliness will correlate negatively with resilience.

## Methods

### Data Collection and Cleaning

The data analyzed in this paper is originally from a study by Christopher Knowles, Stephen Shannon, Garry Prentice, and Gavin Breslin. The study is titled "Comparing Mental Health of Athletes and Non-athletes as They Emerge From a COVID-19 Pandemic Lockdown" ((C. Knowles, S. Shannon, G. Prentice, G. Breslin. Comparing mental health of athletes and non-athletes as they emerge from a COVID-19 pandemic lockdown. *Frontiers in Sports and Active Living*. **3**, 612532 (2021).)). The study primarily focused on differences in mental factors between athletes and non-athletes coming out of the COVID-19 pandemic lockdown. They found that during transitionary times such as Covid-19, athletes, and non-athletes have no significant difference in resilience.

The vast amount of data available in the dataset ((C. Knowles, S. Shannon, G. Prentice, G. Breslin. Comparing mental health of athletes and non-athletes as they emerge from a COVID-19 pandemic lockdown. *Frontiers in Sports and Active Living*. **3**, 612532 (2021).)) allows us to test new hypotheses.

To clean the data, we removed numerous columns we did not plan to use. These columns were simply subscores that contributed to the measures we used in our analyses. For example, the individual scores for each question of the Athletic Identity Measurement Scale were removed, leaving only the overall Athletic Identity Measurement Scale score for each respondent. This same rule was applied to the other measures, so for all psychological tests, we removed values for individual questions and retained

In addition to removing columns, we also set values greater than or equal to 999 to N/A. In the original dataset, non-applicable values were set to 999 or greater values (far beyond the range of any measure) to indicate N/A.

**Tests Used**

The Athletic Identity Measurement Scale (AIMS) ((B. W. Brewer, J. L. Van Raalte, D. E. Linder. Athletic Identity Measurement scale. *PsycTESTS Dataset*. (1993).)) includes seven statements in which the respondent indicates how strongly they agree with each statement, providing a numerical answer from 1-7 on a seven-point Likert scale with 1 being the least strongly agreeing and 7 being the most. The mean of the ten results is then calculated, which indicates the athletic identity score. An example of a statement is, "Sport is the most important part of my life."

The Brief Resilience Scale ((B. W. Smith, J. Dalen, K. Wiggins, E. Tooley, P. Christopher, J. Bernard. The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine*. **15**, 194–200 (2008).)) includes six statements in which the respondent indicates how strongly they agree with each statement, providing a numerical answer from 1-5 on a five-point Likert scale, with 1 being "strongly disagree" and 5 being "strongly agree." The mean of the six results is then calculated, which indicates the resilience score. An example of a statement is, "I tend to bounce back quickly after hard times."

The Mental Health Continuum Short Form (MHC-SF) ((C. L. M. Keyes. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior*. **43**, 207-222 (2002).)) involves a combination of questionnaire categories that assess emotional, psychological, and social well-being. Emotional well-being is scored 0-15, psychological well-being 0-30, and social well-being 0-25. These three factors are then summed to produce a score from 0-70. The questionnaire involves three items for emotional, five for social, and six for psychological. Each item is scored on a six-point Likert scale that ranges from 0 "never" to 5 "every day" ((C. L. M. Keyes. The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior*. **43**, 207-222 (2002).)). An example of a question is, "How often during the past month did you feel confident to think or express your own ideas and opinions?"

The Short Loneliness Scale ((J. De Jong Gierveld, T. Van Tilburg. A 6-item scale for overall, emotional, and social loneliness. *Research on Aging*. **28**, 582–598 (2006).)) includes six statements in which the respondent indicates how strongly they agree with each statement, providing a numerical answer from 1-5 on a five-point Likert scale with 1 being "strongly disagree" and 5 being "strongly agree." The mean of the six results is then calculated, which indicates the loneliness score. An example of a statement is, "I experience a general sense of emptiness."

Sport level, which indicates the highest level of sport that a given athlete regularly participates in, is measured using three levels, ordered from lowest to highest: "non-elite," "semi-elite," and "elite," respectively. "Non-elite" is designated as "1," "semi-elite" as "2," and "elite" as "3" to signify the three different levels of sport[7]. These numerical designations are not universal but rather just used for the study from which we are pulling our dataset ((C. Knowles, S. Shannon, G. Prentice, G. Breslin. Comparing mental health of athletes and non-athletes as they emerge from a COVID-19 pandemic lockdown. *Frontiers in Sports and Active Living*. **3**, 612532 (2021).)).

**Statistical Methods**

This was a quantitative study where we leveraged linear regression analyses that analyzed how independent variables impacted dependent variables. All analyses were performed using R Statistical Software (R version 4.4.0 (2024-04-24 ucrt)).

**Procedure**

Models 1 and 2 examined how total weekly hours spent on sport and sport level influence an athlete's athletic identity. Total weekly hours and sport level were the independent variables, respectively, and athletic identity was the dependent variable for each model.

Model 2 examined the relationship between overall mental health and resilience. Mental health was the independent variable, and resilience was the dependent variable.

Models 4, 5, and 6 analyzed how sleep influenced mental health, resilience, and athletic identity, respectively. Sleep was the independent variable for each model, and the other measures were all individual dependent variables for each model.

