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## SCIENTIFIC INVESTIGATIONS

# Women are underrepresented in major US sleep societies recognition awards

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**Study Objectives:** To investigate gender distribution of US sleep professionals who received major recognition awards over a 40-year period from the 2 national sleep societies: the American Academy of Sleep Medicine and the Sleep Research Society.

**Methods:** We reviewed and analyzed the publicly available lists of sleep recognition awards recipients from the American Academy of Sleep Medicine and the Sleep Research Society websites. The primary outcome measures were the overall proportion of individual sleep recognition awards given to US men and women sleep professionals and the trend over time (1981–2020) analyzed by decade using the Cochran-Armitage test.

**Results:** Seven major sleep recognition awards (4 by the American Academy of Sleep Medicine and 3 by the Sleep Research Society) were identified over 40 years. There were overall 164 individual sleep recognition awards presented by the 2 sleep societies to US sleep professionals, including 136 (82.9%) awarded for men and only 28 (17.1%) awarded for women. The analysis of the sleep recognition awards over time by decade revealed a significant increasing trend ($P < .0001$) in the proportion of awards recognizing women relative to men, with a progression from 0.0% in the 1980s to 3.4% in the 1990s to 13.1% in the 2000s and to 31.7% in the 2010s.

**Conclusions:** US women sleep professionals were historically underrepresented in major sleep recognition awards, with a reduction in the gender gap in the last 10 years. The reasons behind gender inequality in sleep recognition awards remain unclear and deserve further investigation.

**Keywords:** awards; sexism; gender bias; gender disparities; sleep societies; sleep professionals

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**BRIEF SUMMARY**

**Current Knowledge/Study Rationale:** Gender disparities between men and women exist at different levels and in different specialty societies; however, there is paucity of data on the gender distribution in sleep recognition awards among women and men sleep professionals. This study aims to analyze gender disparity in sleep recognition awards from 2 major sleep societies and among US sleep professionals.

**Study Impact:** This study highlights the gender gap in sleep recognition awards with a clear historical underrepresentation of women compared to men sleep professionals. Reporting these results will help address the problem of gender disparities in sleep societies as well as open the door for further investigations into the reasons for gender bias.

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## INTRODUCTION

Gender discrimination toward women has been well described in science and medicine,[1] including in specialties where they comprise the prominent workforce.[2,3] The gender gap favoring men in science and health care exists at multiple levels, including in salaries and compensation,[4–8] academic ranking and leadership,[5,9–12] and authorship in scientific publications.[13–17] In the sleep medicine and sleep research fields, data are sparse on gender disparities and representation of women sleep physicians and scientists. Unequal pay between women and men sleep physicians has been recently described in the American Academy of Sleep Medicine (AASM) 2018 compensation survey, with women reporting earning about 20% less than men (median compensation of $242,212 vs $303,515).[18] According to the AASM diversity and inclusion committee report from 2019, physicians who are members of the AASM are predominantly men, with no parity achieved yet (approximately 26% women vs 72% men vs 2% no disclosed gender).[19] Moreover, there were significant delays in women's access to

the sleep medicine and sleep research leaderships, with the first woman elected only in 1995 as president of the AASM (established in 1975),[20] and the first woman elected only in 1999 as president of the Sleep Research Society (SRS) that was established in 1961.[21] In addition, only 6 women were elected as AASM presidents (17% of the total 35 presidents) and only 5 women were elected as SRS presidents (14% of the total 36 presidents) to date.[20,21] These women presidents served during only 13% of the 46 AASM years and during only 8% of the 59 SRS years (data extracted from the AASM and SRS websites).[20,21]

The underrepresentation of women in scientific and medical societies is not only limited to leadership roles but also extends to recognition awards.[22] In the scientific and medical communities, awards are considered markers of professional achievement and are important for career growth and promotion.[22,23] Silver et al[22,24–26] were the first to describe gender inequalities in recognition awards of several medical societies and to demonstrate zero or near-zero representation of women physicians in many recognition awards.[22] Of these, the Wayne A. Hening

**Table 1**—Description of the sleep recognition awards that were selected for analysis in this study.

| Sleep Society | Sleep Recognition Award Description | Years Awarded |
|---|---|---|
| American Academy of Sleep Medicine (AASM) | **Nathaniel Kleitman Distinguished Service Award** honors individuals dedicated to the sleep field who have made significant contributions in the areas of administration, public relations, and government affairs. | 1981–2020 |
| | **William C. Dement Academic Achievement Award** recognizes members of the sleep field who have displayed exceptional initiative and progress in the areas of sleep education and academic research. | 1994–2020 |
| | **Mark O. Hatfield Public Policy or Advocacy Award** acknowledges an individual who has developed public policy that positively affects the healthy sleep of all Americans. This contribution is unique yet vital to the advancement of the field. | 1996–2020 (not given in 2002 and 2004) |
| | **Excellence in Education Award** presented to those individuals who have made outstanding contributions in the teaching of sleep medicine. The award serves to recognize and honor dedicated individuals who have skillfully taught and enhanced the knowledge of professional and lay people in the areas of sleep and sleep medicine. | 2002–2020 (not given in 2003 and 2005) |
| Sleep Research Society (SRS) | **Distinguished Scientist Award** recognizes significant, original, and sustained scientific contributions of a basic, translational, clinical, or theoretical nature to the sleep and circadian research field. This award honors a single individual of prominence in the research community over an entire career. | 1989–2020 |
| | **Mary A. Carskadon Outstanding Educator Award** honors excellence in education in the sleep and circadian research field. This award is given to a sleep professional to honor outstanding educational contributions to disseminating the knowledge base, research methods, and health and safety significance of the sleep and circadian field. | 2005–2020 |
| | **Outstanding Scientific Achievement Award** presented to individuals to recognize novel and seminal research dealing with a specific thematic area (not a collection of disparate findings) that has made a significant impact to the sleep and circadian research field. Generally, the major contribution is presented in a single publication, although in some cases the scientific contribution is best represented in a small series of discoveries. | 2006–2020 |

