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Article in *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine* · February 2021

DOI: 10.5664/jcsm.8938

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## SPECIAL ARTICLES

### Urgent wake up call for the National Basketball Association

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Frequent air travel and the condensed game schedule typical of a National Basketball Association (NBA) team during the season, often results in accompanying sleep disturbances related to sleep length, sleep quality, and sleep timing (with highly harmful impacts on health, both physical and mental). These issues are not only problematic for NBA players, but also the coaches, training staff, and management support. In this narrative review, we summarize the detrimental effects that this travel and game schedule could have on NBA team members' sleep, as well as their physical and mental health. Multiple peer-reviewed articles address the role of sleep in athletic performance and health; however, to date, the literature focused on sleep-related issues that are unique to the NBA schedule is scarce. Firstly, this review addresses the impact of the NBA schedule, outlining the number of games and the travel involved (number of flights, the timing of flights, timings of arrival at destination and hotel); we also outline a typical daily NBA travel schedule, providing the reader a glimpse of what this encompasses. Secondly, we provide a brief overview of sleep science and discuss specific applications related to the NBA. Finally, we provide comment on the unique current situation of the NBA "bubble". Based on this review, there appears to be considerable scope for further investigation of the acute and chronic effects of sleep disturbances concerning the NBA travel and game schedule. Sleep science recommendations need to inform practice, target sleep interventions, and personalized protocols designed to enhance sleep health that can be incorporated at the organizational level.

**Keywords:** sleep, NBA, basketball, sleep science, sleep disturbances

**Citation:** Singh M, Bird S, Charest J, Huyghe T, Calleja-Gonzalez J. Urgent wake up call for the National Basketball Association. *J Clin Sleep Med.* 2021;17(2): 243–248.

#### INTRODUCTION

It's a "hard-knock life",<sup>1</sup> that is often how National Basketball Association (NBA) insiders (players, coaches, and managers) describe their life, and, although said in half jest, the sleep deprivation and circadian disruption inherent in a typical NBA season has serious implications for the health and performance of all team members. For decades, NBA culture has glorified sleep deprivation and the willingness to endure the constant travel and the congested game schedule has become a norm, often routing out those players who are unable to cope and survive this schedule.<sup>2–4</sup> Over the last few years, the science surrounding the detrimental effects of poor sleep on the health and performance of athletes is growing as is the knowledge that interventions aimed at improving sleep enhance athletic health and performance.<sup>5–8</sup> This knowledge has trickled down to the league and team level, but without an accompanying change in NBA culture, impact will be limited. It is commonly accepted that playing in the NBA creates a significant challenge for sleep health, and successful performance requires a planned approach to addressing this challenge. This opinion article will present the case for why it's imperative for the league and NBA team members to make sleep health a priority.

#### SLEEP SCIENCE

The recommended amount of sleep needed to achieve optimal health and quality of life varies across the life span, with a

gradual decrease from birth to older adulthood, and, according to the American Academy of Sleep Medicine, adults require between 7 and 9 hours of sleep for optimal performance and health.<sup>9</sup> In general, reports of poor sleep quality and inadequate sleep duration are high among elite individual and team sport players in various sports categories.<sup>10,11</sup> These sleep complaints range from athletes sleeping inadequate amounts to complaints of poor quality of sleep described variously as unrefreshing sleep and dissatisfaction with sleep.<sup>10,13</sup> Additionally, athletes with poor quality and inadequate amount of sleep also complain of accompanying daytime sleepiness and fatigue.<sup>10,14</sup> The question of whether participation in sports itself results in degraded sleep has been explored.<sup>15</sup> Indeed, athletes may have multiple reasons why they sleep poorly, including their training, practices, and travel schedules.<sup>14,16</sup> Scientific research shows that both waking up early for training and night time competition reduced sleep.<sup>14,17</sup> Indeed sleep behavior may notably vary depending on the athlete's typical daily schedule.<sup>16</sup> In fact, specificity of training and competition schedules possibly accounts for the single most influential factor leading to inconsistency in sleep opportunity among elite athletes (eg, "social jet lag"). Additionally, athletes are affected by extensive exposure to electric light and evening use of electronic media device, each of which can have a significant negative impact on sleep.<sup>18,19</sup> Finally, sleep in athletes also can be undermined as a consequence of long-distance travel and the associated disturbances in mood, stress, and anxiety.<sup>15</sup> Taken together, there is compelling evidence that elite athletes often fail to obtain the

recommended amount of sleep, and importantly, athletes have been found to demonstrate poor self-assessment of their sleep health, including duration and quality.<sup>20</sup>