Models 7 and 8 examined how loneliness influences mental health and resilience, respectively. Loneliness was the independent variable for each model, and the other measures were the individual dependent variables for each model.

## Results

### Figure 1: The Impact of Total Weekly Hours on Athletic Identity (Model 1)

Simple linear regression analysis was conducted to evaluate the extent to which total weekly hours could predict athletic identity. A significant regression was found where $p < 0.001$. The $R$-squared was 0.1941, indicating that total weekly hours explained approximately 19.41% of the variance in athletic identity. The total weekly hours an athlete dedicates to their sport is positively correlated with their athletic identity. See Figure 1 for results.
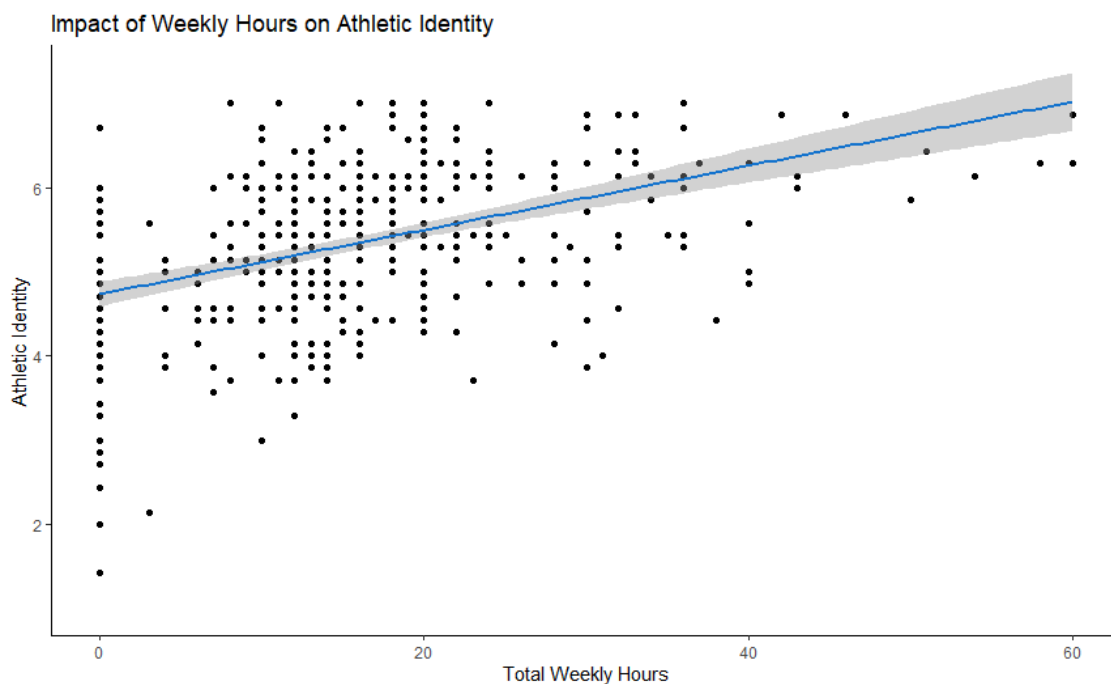


Impact of Weekly Hours on Athletic Identity

**Figure 2: The Association Between Sport Level and Athletic Identity (Model 2)**

Simple linear regression analysis was conducted to evaluate the extent to which sport level could predict athletic identity. A significant regression was found where $p<0.001$. The $R$-squared was 0.09616, indicating that sport level explained approximately 9.616% of the variance in athletic identity. The sport level of an athlete is positively correlated with their athletic identity. See Figure 2 for results.
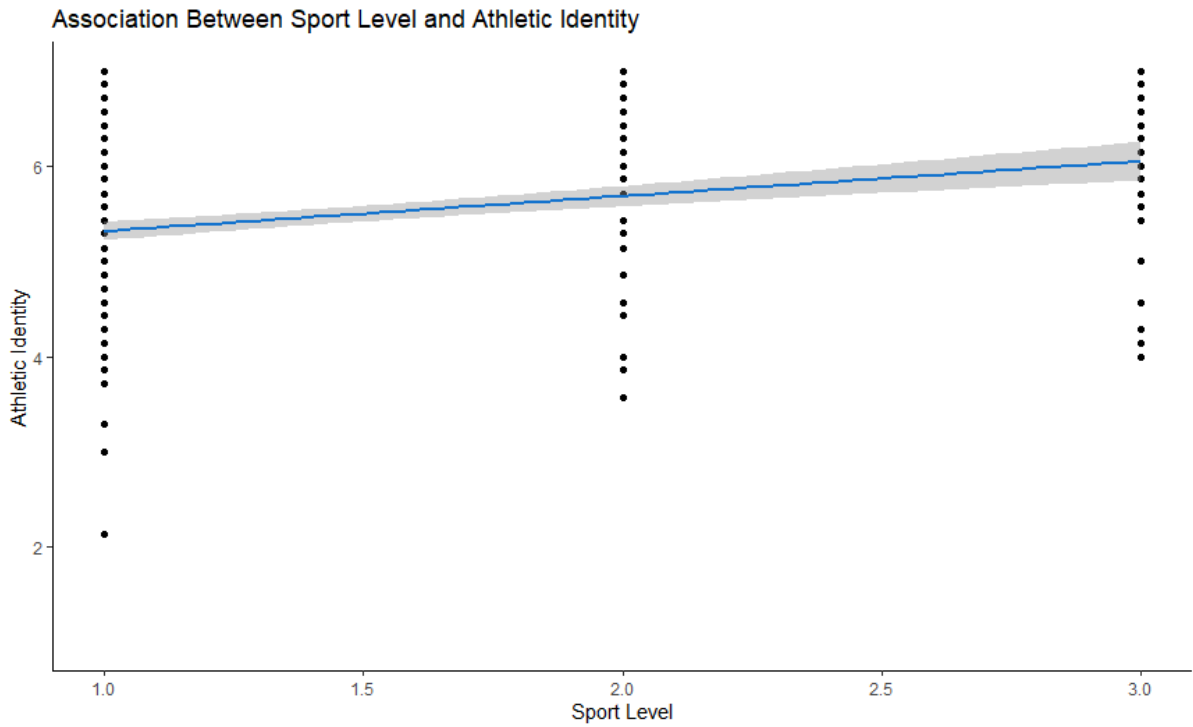