The information above about the sleep recognition awards for each of the sleep society was retrieved from their respective website available at: https://aasm.org/about/awards and https://www.sleepresearchsociety.org/awards.

Sleep Medicine Investigator Award of the American Academy of Neurology was given to only 2 women out of 10 physicians awardees since 2011, with no woman receiving this award for the first 6 years.[22]

The finding above suggested that there was a need for further investigation of the representation of women within major recognition awards of sleep societies. Therefore, the aim of this study was to explore the gender distribution and trend over time within sleep recognition awards given to sleep professionals (physicians and nonphysicians with a doctoral degree) based in the United States by the 2 national US sleep societies.

## METHODS

### Study design and selection of sleep awards and recipients

For this study, data were extracted between October and December 2019 and updated between May and June 2020 after examination of the lists of sleep awards published online from the websites of the two main US national sleep organizations: the AASM[27] and the SRS.[28] Given that all data collected were publicly available, this study did not need any institutional review board approval. Among the sleep awards available on the websites of the two US national sleep societies at the time of data retrieval, we included only the awards that recognized individuals who made substantial contributions to the sleep and circadian fields through research, education, and/or public service. Training programs awards (eg, mentor-mentee programs, career development awards), early or trainee investigator awards, scholarships, fellowships, and grants awards were not considered major recognition awards and were excluded. The sleep recognition awards analyzed from the AASM were the "Nathaniel Kleitman Distinguished Service Award", the "William C. Dement Academic Achievement Award", the "Excellence in Education Award", and the "Marc O. Hatfield Public Policy or Advocacy Award". The sleep recognition awards analyzed from the SRS were the "Distinguished Scientist Award", the "Outstanding Scientific Achievement Award", and the "Mary A. Carskadon Outstanding Educator Award". The description of each of these 7 selected sleep recognition awards is summarized in **Table 1**. Only sleep professionals, physicians (eg, MD, DO, MBChB, MD PhD) or nonphysicians with a doctoral degree (eg, PhD, DSc, DVM) who received 1 of the above sleep recognition awards and were based in the US at the time of a given award were included in this study. Awardees who were not sleep professionals (eg, administrators, public figures) or awardees who were sleep professionals (physicians or nonphysicians with a doctoral degree) but working outside of the US at the time of the award were excluded from further analysis. There was no exclusion for the number of times the same US-based sleep professional awardee can receive a specific award or different awards (each award being accounted for separately). To determine the gender

(woman or man) of each awardee selected for this study, a 2-step analysis was performed. First, the names of US-based sleep professionals who were recipients of one of the above selected sleep recognition awards were collected from the year each award was established until the most recent year at the time of this study and were assigned a gender based on their first name as listed on the websites of the AASM and the SRS.[27,28] Second, an online verification of the full name, biographies, and photographs for each awardee was performed to confirm the actual gender assigned. This 2-step process was independently done by the 2 authors of this study and any discrepancy was resolved by further discussion and verification between them. Of note, gender and not biological sex was used in similar previous studies to identify an individual as a woman or a man.[26] Although not ideal, it is assumed that the person's first name and physical appearance reflects whether the individual wishes to be identified as a man or a woman.[26]

## Primary and secondary measures

The data collected, reported on an Excel sheet (Microsoft Corporation, Redmond, WA), and further analyzed from both the AASM and the SRS websites[27,28] included the full individual name of each US-based sleep professional awardee selected with the associated name of the award given, the year the award was given, the sleep society giving the award, the credentials of each awardee, and the gender identified for each awardee. The primary measures for this study were 1) the overall proportion of individual sleep recognition awards given to US-based sleep professionals who were identified as women (vs men) across all sleep recognition awards and for all years as selected from the 2 national US sleep societies (AASM and SRS) and 2) the trend over time (over 4 different decades: 1980s, 1990s, 2000s, and 2010s) of this gender distribution. The secondary measures included the gender distribution of 1) the total individual awardees, 2) the total individual awards per awardee (single/ multiple awards), 3) the total individual awards per national US sleep society (AASM/SRS), 4) the total individual awards per type of award (research/education/service), and 5) the total individual awards per each of the 7 sleep recognition awards selected. The above primary and secondary measures were also summarized and analyzed for the subgroups of awardees who were physicians and those who were nonphysicians with a doctoral degree. In addition, for each individual awardee, we retrieved from Scopus the total number of publications and their citations as well as the total number of original publications (defined as research papers and review articles) and their citations up to the year each award was given. Scopus is Elsevier's multidisciplinary abstract and citation internet database with one of the largest numbers of indexed peer-reviewed biomedical journals.[29] Given that the number of publications and citations can change with time for each author, these were rechecked and updated in a 20-day period between May and June 2020. The number of publications and citations were considered as measures of scientific contribution and impact on the sleep and circadian fields. Furthermore, for each individual awardee, the year of medical school graduation (for physicians) or the year the nonmedical doctorate degree was awarded (for nonphysicians) was retrieved using several relevant internet websites (eg,