Although, there has been no formal research aimed at studying sleep habits of NBA players, it is well known that the NBA faces many unique sleep challenges, given its congested game schedule and the accompanying travel.<sup>21,22</sup> Additionally, their daily schedules that traditionally include morning practices balanced with the evening and occasional afternoon games interspersed with pre and post practice shoot-around, medical treatments, media commitments, and charity events, as well as family and social obligations, often make adequate and regular sleep extremely challenging. A detailed dive into NBA travel and game schedules provides critical insight into the question: does sport, specifically NBA, degrade sleep? We make the case that it most certainly does.

## SCHEDULE DENSITY

The NBA schedule is described as an intensified and congested structure of competition, consisting of 30 teams from 4 different time zones up to 2,708 miles apart.<sup>21</sup> The league is composed of 2 conferences with 3 division each, with each team playing 82 games in the regular season, spanning approximately 26 weeks (177 days), between November and April.<sup>22</sup> This is followed by the postseason playoffs (April–May) and NBA finals (potentially 28 games). Therefore, teams are confronted with high-density fixture scheduling throughout the season,<sup>23</sup> which has required players, on occasion, to play 5 games in 7 nights. Thus, players are rarely provided with 2 or more days of recovery between games. In recent years, there has been growing media concern surrounding the injuries incidence within the NBA, as a potential result of increased travel and game demands, namely, the game dense schedule.<sup>23–26</sup> Add to that international global games for some NBA teams and the picture becomes very clear: travel and sleepiness are constant challenges in the NBA. For example, in the 2018–2019 season, the average NBA team played every 2.07 days, had 13.3 back-to-back sets, and flew the equivalent of 250 miles a day for 25 straight weeks.<sup>27</sup> This is an important consideration regarding the long-term health and wellbeing of not only players but coaches and managers as well.

## IMPACT OF POOR SLEEP

### Does poor and inadequate sleep in the NBA degrade athlete mental and physical health?

Maintaining and optimizing physical and mental health is crucial for athletic performance. The necessary foundation for athletes is the ability to stay healthy; avoiding illness and injury is fundamental for a successful athletic season and even career. These mental and physical aspects are directly linked to sleep quantity and quality. We know that in the general population, a host of negative health effects, including neurocognitive, metabolic, immunologic, and cardiovascular dysfunction are associated with reduced sleep quantity.<sup>28</sup> Notably, sleep deprivation increases proinflammatory cytokines, which impair

immune system function.<sup>29</sup> Indeed, it has been suggested that adequate sleep is a protective factor against illness. Specifically, in 2009, Cohen and colleagues<sup>30</sup> exposed 153 healthy men and women (age range 21–55 years) to rhinovirus by administering nasal drops, and they monitored the development of clinical cold 5 days after exposure. Participants sleeping fewer than 7 hours per night were 2.94 more likely to develop a cold than those with 8 hours or more per night of sleep. Additionally, fever, which is ultimately intertwined with flu, has many ill effects on the body, such as an increase in insensible fluid losses, dehydration, metabolic demands, and a dysregulation of body temperature,<sup>31</sup> and is correlated with a reduction in exercise tolerance, decreased endurance, and muscle strength and an increase in perceived fatigue.<sup>31</sup> Ultimately, it is fundamental for an athlete to strategize their sleep adequately to reduce the likelihood of getting ill and impacting their athletic performance negatively.