Association Between Sport Level and Athletic Identity

**Figure 3: The Relationship Between Mental Health and Resilience (Model 3)**

Simple linear regression analysis was conducted to evaluate the extent to which mental health could predict resilience. A significant regression was found where $p<0.001$. The $R$-squared was 0.2489, indicating that mental health explained approximately 24.89% of the variance in resilience. Mental health is positively correlated with resilience. See Figure 3 for results.
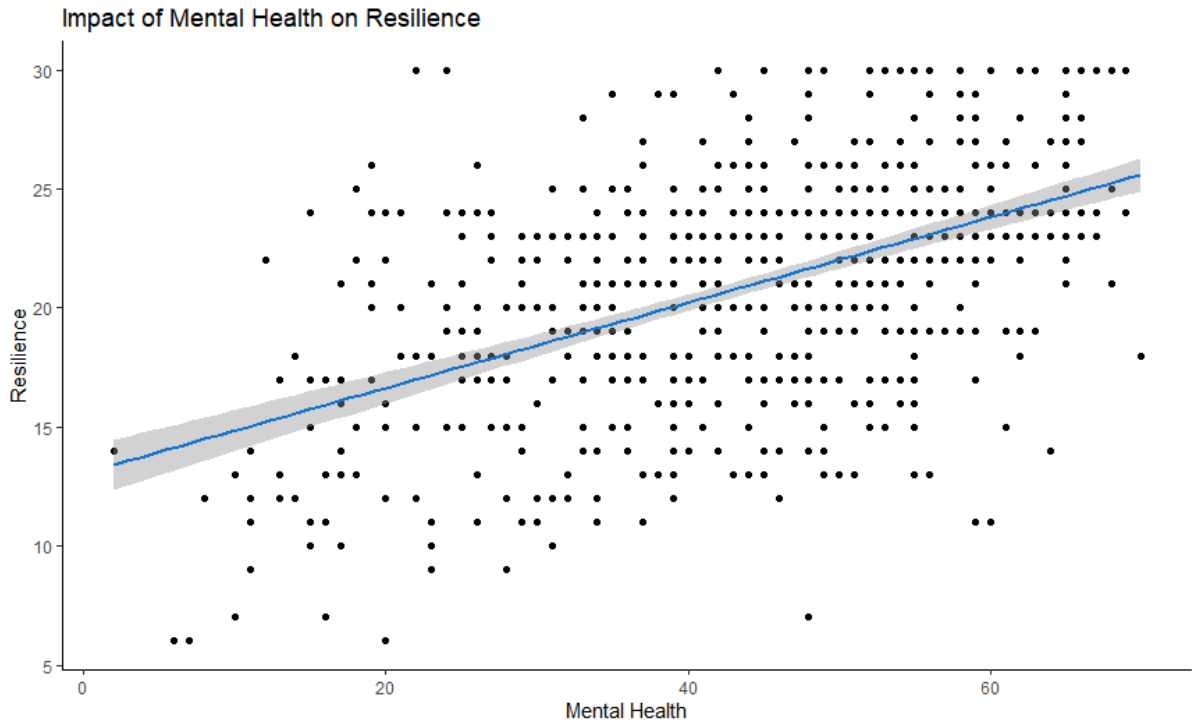