Doximity, department affiliation or institution) and the number of years since medical or doctorate graduation until the year the award was received was calculated.

## Statistical analysis

Continuous variables are presented as mean ± SD and, when appropriate, the median was also used (given nonnormally distributed continuous variables). Categorical variables are presented as percentage (frequency). The Cochrane–Armitage test was used to evaluate the trend of gender distribution (proportion of women and men) within the overall total number of individual sleep recognition awards over time by decades (this test was also performed for the physicians and nonphysicians with a doctoral degree separately). To compare 2 independent groups based on continuous variables, the nonparametric Mann–Whitney–Wilcoxon rank sum test was used. To compare 2 independent groups based on categorical variables (dichotomous or polytomous), the chi-square test (or Fisher's exact test when appropriate) was used. All statistical tests were 2-tailed, and a $P$ value $< 0.05$ was considered significant. Statistical analyses were conducted using XLSTAT 2020.5.1.[30]

## RESULTS

A total of 192 individual sleep recognition awards were given by the AASM and the SRS over 40 years (from 1981 to 2020). The majority (90.6%; 174 awards) of the sleep recognition awards were given to individuals working at institutions in the United States. In addition, the sleep awards were given mostly to physicians (59.9%; 115 awards) or nonphysicians with a doctoral degree who were all PhDs (34.9%; 67 awards). There were 141 awardees over the 40 years of sleep recognition awards, with 110 (78.0%) awardees having a single award and 31 (22.0%) awardees having multiple awards. Of the 192 total sleep recognition awards, 164 (85.4%) were given to sleep professionals (physicians and nonphysician PhDs) based in the United States. Therefore, further analysis presented below was only conducted for those US-based sleep professionals as a whole group as well as for the subgroups of US-based physicians and US-based nonphysician PhDs.

## Gender differences and trend over time in total sleep recognition awards

Of the 164 total sleep recognition awards given to US-based sleep professionals over 40 years, 28 (17.1%) awards were given to women and 136 (82.9%) awards were given to men. There were 115 US-based sleep professionals awardees over the 40 years of sleep recognition awards, including 19 women (16.5%) and 96 men (83.5%). The overall trend in the number of sleep recognition awards given to women and men US-based sleep professionals over 40 years is illustrated in **Figure 1A**. Over the first 22 years (1981–2002), only 1 sleep award was given to a woman sleep professional (1.9% of the total sleep awards) compared to 51 sleep awards given to men sleep professionals (98.1%). The first US-based woman sleep professional (Mary A. Carskadon, PhD) was recognized only in 1991 after a delay of 11 years. In addition, the second sleep

**Figure 1**—Total number and proportion of sleep recognition awards by gender.
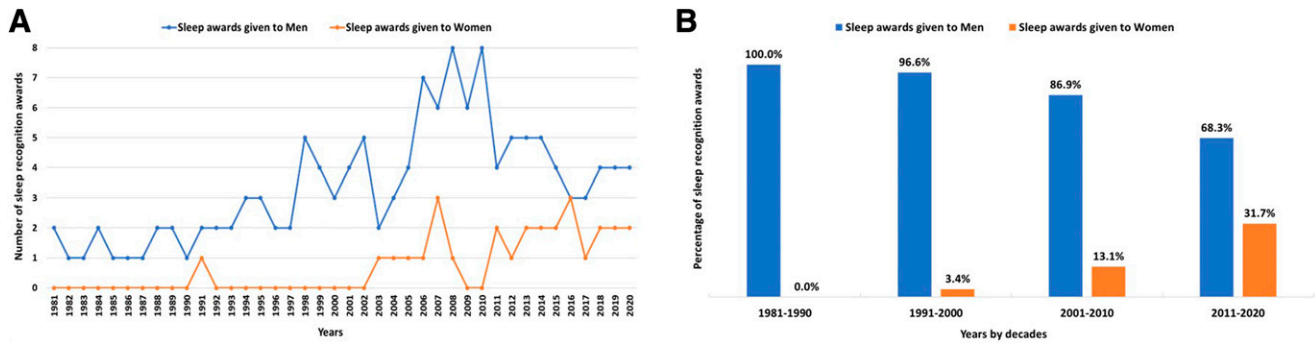


**(A)** Total number of sleep recognition awards given each year to sleep professionals based in the United States by the AASM and the SRS. From 1981 to 2002, women received only 1 (1.9%) of the total 52 sleep awards. From 2003 to 2020, women received 27 (24.1%) of the total 112 sleep awards. **(B)** Proportion of sleep recognition awards given each decade and over the last 40 years to men and women US-based sleep professionals by the AASM and the SRS. Using the Cochran-Armitage test, a significant trend toward a greater proportion of sleep awards given to women relative to men was observed over time, particularly in the last decade (*P* < .0001). AASM = American Academy of Sleep Medicine; SRS = Sleep Research Society.