### Does poor and inadequate sleep in the NBA increase injury risk?

There is growing evidence in research literature that decreased sleep is associated with an increased risk of injury in athletes in general. A recent study of 496 adolescent athletes from 16 different individual and team sports found that increased training load and decreased self-reported sleep duration were independently associated with an increased risk of injury.<sup>32</sup> The impairments in reaction time and cognitive function associated with sleep deprivation were thought to underlie this increased risk. However, the question of whether the NBA schedule density impacts injuries is complex and multifactorial.<sup>1</sup> Teramoto and colleagues<sup>33</sup> examined game injuries and game schedules in the 2012–2013 through 2014–2015 NBA season and found that playing back-to-back games and away games were significant predictors of game injuries (3.5 odds ratio). However, Mack et al,<sup>34</sup> argue that the statistical approach employed by Teramoto et al was fundamentally flawed, suggesting that the authors described the relationship between 2 exposures to game scheduling, but not the relationship of these exposures with injury risk. More recently, Esteves et al,<sup>21</sup> outlined the detrimental effect of playing back-to-back games on the game outcome, reporting that having at least 1 day of rest between games increased the likelihood of winning by 37.6%. As with all research, academic inquiry and debate is encouraged, however with player health and wellness at the forefront, the NBA schedule was subsequently modified to promote greater recovery time between games by reducing the number of back-to-back games and eliminating scheduling of 4 games in 5 days.<sup>35</sup> Purely, from a performance perspective, it is a balancing act for coaches between interpreting the science and practical application (the art) to maximize the probability of winning and minimize the risk of injury. This has seen evolution of the NBA “Did not play rest” strategy, credited to Gregg Popovich and the San Antonio Spurs,<sup>36</sup> with preliminary data supporting its utility. Lewis<sup>1</sup> reports that not playing in back-to-back games can reduce the probability of an injury by almost 16% for the average player. Ultimately, the goal for many NBA players is to maintain an impactful playing career for several consecutive years. Based on NBA data, the average career length of an NBA player

between the years 1946 and 2011 was 4.87 seasons. The high rate of injuries among NBA players may be one of the factors for such short careers.<sup>33</sup>

### Does inadequate and irregular sleep affect performance in the NBA?

The extensive travel inherent in the NBA may directly interfere with performance due to reduction in sleep quantity as well as alteration in sleep schedules and the accompanying disruption to circadian rhythms. The negative effects of sleep deprivation on performance, including reaction time, accuracy, vigor, submaximal strength, physical qualities (strength and speed), physiological and psychological health, injury and illness risk, and recovery and endurance, as well as on cognitive functions such as judgment and decision making are well established.<sup>37</sup> This would ultimately mean impaired athletic performance and an impact on in-game performance in the NBA player.

One study exploring this very question found that late-night tweeting (compared to no late-night tweeting) is associated with within-person reductions in next-day game performance, specifically fewer points scored, fewer rebounds, less time played per game, more turnovers, more personal fouls committed, and a lower shooting accuracy.<sup>38</sup> In this case, late-night tweeting served as proxy to sleep restriction. Once again, this raises a potential link between electric light and electronic device use and negative impact on sleep. The effect of sleep restriction may also accumulate over a typical NBA season, culminating in extensive sleep deprivation negatively impacting performance just at the time when optimal performance is critical for team success. Additionally, among athletes in general, transmeridian travel with its associated jet lag and/or circadian disruption, can be associated with fatigue, disorientation, impaired sleep, and general discomfort, all of which are threats to athletic performance.<sup>39</sup> Performance decrements after travel across time zones also can be compounded by training or competition times that do not align with the typical circadian rhythms based on the athletes' home time zone.<sup>40,41</sup>

In contrast, experiments of sleep extension by a few hours have demonstrated improved performance among collegiate basketball players.<sup>42</sup> In particular, the increment of total objective sleep time, including both nocturnal sleep and daytime naps (110.9 ± 79.7 minutes of additional sleep time) compared to baseline resulted in faster sprint times, increased free throw percentage by 9%, increased 3-point field goal percentage by 9.2% ( $P < .001$ ), increased Profile of Mood States scores ( $P < .001$ ), improved psychomotor vigilance task (reaction test) and decreased Epworth Sleepiness Scale ( $P < .01$ ), and improved overall ratings of physical and mental well-being during practices and games. Taken together, the abovementioned evidence points to converging pathways of how the NBA schedule may have a negative influence on the health and performance of NBA players. Thus, this subject matter warrants further awareness, education, and promotional incentives among players, staff, and club stakeholders, as well as urgency for future research dedicated to novel noninvasive, valid, and reliable fatigue monitoring and recovery strategies to compensate for the

unavoidable sleep and circadian disruptions that occur in the NBA.

## OTHER CONSIDERATIONS

### Frequent flyers, NBA stakeholder voices, and what the future holds

While the 2017–2018 NBA season marked the 1st season in NBA history in which no team played 4 games in 5 nights,<sup>22</sup> the NBA schedule and air travel requirements remain an ongoing concern (Table 1). According to ESPN's Baxtor Holmes,<sup>27</sup> NBA teams travel more miles in a season than do teams in any other sport, with the Trail Blazers flying an NBA-high 54,004 miles during the 2017/2018 season. To put that in perspective, that is the equivalent of flying from Chicago to Cleveland every single day for 176 consecutive days. In another example, the Sacramento Kings faced a schedule that included 16 back-to-back games, an intensified period of 6 road games in 12 days, with the team traveling 49,159 miles over the course of the season.<sup>43</sup> This may have significant health and performance implications, especially for rookies in their professional transition. Anecdotal reports suggest that there is a tendency for NBA rookies to "do more", "put more shots up", and "spend more time on the floor" in an effort to get that competitive edge. In doing so, they may not devote appropriate time to psychological and physical recovery.