Impact of Mental Health on Resilience

**Figure 4: The Relationship Between Sleep and Mental Health (Model 4)**

       Simple linear regression analysis was conducted to evaluate the extent to which hours of sleep could predict mental health. A significant regression was found where p<0.005. The *R*-squared was 0.0121, indicating that hours of sleep explained approximately 1.21% of the variance in mental health. The number of hours an athlete sleeps is positively correlated with their mental health. See Figure 4 for results.
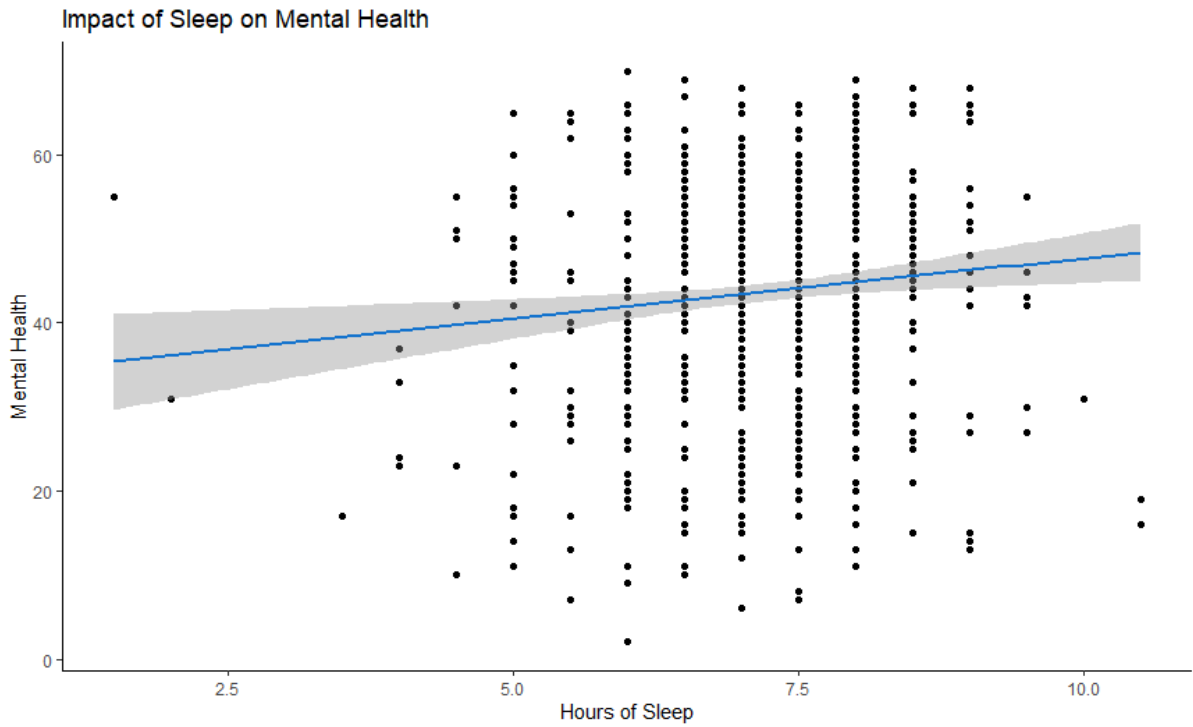


Impact of Sleep on Mental Health

**Figure 5: The Relationship Between Sleep and Resilience (Model 5)**

       Simple linear regression analysis was conducted to evaluate the extent to which hours of sleep could predict resilience. A significant regression was found where $p < 0.01$. The $R$-squared was 0.01013, indicating that hours of sleep explained approximately 1.013% of the variance in resilience. The number of hours an athlete sleeps is positively correlated with their resilience. See Figure 5 for results.
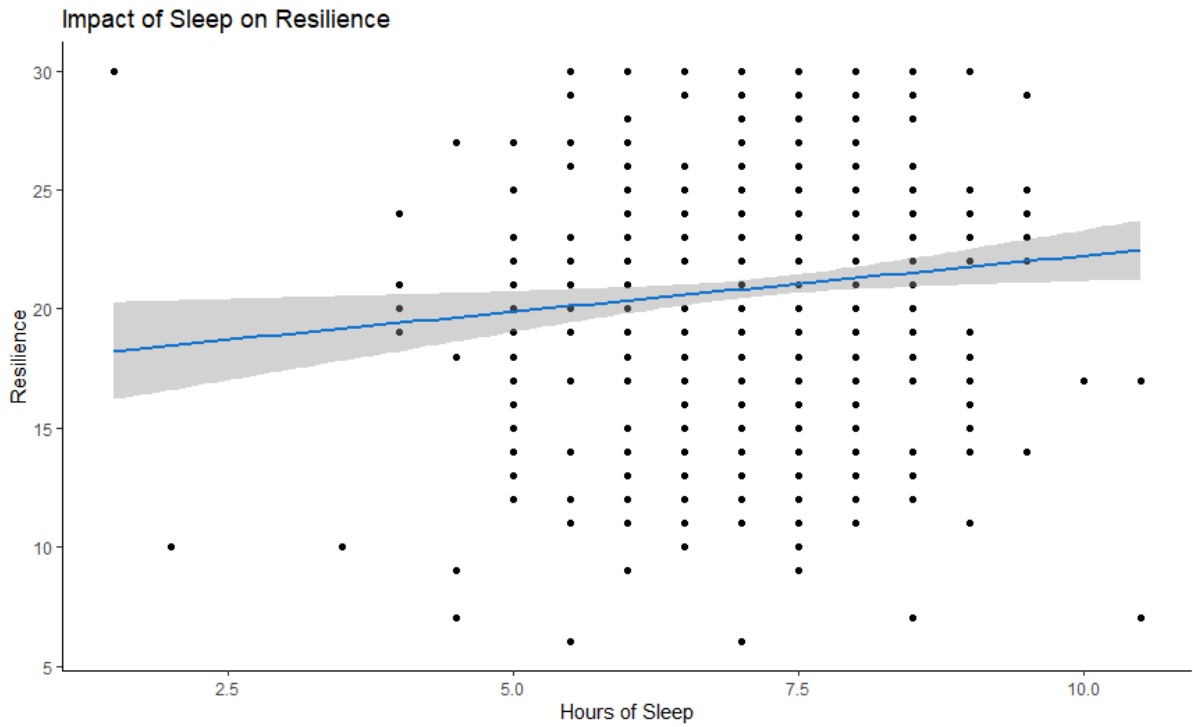