recognition award given to a woman sleep professional (also to Mary A. Carskadon, PhD) was delayed by another 12 years and occurred only in 2003. In the subsequent 18 years (2003–2020), only 27 sleep recognition awards were given to women sleep professionals compared to 85 awards given to men sleep professionals (24.1% vs 75.9% of 112 total sleep awards). The analysis of the US-based sleep professionals' sleep recognition awards over time by decade (**Figure 1B**) revealed a significant increasing trend (*P* < .0001) in the proportion of awards recognizing women relative to men, with a positive progression from 0% in the 1980s to 31.7% in the last decade.

When looking at the gender distribution of total sleep recognition awards in the 2 subgroups of US-based physicians and nonphysician PhDs, a significantly lower proportion of awards (*P* = .0015) was given to women physicians (9.8% of the total 102 awards) compared to women nonphysician PhDs (29.0% of the total 62 awards). A similar trend (*P* = .0539) was observed for the women physician awardees (11.3% of the total 71 awardees) compared to the women nonphysician PhDs awardees (25.0% of the total 44 awardees). The overall trend in the number of sleep recognition awards given to women and men US-based physicians and nonphysician PhDs over 40 years is illustrated in **Figure 2A** and **B**, respectively). Over the first 25 years (1981–2005), no sleep awards were given to women physicians compared to 40 sleep awards given to men physicians (0.0% vs 100.0% of 40 total sleep awards). During that same 25-year period, the proportion of sleep awards given to women nonphysician PhDs was also low (16.7% of 24 total sleep awards given to nonphysician PhDs) but still significantly higher compared to women physicians (*P* = .0167). The first US-based woman physician (Judith A. Owens, MD) was recognized only in 2006 after a further delay of 15 years from the first woman nonphysician PhD recognized as stated above in 1991. In addition, the second sleep recognition award given to a US-based woman physician (Barbara Phillips, MD) was delayed by another 5 years and occurred only in 2011 (after a further delay of 8 years from the second sleep award given to the same nonphysician PhD as stated above in 2003). In the last 15 years

of sleep recognition awards (2006–2020), only 10 sleep awards were given to women physicians compared to 52 awards given to men physicians (16.1% vs 83.9% of 62 total sleep awards). During that same 15-year period, the proportion of sleep awards given to women nonphysician PhDs was significantly higher compared to women physicians (*P* = .0186) and accounted for more than one-third of the total sleep awards given to nonphysician PhDs (36.8% of 38 total sleep awards). The analysis of the sleep recognition awards over time by decade for the US-based physicians and the US-based nonphysician PhDs (**Figure 2C** and **D**, respectively) revealed a significant increasing trend in the proportion of awards recognizing women relative to men in both subgroups. For the subgroup of physicians, the positive progression of women representation in sleep awards (*P* = .0002) increased sharply only in the last decade (2011–2020). In the subgroup of nonphysician PhDs, this positive progression of women representation in sleep awards (*P* = .0193) increased sharply earlier in the third decade (2001–2010), with data suggesting a plateau may have been reached in the last decade (2011–2020).

## Gender differences in characteristics of the sleep recognition awards

**Table 2** summarizes the gender distribution based on several characteristics of the sleep recognition awards given to US-based sleep professionals. Overall, women sleep professionals constituted 15.3% of single sleep awardees and 20.0% of multiple sleep awardees. The gender distribution among single sleep awardees compared to multiple sleep awardees was not statistically different (*P* = .5734). The analysis of sleep recognition awards based on each sleep society showed that US-based women sleep professionals received 14.0% of the total AASM recognition awards and 21.9% of the total SRS recognition awards. There were no significant differences between the AASM and the SRS in terms of overall gender distribution of US sleep professionals' sleep recognition awards (*P* = .1911), even when considering a similar time period (1989–2020) when awards from both sleep societies were given (*P* = .3322). The