### Inside the locker room

Former Sacramento Kings Assistant Coach, Jason March, is adamant that fatigue is the biggest challenge for potential draft picks as they find themselves flying in from all over the country for predraft workouts, "I think the biggest challenge for the rookies is fatigue, it does take a toll on them. Some of these guys are flying across the country, there is 'I got to get on a flight be here at this time'... so fatigue definitely plays a factor."<sup>44</sup> Following the 2017–2018 season, the challenges faced by rookies was further highlighted on the Sacramento Kings Rookie Roundtable.<sup>45</sup> Dave Mason and Morgan Ragan spoke with 4 of the Kings rookies, and when Mason asked, "Hitting the rookie wall, everyone talks about the rookie wall, do you guys feel like you ever hit it, is that like a real thing to you guys?" De'Aaron Fox replied, "Oh, I hit mine, so after I did that, is like I started playing well, it's like, once you hit it, accept it, and overcome it. We played the Clippers back-to-back, played them here, had a day off, and played them there, had a day off, and then went to OKC [Oklahoma City]. I just felt like, I was sick, and my body was, well it felt like my body was falling apart. After that, you know I let it go, I felt like that's what really started to get rolling." Collectively, this insight provides a glimpse inside the world of an NBA rookie.

And it's not just the players, as the wellbeing of coaches is also under the spotlight. Dan Woike of the *Los Angeles Times* reported<sup>46</sup> that in discussions with more than half a dozen NBA coaches about a wide range of health issues, it is lack of sleep that has people most concerned. On the road, that means late-night flights poring over game film. At home, it means trying to battle the emotional extremes that competing in an NBA game

**Table 1—2017/2018 Most miles traveled by playoff teams.**

2017/2018 Likely Playoff Teams	Miles	Conference	Record (W/L)
Portland Trail Blazers	54,004	Western	49/33
Minnesota Timberwolves	52,401	Western	47/35
Oklahoma City Thunder	48,459	Western	48/34
Houston Rockets	48,194	Western	65/17
Miami Heat	47,775	Eastern	44/38
Utah Jazz	47,447	Western	48/34
New Orleans Pelicans	47,294	Western	48/34
Boston Celtics	47,215	Eastern	55/27
Golden State Warriors*	46,415	Western	58/24
San Antonio Spurs	46,258	Western	47/35
Milwaukee Bucks	43,194	Eastern	44/38
Philadelphia 76ers	40,751	Eastern	52/30
Washington Wizards	40,741	Eastern	43/39
Cleveland Cavaliers	38,303	Eastern	50/32
Toronto Raptors	36,457	Eastern	59/23
Indiana Pacers	35,520	Eastern	48/34
<b>Average</b>	<b>48,546</b>		

Adapted from Holmes.<sup>27</sup> \*NBA champions. W/L = wins/losses.

bring with it. This is further evidenced by Charlotte's Steve Clifford having to recently step away from coaching for nearly 6 weeks so he could resolve stress-related headaches caused by a lack of sleep.<sup>47</sup>

### Player and coach voices

In this ever-evolving sport science world, it is easy to get lost in the numbers and often forget about the most ecological valid data at our fingertips, that of the "player's voice". Above all, when players talk about their health and wellbeing, the warning signs are there, we all need to wake up and listen.<sup>2-4,23,26,27</sup>

- "You ask anybody in the room, the thing I talk about is sleep. I think in a couple years, [sleep deprivation] will be an issue that's talked about, like the NFL with concussions."
- "Lack of sleep messes up your recovery, messes up how you play, your cognitive function, your mindset, how you're moving on the court. Sleep is everything."
- "You grow up knowing about the 82-game schedule in the NBA, but it's totally different when you experience the difficulty of that schedule yourself."
- "The travel can mess with you, whichever direction you are travelling. You get in super late at night, but you're wide awake at two in the morning because your body is used to a different time zone"
- "Travel and sleep are just destroying these athletes, and I think that's what the NBA really needs to think about."
- "Unfortunately, we'll never really see what these guys can really do, because they're tired all of the time – because of the schedule."
- "By the end of the season, if you were 6 feet tall when it started, now you're 5-foot-2, it just wears you down and you just have to somehow focus on yourself and your health

- "It's the grind of the season. You're reading more and more about the importance of sleep. Sleep is your recovery, whether you're a player or a coach, for everyone. It's so important you can't overlook it."