Impact of Sleep on Resilience

**Figure 6: The Relationship Between Sleep and Athletic Identity (Model 6)**

 Simple linear regression analysis was conducted to evaluate the extent to which hours of sleep could predict athletic identity. A significant regression was found where $p<0.005$. The *R*-squared was 0.01754, indicating that hours of sleep explained approximately 1.754% of the variance in athletic identity. The number of hours an athlete sleeps is positively correlated with their athletic identity. See Figure 6 for results.
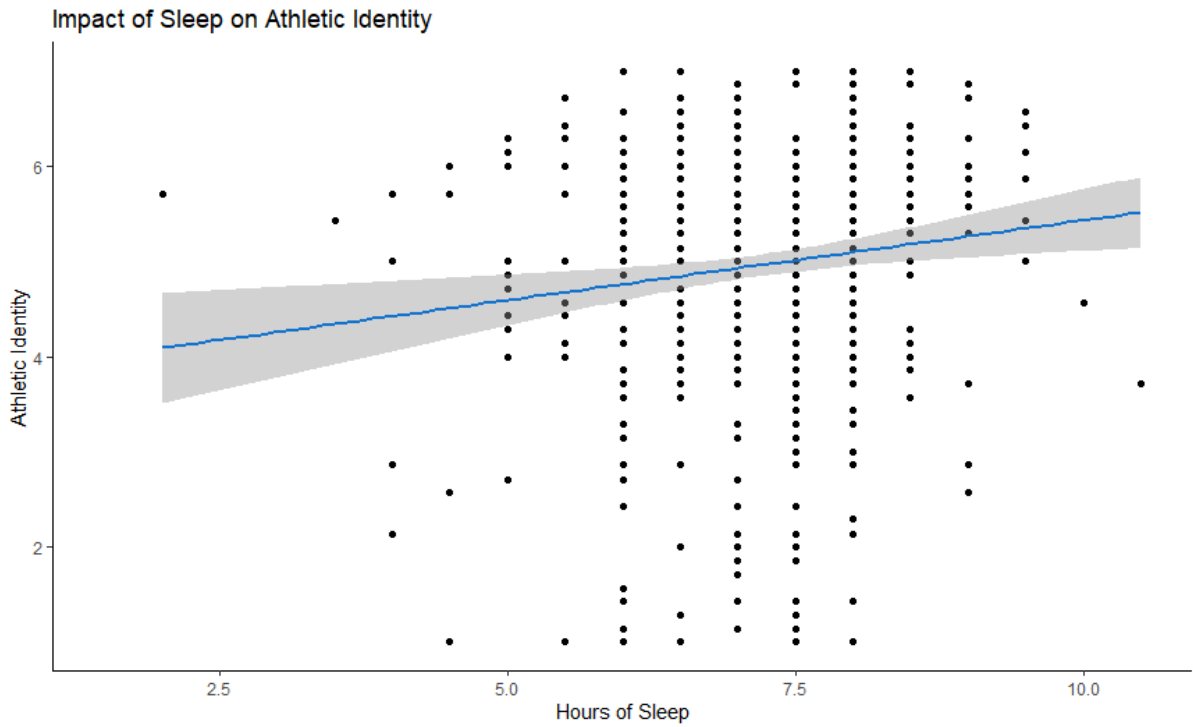
**Figure 7: The Relationship Between Loneliness and Mental Health (Model 7)**

Simple linear regression analysis was conducted to evaluate the extent to which loneliness could predict mental health. A significant regression was found where $p < 0.001$. The $R$-squared was 0.4294, indicating that loneliness explained approximately 42.94% of the variance in mental health. An athlete's loneliness is negatively correlated with their mental health. See Figure 7 for results.
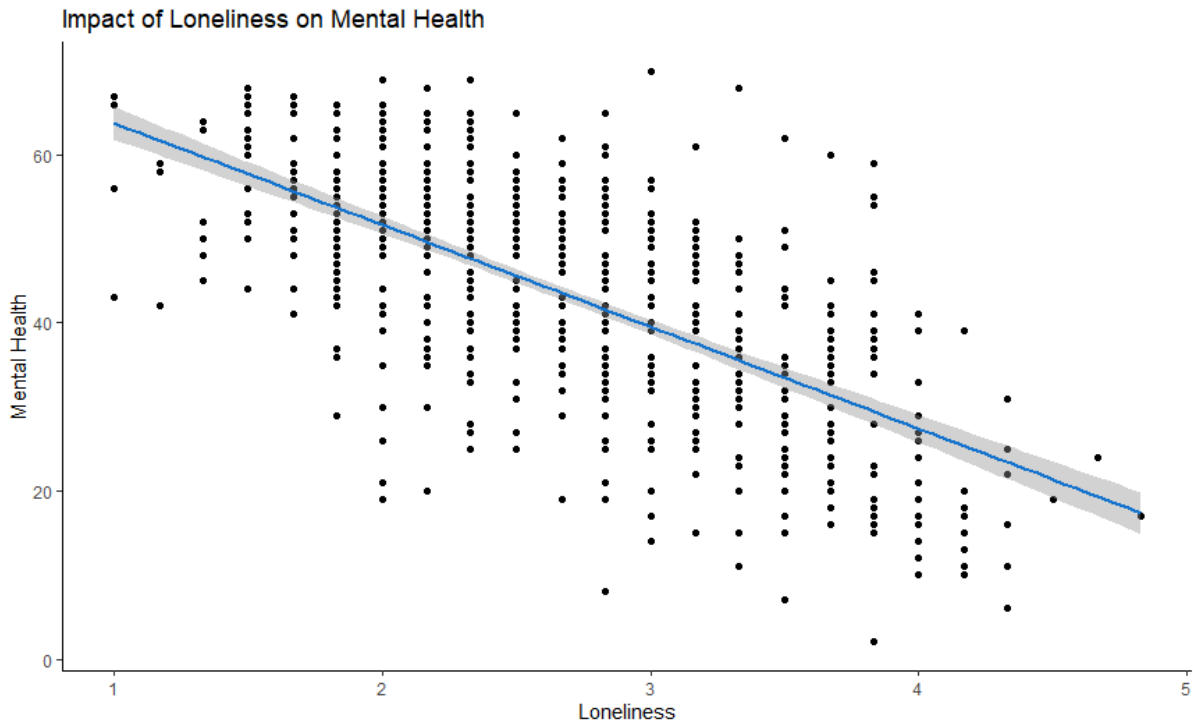