**Figure 2**—Total number and proportion of sleep recognition awards by gender and advanced degree.
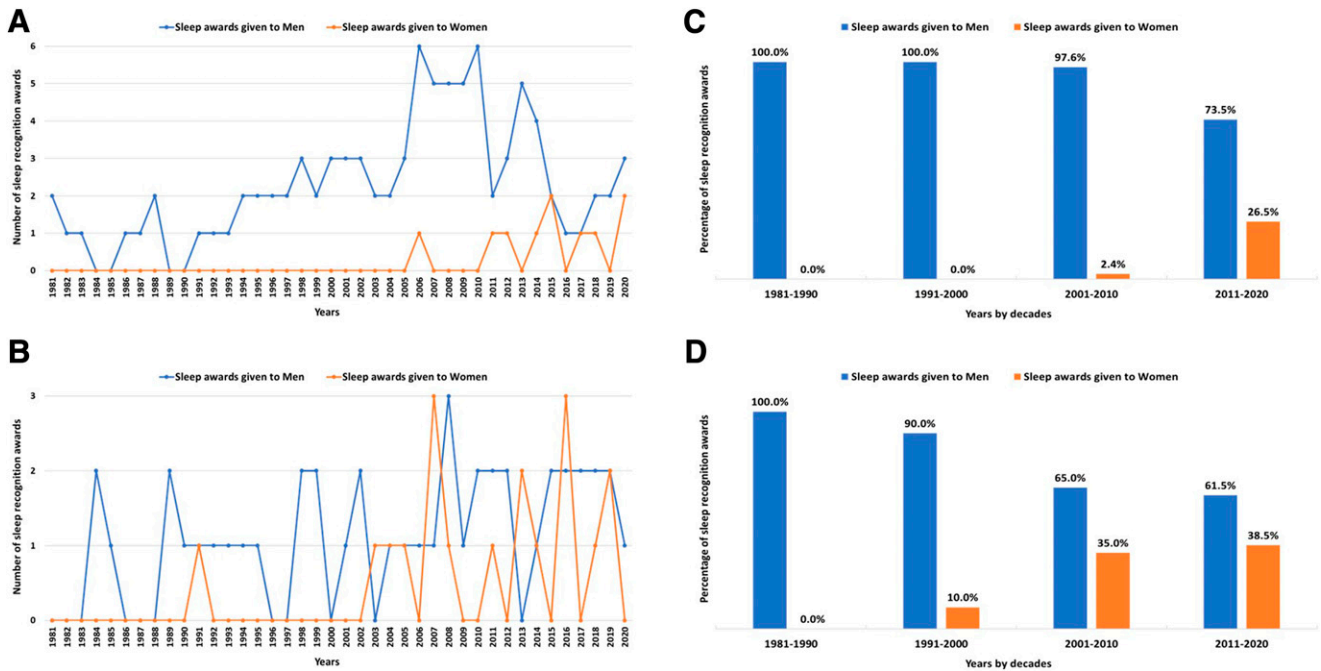


Total number of sleep recognition awards given each year to physicians **(A)** and nonphysician PhDs **(B)** based in the United States by the AASM and the SRS. From 1981 to 2005, women physicians did not receive any (0.0%) of the total 40 sleep awards given to physicians, while women nonphysician PhDs received 4 (16.7%) of the total 24 sleep awards given to nonphysician PhDs. From 2006 to 2020, women physicians received 10 (16.1%) of the total 62 sleep awards given to physicians, while women nonphysician PhDs received 14 (36.8%) of the total 38 sleep awards given to nonphysician PhDs. Proportion of sleep recognition awards given each decade and over the last 40 years to men and women US-based physicians **(C)** and nonphysician PhDs **(D)** by the AASM and the SRS. Using the Cochran-Armitage test, a significant trend toward a greater proportion of sleep awards given to women relative to men physicians ($P$ = .0002) and nonphysician PhDs ($P$ = .0193) was observed over time with a possible plateau reached for the nonphysician PhDs. AASM = American Academy of Sleep Medicine; SRS = Sleep Research Society.

**Table 2**—Characteristics of 164 sleep recognition awards given to 115 sleep professionals based in the United States.

|  | Women Awardees or Awards Given to Women | *P* |
|---|---|---|
| Number of awards per awardee |  |  |
| Single award per awardee (85 awardees) | 15.3% (13) | .5734 |
| Multiple awards per awardee (30 awardees) | 20.0% (6) |  |
| National sleep societies awards |  |  |
| American Academy of Sleep Medicine (100 awards) | 14.0% (14) | .1911 |
| Sleep Research Society (64 awards) | 21.9% (14) | .3322* |
| Type of awards |  |  |
| Service awards (59 awards) | 8.5% (5) | .0822 |
| Research awards (72 awards) | 20.8% (15) | .2661* |
| Education awards (33 awards) | 24.2% (8) |  |
| Individual awards |  |  |
| Nathaniel Kleitman Distinguished Service Award (41 awards) | 4.9% (2) | .1609 |
| Marc O. Hatfield Public Policy or Advocacy Award (18 awards) | 16.7% (3) | .5589* |
| Distinguished Scientist Award (29 awards) | 17.2% (5) |  |
| Excellence in Education Award (17 awards) | 17.6% (3) |  |
| Outstanding Scieﬁti c Achievement Award (19 awards) | 21.1% (4) |  |
| William C. Dement Academic Achievement Award (24 awards) | 25.0% (6) |  |
| Mary A. Carskadon Outstanding Education Award (16 awards) | 31.3% (5) |  |

Data are displayed as percentage (frequency). All *P*-value results are derived from statistical analysis (chi-square test or Fisher's exact test when appropriate) applied to compare gender distribution between categories in each characteristic of sleep recognition awards (number of awards per awardee, national sleep societies awards, type of awards, and individual awards). *P value results when considering a similar time period between the national sleep societies awards (1989–2020), the types of sleep awards (2002–2020), and the individual sleep awards (2006–2020).

analysis of sleep recognition awards based on the type of award showed that US-based women sleep professionals received 8.5% of the total service awards, 20.8% of the total research awards, and 24.2% of the total education awards. The service award type had the largest gender gap favoring men, but this was not statistically different when comparing the 3 types of sleep recognition awards ($P = .0822$), even when considering a similar time period (2002–2020) when the 3 types of awards were given ($P = .2661$). The analysis of each of the 7 sleep recognition awards showed a wide variation in the proportion of individual awards given to women sleep professionals with the Nathaniel Kleitman Distinguished Service Award being the lowest at 4.9% and the Mary A. Carskadon Outstanding Education Award being the highest at 31.3%. However, this was not statistically different ($P = .1609$), even when considering a similar time period (2006–2020) when the 7 sleep awards were given ($P = .5589$).