### The NBA "bubble"

Given the above discussion, it becomes important to comment on the current situation, on how the current NBA playoffs format in the "bubble" provides an opportunity for a controlled experiment, where all travel is eliminated. Due to the unprecedented circumstances and challenges presented by coronavirus disease (COVID-19),<sup>48</sup> the 2019/2020 NBA implemented a unique and unknown playoff format due to the COVID-19 pandemic, with all 16 teams located within the NBA "bubble" in Orlando, Florida, competing at the ESPN (Entertainment and Sports Programming Network) Wide World of Sports Complex in Walt Disney World.<sup>49</sup> Not only has the NBA bubble been successful in protecting players from COVID-19 (since entering the bubble, there have been no reports of any NBA player or staff members testing positive from COVID-19), the NBA bubble has been suggested to be a "competitive equalizer" by eliminating team travel. It would be logical to link the numerous advantages of eliminated travel to improved player health and wellbeing and a potential differentiating factor between teams (Eastern Conference compared to Western Conference).<sup>49</sup>

For example, a recent abstract published in *Sleep*<sup>50</sup> reported that during NBA playoffs, team scoring improved during eastward travel (compared to westward travel) and travel in the same zone, while game outcomes remaining unaffected by direction of travel. However, the authors noted that teams had lower predicted probabilities of winning after traveling 3 time zones westward and lost more games when traveling 2 time zones

westward compared to most other types of travel, thereby influencing in-game performances and NBA playoff outcomes.<sup>50</sup> It is not unreasonable to suggest that such responses could be attributed to the effect of travel-related circadian disadvantage. These preliminary findings may be of important consideration for the current NBA playoffs, in that the NBA bubble may eliminate the disadvantages related to long-distance travel. Such a contention is supported, in part, by anecdotal reports by NBA General Managers suggesting the benefits of the lack of travel. Recently, ESPN's Baxter Holmes quoted one Western Conference General Manager,<sup>51</sup> "Our guys feel better ... we've got these games and we don't have to jump on planes [afterward]." This is further supported by comments from a Western Conference Athletic Trainer inside the bubble, "This is the advantage that we have not had. We're always tired ... Our guys have been rested. They've been fresh. We've been able to get them recovered again and again."<sup>51</sup> However, while the players may feel physically recovered, the NBA bubble presents significant mental health challenges.<sup>52,53</sup> Collectively, these are key considerations in the context of "emotional wellness",<sup>54</sup> which is described as "person's ability to cope with daily circumstances and to deal with personal feelings in a positive, optimistic, and constructive manner".<sup>55</sup> It is well-established that sleep plays a critical role in emotional wellness.<sup>56-58</sup> Such is the importance of sleep, Scott and colleagues<sup>59</sup> highlight that many, if not all, mental health problems are associated with problems sleeping. Hence the recent emergence of the important role of sleep science in player health and wellbeing.

## FINAL WAKE-UP CALL FOR THE NBA

The impact of sleep restriction and circadian rhythm disruption on NBA teams members' overall health and performance is one of the worst kept secrets in sports.<sup>35-37</sup> This paper is a final wake-up call to the NBA, given the inherent sleep problems we have described. The significance of the reported sleep restriction and circadian rhythm disruption is the potential long-term detrimental effects not only on athletic performance but, more importantly, on player health and wellbeing.<sup>7</sup> Ultimately, this means that implementing strategies, such as napping<sup>27</sup> and sleeping adequately<sup>7</sup> and strategically among others, could be beneficial for NBA players and staff members. In particular, the specific goals of these recovery strategies, such as napping and sleep scheduling, need to be investigated thoroughly to address the 82-game NBA schedule to protect the health and performance of athletes. Finally, implementing an adequate sleep screening and sleep education strategy could have significant implications for health, athletic performance, and beyond. This would be the first step toward new opportunities to explore crucial aspects of mental and physical health, paving the way toward novel interventions to enhance wellbeing among NBA athletes and staff members.

## ABBREVIATIONS

COVID-19, coronavirus disease  
NBA, National Basketball Association

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## SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication September 3, 2020

Submitted in final revised form October 13, 2020

Accepted for publication October 13, 2020

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## DISCLOSURE STATEMENT

All authors have seen and approved this manuscript. The authors report no conflicts of interest.