Impact of Loneliness on Mental Health

**Figure 8: The Relationship Between Loneliness and Resilience (Model 8)**

Simple linear regression analysis was conducted to evaluate the extent to which loneliness could predict resilience. A significant regression was found where $p<0.001$. The *R*-squared was 0.2385, indicating that loneliness explained approximately 23.85% of the variance in resilience. An athlete's loneliness is negatively correlated with their resilience. See Figure 8 for results.



Impact of Loneliness on Resilience
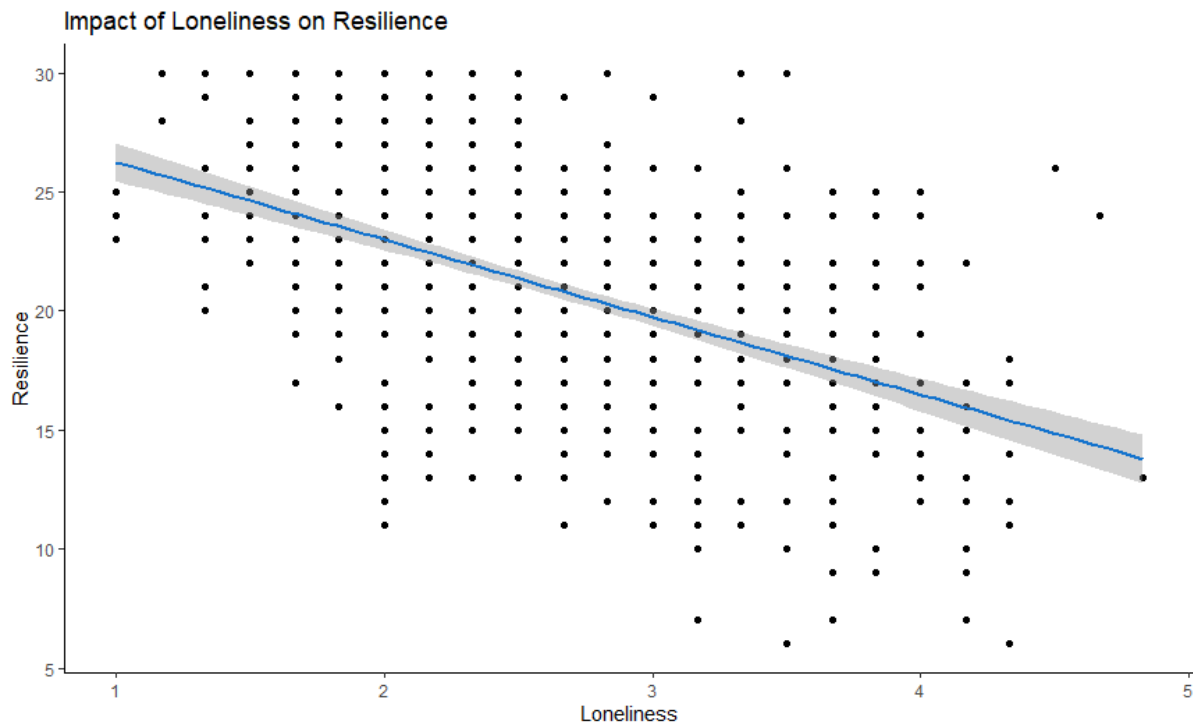
## Discussion

Model 1 showcases a relationship between a physical factor (total weekly hours) and athletic identity. The model shows that, typically, as total weekly hours increase, athletic identity also increases. Prior research shows that commitment to performance is closely linked to athletic identity ((B. R. Edison, M. A. Christino, K. H. Rizzone. Athletic identity in youth athletes: A systematic review of the literature. *International Journal of Environmental Research and Public Health*. **18**, 7331 (2021).)), which this model confirms since the total weekly hours spent on a sport are a major aspect of commitment to that sport. This shows that athletes who commit more hours to their sports will tend to have greater athletic identity.