The gender distribution over several characteristics of the sleep recognition awards in the 2 subgroups of US-based physicians and nonphysician PhDs is summarized in **Table 3**. Overall, when analyzing each subgroup separately, similar results to the above total US-based sleep professionals' group (favoring men) were observed for the gender representation in the number of awards per awardee, in each sleep society total recognition awards, and in each type of sleep recognition award. For these above-mentioned sleep recognition awards' characteristics, there was a clear lower proportion of awards given to women (vs men) physicians compared to a higher proportion of awards given to women (vs men) nonphysician PhDs, but this was only statistically significant ($P = .0316$) for the SRS recognition awards. When analyzing the 7 sleep recognition awards in each subgroup separately, there was again a wide variation in the proportion of individual awards given to women (0–20% in the physicians' subgroup and 0–60% in the nonphysician PhDs' subgroup), but this was not statistically significant, even when considering a similar period when distinct sleep awards were given. When comparing each individual sleep award between the 2 subgroups, the representation of women was lower for most sleep awards in the physicians' subgroup (vs higher in the nonphysician PhDs' subgroup) except for the Excellence in Education Award. However, these results were not statistically significant.

## Awardees' gender differences in publications, citations, and years of expertise

The total number of publications and citations in Scopus for each woman and man US-based sleep professional awardee, up to the year the sleep recognition award was given, is summarized in **Table 4**. Women (vs men) sleep professionals had a slightly higher (but not statistically significant) number of total publications (median: 135.5 vs 127.0; $P = .2872$). However, the number of citations of the total publications was significantly higher for women compared to men (median: 6,709.0 vs 2,827.0; $P = .0070$). Similar results were observed when considering only original publications (median: 107.5 vs 105.0; $P = .3576$) or citations of original publications (median: 5,900.0 vs 2,697.5; $P = .0099$). In addition, the same results were observed for the US-based nonphysician PhDs' subgroup, with

significantly more citations given to publications by women vs men sleep recognition awardees (**Table 4**). In the US-based physicians' subgroup, a similar trend favoring women was observed, but this was not statistically significant for neither the number of publications nor for the citations (**Table 4**). There was no significant difference between women (n = 10) and men (n = 92 with 7.6% of missing data) US-based physicians sleep awardees in terms of years since medical school graduation ($33.2 \pm 4.8$ vs $32.4 \pm 8.1$; $P = .6976$). Furthermore, there was no significant difference between women (n = 18 with 16.7% of missing data) and men (n = 44) US-based nonphysician PhDs sleep awardees in terms of years since the doctoral degree was awarded (mean: $29.7 \pm 9.6$ vs $32.8 \pm 9.5$; $P = .1659$).

## DISCUSSION

This study, to our knowledge, is the first to examine gender disparity in sleep recognition awards. It showed that women sleep professionals based in the US were overall underrepresented in the last 40 years of sleep recognition awards (receiving approximately one-fifth of the total sleep awards). This underrepresentation of women was also observed for each of the two US national sleep societies (AASM and SRS), for each of the 3 distinct types of sleep recognition awards (research, education, or service), and for each individual sleep recognition award studied. In addition, this gender disparity in sleep recognition awards seems to be more pronounced for women physicians compared to women nonphysician PhDs. The overall lower level (17.1%) of women sleep professionals' representation in sleep recognition awards is in line with the general finding by Silver et al,[24] where women were underrepresented in recognition awards given by medical societies such as the American Academy of Physical Medicine and Rehabilitation (15.9%), the American Academy of Neurology (18.3%),[26] and the Association of Academic Physiatrists (20.0%).[25] The gender gap in sleep recognition awards favoring men adds further data illustrating the substantial underrepresentation of women sleep professionals and particularly physicians in sleep medicine and research as noted in compensations[18] and workforce,[19] as well as in overall prestigious authorships position within original articles published by high-impact sleep journals over 35 years.[31]

This study also demonstrated an absence followed by a paucity of representation of US-based women sleep professionals in the early years of sleep recognition awards. It is interesting to note that over a period of 40 years, US women sleep professionals did not receive any sleep recognition award until the second decade (with further significant delay for women physicians compared to women nonphysician PhDs). Moreover, this study showed that US-based women sleep professionals were excluded, or almost excluded, from certain sleep recognition awards. For instance, the Nathaniel Kleitman Distinguished Service Award, the oldest sleep recognition award from the list of awards studied, was given to only 2 US women sleep professionals (approximately 5% of total 41 awards given). This absence or exclusion has been discussed by Huang in the *Harvard Law Review* as the "inexorable zero"[32] and was later further used by Silver et al[22] to highlight the lack of