Model 2 expands on the relationship shown in Model 1 by showcasing a relationship between sport level and athletic identity that reveals that athletes in higher skill levels also tend to have higher athletic identity. This confirms existing research, which says that a higher sport level is associated with higher athletic identity ((A. Lamont-Mills, S. A. Christensen. Athletic identity and its relationship to sport participation levels. *Journal of Science and Medicine in Sport*. **9**, 472–478 (2006).)), strengthening the validity of this association by exemplifying this relationship in Model 2. This helps confirm the idea that higher-level athletes tend to have greater athletic identity.

Model 3 showcases a relationship between mental health and resilience, two important mental factors for performance. The model shows that, typically, as mental health improves, resilience also improves. Our study appears to be the first to look at this relationship in elite and semi-elite athletes, which helps fill a gap in prior research on semi-elite and elite athletes since prior research mainly focuses on this relationship in regular people, not athletes ((S. A. Vella, C. Swann, M. Batterham, K. M. Boydell, S. Eckermann, H. Ferguson, A. Fogarty, D. Hurley, S. K. Liddle, C. Lonsdale, A. Miller, M. Noetel, A. D.

Okely, T. Sanders, M. J. Schweickle, J. Telenta, F. P. Deane. An intervention for mental health literacy and resilience in organized sports. *Medicine & Science in Sports & Exercise*. **53**, 139–149 (2020).)). It is assumed that elite and even semi-elite athletes must have incredible levels of resilience to perform well and improve at their level. However, knowing that their mental health is linked with their resilience based on our models, it is evident that elite and semi-elite athletes should also focus on improving or maintaining good mental health, as this will act as a driving force for greater levels of resilience. Knowing this means athletes could focus on building good mental health as a preemptive measure to reduce the risk of burnout and increase resilience.

Model 4 shows that sleep has a positive correlation with mental health. This confirms prior research, which says that poor sleep quality positively correlates with poor mental health ((A. J. Scott, T. L. Webb, M. M.-S. James, G. Rowse, S. Weich. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. *Sleep Medicine Reviews*. **60**, 101556 (2021).)), by modeling this same relationship. This further emphasizes the importance of good sleep in athletes since sleep is positively correlated with mental health, and, in turn, mental health is positively correlated with performance ((D. L. Rogers, M. J. Tanaka, A. J. Cosgarea, R. D. Ginsburg, G. M. Dreher. How mental health affects injury risk and outcomes in athletes. *Sports Health a Multidisciplinary Approach*. **16**, 222–229 (2023).)).

Model 5 shows a positive correlation between sleep and resilience, confirming prior research ((M. Breus. How sleep helps build resilience. *Sleep Doctor*. (2024).)). Resilience is incredibly important to athletes because it allows them to better recover from failures, adapt to challenges, and bounce back from setbacks ((M. Sarkar, D. Fletcher. Psychological resilience in sport performers: A review of stressors and protective factors. *Journal of Sports Sciences*. **32**, 1419-1434 (2014).)). This means that sleep is important for athletes who want to improve their resilience and, by extension, performance.

Model 6 shows that sleep positively correlates with athletic identity in athletes, which is the opposite result of what we initially hypothesized and has not been specifically covered in prior research. A prior study identified that athletic identity negatively correlates with sleep time and quality for retired athletes ((A. Montero, J. Baranoff, R. Adams, M. Drummond. Athletic retirement: Factors contributing to sleep and mental health problems. *Frontiers in Psychology*. **15**, (2024).)). In the context of this prior research, our finding indicates that there is a dramatic shift in the relationship between sleep and athletic identity when athletes retire: before retirement, athletes exhibit a positive relationship between sleep and athletic identity, but after retirement, they exhibit a negative relationship between sleep and athletic identity. For athletes, this may mean that the performance benefits of a high athletic identity may turn to mental health-harming effects once they retire from being an athlete. This essentially may indicate that, at retirement, the benefits of a high athletic identity for an athlete switch to drawbacks. The reasons for this are not entirely clear. However, we think a possible cause is that retirement causes athletes to lose the part of their sense of self that is athletic identity, which harms their mental health since the loss of a previously held identity has been shown to have adverse effects on mental health ((J. P. Wisdom, K. Bruce, G. A. Saedi, T. Weis, C. A. Green. 'Stealing Me from Myself': Identity and recovery in personal accounts of mental illness. *Australian & New Zealand Journal of Psychiatry*. **42**, 489–495 (2008).)).

Our finding that sleep is positively correlated with athletic identity is another reason why sleep is so vital for athletes. Sleep not only improves an athlete's mental health ((A. J. Scott, T. L. Webb, M. M.-S. James, G. Rowse, S. Weich. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. *Sleep Medicine Reviews*. **60**, 101556 (2021).)) and resilience ((M. Breus. How sleep helps build resilience. *Sleep Doctor*. (2024).)) but also strengthens their athletic identity—the link between their

identity and their sport—fostering more commitment and dedication that is vital to performance gains that resilience alone may not drive.