**Table 3**—Characteristics of sleep recognition awards given to physicians and nonphysician PhDs based in the United States.

| | 71 Physicians (102 Awards) | | 44 Nonphysician PhDs (62 Awards) | | |
|---|---|---|---|---|---|
| | Women Awardees or Awards Given to Women | $P^a$ | Women Awardees or Awards Given to Women | $P^b$ | $P^c$ |
| Number of awards per awardee | | | | | |
|   Single award per awardee | 11.8% (6/51) | 1.0000 | 20.6% (7/34) | .2372 | .2682 |
|   Multiple awards per awardee | 10.0% (2/20) | | 40.0% (4/10) | | .1413 |
| National sleep society awards | | | | | |
|   American Academy of Sleep Medicine awards | 10.4% (8/77) | 1.0000 | 26.1% (6/23) | .6948 | .0835 |
|   Sleep Research Society awards | 8.0% (2/25) | 1.0000* | 30.8% (12/39) | .9516* | .0316 |
| Type of awards | | | | | |
|   Service awards | 4.7% (2/43) | .3180 | 18.8% (3/16) | .3838 | .1175 |
|   Research awards | 13.2% (5/38) | .5289* | 29.4% (10/34) | 1.0000* | .0900 |
|   Education awards | 14.3% (3/21) | | 41.7% (5/12) | | .1057 |
| Individual awards | | | | | |
|   Nathaniel Kleitman Distinguished Service Award | 3.1% (1/32) | .4611 | 11.1% (1/9) | .3565 | .3951 |
|   Marc O. Hatfield Public Policy or Advocacy Award | 9.1% (1/11) | .8336* | 28.6% (2/7) | .3075* | .5282 |
|   Distinguished Scientist Award | 9.1% (1/11) | | 22.2% (4/18) | | .6221 |
|   Excellence in Education Award | 20.0% (3/15) | | 0.0% (0/2) | | 1.0000 |
|   Outstanding Scientific Achievement Award | 12.5% (1/8) | | 27.3% (3/11) | | .6027 |
|   William C. Dement Academic Achievement Award | 15.8% (3/19) | | 60.0% (3/5) | | .0785 |
|   Mary A. Carskadon Outstanding Education Award | 0.0% (0/6) | | 50.0% (5/10) | | .0934 |

Data are displayed as percentage (women awardees or awards given to women/total awardees or awards). [a]$P$ value and [b]$P$-value results are derived from statistical analysis applied to compare gender distribution between categories in each characteristic of sleep recognition awards (number of awards per awardee, national sleep societies awards, type of awards, and individual awards) within the physicians' subgroup and the nonphysician PhDs' subgroup, respectively. *$P$-value results when considering a similar time period between the national sleep societies awards (1989–2020), the types of sleep awards (2002–2020), and the individual sleep awards (2006–2020). [c]$P$-value results are derived from statistical analysis applied to compare gender distribution between the physicians' subgroup and the nonphysician PhDs' subgroup for each category of the characteristics of sleep recognition awards. All statistical analyses were performed using chi-square test or Fisher's exact test when appropriate.

gender diversity with underrepresentation of women in recognition awards given by several medical societies. Indeed, zero can be a very powerful and persuasive number and has been used in courts to suggest a clear cut dysfunction in employment and hiring behaviors with discrimination toward women and minorities.[22,32] Despite the above findings in this study, it is encouraging to note that the proportion of awards going to US-based women physicians from both national sleep societies combined in the last decade (26.5%) as well as in the last 5 years (30.8%) is similar to the proportion of women physicians (26.3%) who were members of the AASM in 2019.[19] This proportion of awards was even more promising in the last decade for women nonphysician PhDs (38.5%), although there were no publicly available gender distribution data on the workforce of sleep professionals in the SRS or in the United States for nonphysician PhDs to compare to our results.

There are various factors responsible for the lower proportion of women receiving awards. While these factors were not the primary focus of this study, it is important to mention several points that could explain underrepresentation of women in sleep recognition awards. One reason that is frequently discussed is the pipeline factor with the lack of qualified women scientists to be considered for awards.[23] It is possible that this pipeline factor may have had some influence on the proportion of sleep recognition awards given to US-based women sleep professionals, especially physicians, at least in the early decades. However, some studies have challenged the importance of the pipeline theory and have shown that the issue of women underrepresentation is probably more related to the award selection process rather than to the pipeline for awards.[23,24,26] In particular to the sleep medicine workforce, it seems that the leaderships (board members, chairs, and vice chairs) at the AASM are almost at gender parity (44.5% of women),[19] which suggests that there is currently an adequate number of qualified US-based women to be candidates for sleep recognition awards.

One factor related to the selection process and considered a major reason for gender disparities favoring men, including in recognition awards, is implicit bias.[23] This is an unconscious bias that is perceived throughout a scientist and physician's journey in building a career and can affect the award committee members when choosing a recipient, as well as those putting forth nominees and providing letters of support.[23,33–35] It is

**Table 4**—Gender differences in number of publications and citations retrieved from Scopus for sleep recognition awardees based in the United States.

|  | **Men** | **Women** | *P* |
|---|---|---|---|
| Total group, n | 136 | 28 |  |
|    Total publications | 155.3 ± 124.9 | 173.9 ± 129.1 | .2872 |
|    Citations for total publications | 6,580.4 ± 8,301.0 | 9,602.5 ± 9,369.9 | .0070 |
|    Original publications | 131.7 ± 107.7 | 147.3 ± 116.2 | .3576 |
|    Citation for original publications | 6,198.0 ± 7,848.8 | 8,828.3 ± 8,660.0 | .0099 |
| Physicians' subgroup, n | 92 | 10 |  |
|    Total publications | 163.7 ± 134.0 | 190.2 ± 144.8 | .4050 |
|    Citations for total publications | 7,000.6 ± 8,861.3 | 9,239.1 ± 11,630.4 | .1751 |
|    Original publications | 137.4 ± 117.2 | 150.7 ± 129.9 | .6008 |
|    Citation for original publications | 6,638.1 ± 8,438.0 | 8,521.7 ± 10,373.4 | .1880 |
| Nonphysician PhDs' subgroup, n | 44 | 18 |  |
|    Total publications | 137.6 ± 102.7 | 164.9 ± 122.9 | .4155 |
|    Citations for total publications | 5,701.8 ± 6,999.4 | 9,804.4 ± 8,228.5 | .0166 |
|    Original publications | 119.8 ± 84.5 | 145.3 ± 111.8 | .4473 |
|    Citation for original publications | 5,277.8 ± 6,438.0 | 8,998.7 ± 7,877.5 | .0213 |

Data are displayed as means ± SDs unless otherwise indicated. All statistical analyses were performed using the nonparametric Mann–Whitney–Wilcoxon rank sum test to compare between men and women awardees the number of publications and citations up to the year each award was given.

interesting to note, from the results of the current study, the higher number of publications and especially citations of US women compared to men sleep professionals at the time they were awarded. This could be an example of implicit bias and may suggest that women are expected to attain a much higher level of scientific productivity and more importantly a wider peer attention or impact before they are considered for a sleep recognition award. However, this gender difference in scientific productivity may be more relevant in the selection for research recognition awards in comparison to education or service recognition awards. Another important factor related to the selection process is possibly the male predominance in the composition of award committees. Indeed, several studies support the presence of women in the jury as a factor in increasing the chances to name a woman as an award winner.[23,36] Unfortunately, the data on the composition of sleep award juries from the 2 US national sleep societies were not publicly available.

This study has some limitations that need to be considered. We tried to be precise in assigning a gender to each awardee by performing a 2-step analysis using the person's first name from each of the national sleep societies' websites and subsequently looking at online biographies, including looking at pronouns "he" or "she", and photographs. However, the information was extracted from publicly available internet resources that may be subject to errors. In addition, we were not able to account for transgender or for any other gender distinctions. In the analysis of women and men sleep recognition awardees, we did not compare, for every year or set of years of sleep awards, the gender distribution over these sleep awards with the gender representation in the potential pipeline of sleep professionals (physicians and nonphysician PhDs) as these data were not available, so a binomial exact test could not be performed.

Moreover, as considered by Silver et al,[24] the definition of this pipeline is complicated as one can consider several possibilities (eg, proportion of women: among the total workforce of US sleep professionals, among active sleep professionals who are members of the 2 US national sleep societies, among sleep professionals pursuing academic sleep medicine and sleep research, among nominated sleep professionals for sleep awards). Unfortunately, most of these data were unavailable for any given year, and the only gender related sleep data that we were able to find was for the active members of the AASM in 2019. This study also analyzed the representation of US-based women sleep professionals (physicians and nonphysician PhDs) within specific prestigious sleep awards given by the AASM and the SRS. Therefore, the results of this study may not be generalizable to non-US based sleep professionals, to other types of sleep awards given by these same US sleep societies, or to any sleep awards given to sleep professionals from sleep societies based in other countries.

In summary, our study highlights the gender inequality favoring men in sleep awards by analyzing recognition awards given to sleep professionals by the 2 US national sleep societies over a 40-year period. Despite the historical underrepresentation of women in sleep recognition awards, there is a positive progression achieved over the last decade, suggesting that the sleep community is getting better at recognizing women. However, it seems that women must work harder (as evidenced by the publications and citations analysis) to get to the same degree of representation as men. Reporting these results will hopefully raise questions about the reasons behind this gender gap in sleep awards and open the door for further investigations and concrete actions toward gender equity. We suggest that sleep societies implement several measures, as proposed by Morgan et al,[37] to improve the representation of women in sleep

awards such as including people from all genders and backgrounds in selection committees and award nominations, tracking and diversifying the pool of award nominees, and enhancing transparency by reporting publicly the award nominations.[37]

## ABBREVIATIONS

AASM, American Academic of Sleep Medicine
SRS, Sleep Research Society

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## SUBMISSION & CORRESPONDENCE INFORMATION

## DISCLOSURE STATEMENT

All authors have seen and approved this manuscript. Work for this study was performed at the Department of Neurology, The George Washington University School of Medicine and Health Sciences, Washington, DC. The authors report no conflicts of interest.