The positive correlation between sleep and athletic identity may also suggest that building an identity surrounding a sport is more nuanced than simply the time spent, commitment, and level of success. Rather, athletic identity formation and growth may stem from a more holistic set of factors in an athlete's life. Most athletes do not spend most of their time physically engaged with their sport since the body takes time to recover and repair itself between physically strenuous sessions; a lot of this recovery happens during sleep ((R. Doherty, S. M. Madigan, A. Nevill, G. Warrington, J. G. Ellis. The sleep and recovery practices of athletes. *Nutrients*. **13**, 1330 (2021).)). This link between sleep and athletic identity points towards the greater idea that all aspects of an athlete's lifestyle affect their athletic identity.

Model 7 shows a negative correlation between loneliness and mental health. This correlation has been shown in prior research ((R. Mushtaq, S. Shoib, T. Shah, S. Mushtaq. Relationship between loneliness, psychiatric disorders and physical health ? A review on the psychological aspects of loneliness. *Journal of Clinical and Diagnostic Research*. **8**, WE01-WE04 (2014).)), so Model 7 confirms it. Since maintaining good mental health is important for athletic performance ((D. L. Rogers, M. J. Tanaka, A. J. Cosgarea, R. D. Ginsburg, G. M. Dreher. How mental health affects injury risk and outcomes in athletes. *Sports Health a Multidisciplinary Approach*. **16**, 222–229 (2023).)), the connection between mental health and loneliness means it is also important for athletes to consider whether loneliness may be negatively impacting their mental health and, by extension, performance.

The negative correlation between resilience and loneliness has also been researched before, where it was found that the relationship could help explain some of the variance in depression symptoms ((I. S. Jakobsen, L. M. R. Madsen, M. Mau, O. Hjemdal, O. Friborg. The relationship between resilience and loneliness elucidated by a Danish version of the resilience scale for adults. *BMC Psychology*. **8**, (2020).)). However, prior research has not specifically explored the direct relationship between loneliness and resilience in semi-elite and elite athletes. It has, however, been shown that they have opposite effects on burnout. Loneliness is correlated with more difficulty coping with burnout ((British Psychological Society (BPS). The loneliness of the individual athlete. *ScienceDaily*. (2016).)), while resilience has been shown to mediate burnout ((M. Yıldırım, Ö. Kaynar, F. Chirico, N. Magnavita. Resilience and extrinsic motivation as mediators in the relationship between fear of failure and burnout. *International Journal of Environmental Research and Public Health*. **20**, 5895 (2023).)). Model 8, however, shows that this relationship is a direct negative correlation between loneliness and resilience. This means that loneliness and resilience's opposite effects on burnout are likely, at least in part, due to their negative correlation with each other.

The findings shown by models 7 and 8 are especially important for athletes since loneliness is a prominent issue, especially for athletes who may sacrifice social events and friendly gatherings in pursuit of performance ((A. Pipe, The adverse effects of elite competition on health and well-being. *Canadian Journal of Applied Physiology*. **26**, S192–S201 (2001).)). Mental health and resilience ((M. Sarkar, D. Fletcher. Psychological resilience in sport performers: A review of stressors and protective factors. *Journal of Sports Sciences*. **32**, 1419-1434 (2014).)) are vital to athletic performance ((D. L. Rogers, M. J. Tanaka, A. J. Cosgarea, R. D. Ginsburg, G. M. Dreher. How mental health affects injury risk and outcomes in athletes. *Sports Health a Multidisciplinary Approach*. **16**, 222–229 (2023).)). Athletes who want to maintain or improve these two important mental factors may want to consider if loneliness is a limiting factor in their mental health or resilience and, by extension, their performance.

**Conclusion**

It is important for athletes to understand what factors will affect their athletic identity, as well as how to manage and control mental factors that may affect their performance. The results of this study confirm the importance of maintaining good mental health and sleep, as these factors are associated with some performance-affecting mental factors in athletes, including resilience and athletic identity. In addition, we have confirmed the importance of athletes dedicating a high volume of hours to their sport since this helps build athletic identity, which is the core of an athlete's dedication to a sport. We've also found that sleep is positively associated with athletic identity, showcasing the important role of sleep in athletes who want to strengthen the bond between their identity and their sport. Furthermore, we've found support for how good mental health is positively associated with the resilience of not just regular people but also elite and semi-elite athletes. Connected to the relationship between mental health and resilience is loneliness, which we've shown is negatively associated with both mental health and resilience, the latter of which is a direct relationship that affects the risk of burnout.

The most significant finding of this study is the link between sleep and athletic identity since our study was the first to find this relationship in active athletes. This link emphasizes the holistic development of athletic identity and, by extension, performance. This is to say that the building of an athletic identity does not just depend on actions taken by an athlete that are directly connected to their sport, such as training, competition, and recovery methods. Rather, non-sport aspects of their life, such as sleep, can also contribute to their athletic identity. Athletes are not just created on the field, court, or weight room; their identity as athletes is built through many aspects of their lives, including something as basic as sleep.

This new finding opens new avenues of research that could delve into how sleep's neurological effects and nuances may affect an athlete's sense of identity attached to their sport. Research on this could identify mechanisms and root causes for the strengthening of athletic identity due to increased sleep, which in turn would improve understanding of the processes that contribute to the building of athletic identity. Since athletic identity is important for athletic performance, a deeper understanding of the processes that build athletic identity could be promising for performance improvement.

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