Testimony in Support of Senate Bill SB0449
Workers' Compensation – Occupational Disease Presumption – Correctional Officers – Carroll County

To the Honorable Chair and Members of the Committee:

My name is Matthew J. Engler and I am an attorney who has represented countless public safety professionals, including correctional officers, across the State of Maryland. I respectfully submit this testimony **in strong support of Senate Bill SB0449**, which would extend workers' compensation protections for heart disease and hypertension to correctional officers employed in Carroll County.

Maryland's Current Law Creates Unequal Protection for Correctional Officers

Maryland law has, for decades, recognized that certain public safety professions face occupational hazards that significantly increase the risk of cardiovascular disease. For that very reason, §9-503 of the Maryland Labor and Employment Article establishes a presumption that heart disease and hypertension are occupational diseases for these professions. It includes police officers, firefighters, as well as some correctional officers ***from only certain jurisdictions***.

Unfortunately, Maryland's statutory framework provides these protections **unevenly among correctional officers depending on the jurisdiction in which they serve**. As a result, correctional officers in some counties receive this protection while others performing the same duties do not. For example, correctional officers in Montgomery or Prince George's Counties can claim the benefit of this law, while those in Carroll County cannot. **This inconsistency is fundamentally unfair.** Correctional officers in Carroll County confront the same dangerous working conditions, occupational stressors, and demanding schedules as their counterparts elsewhere in Maryland, yet they lack the same statutory protection.

SB0449 corrects this inequity by ensuring that Carroll County correctional officers receive the same protections afforded to correctional officers in other jurisdictions.

Medical Research Demonstrates Elevated Health Risks for Correctional Officers

Peer-reviewed research demonstrates that correctional officers face **significant health risks associated with the structure and demands of correctional work**, including elevated risk factors for chronic cardiovascular disease.[1] In fact, the correctional environment requires constant vigilance, around-the-clock conflict, exposure to potentially dangerous situations, and long working hours, all of which contribute to chronic occupational stress and adverse health outcomes.

Shift Work and Irregular Schedules Increase Cardiovascular Risk

Another major contributor to cardiovascular risk among correctional officers is the **prevalence of rotating shifts, overnight schedules, and mandatory overtime** required to maintain continuous correctional operations.

A large systematic review and meta-analysis examining the relationship between shift work and cardiovascular disease found that shift work is associated with an increased risk of cardiovascular disease events.[2] Importantly, the study found that "the risk of cardiovascular disease events ***increased by approximately 7% for every additional five years of exposure*** to shift work. (emphasis supplied)"[3]

Additional epidemiological research examining night-shift workers similarly concluded that **night shift work is associated with increased risk of cardiovascular disease and mortality**, particularly among workers exposed to long-term irregular work schedules.[4]

SB0449 Promotes Fairness and Consistency in Maryland Law

Maryland has already recognized that certain public safety occupations carry risks significant enough to warrant presumptive workers' compensation coverage for heart disease and hypertension. The medical literature demonstrates that correctional officers face many of the same occupational stressors and cardiovascular risks.

Extending this presumption to Carroll County correctional officers simply ensures that Maryland law is **applied fairly and consistently**, regardless of the county in which an officer serves.

SB0449 represents a reasonable and fair step to ensure that these public servants receive equal protection under Maryland's Workers' Compensation Act. For these reasons, I respectfully urge the Committee to **issue a favorable report on Senate Bill SB0449.**

Respectfully submitted,

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References

1. Buden JC, Dugan AG, Namazi S, Huedo-Medina TB, Cherniack MG, Faghri PD. Work Characteristics as Predictors of Correctional Supervisors' Health Outcomes. J Occup Environ Med. 2016 Sep;58(9):e325-34. doi: 10.1097/JOM.0000000000000843. PMID: 27483335; PMCID: PMC5016227.

2. Torquati L, Mielke GI, Brown WJ, Kolbe-Alexander T. Shift work and the risk of cardiovascular disease. A systematic review and meta-analysis including dose-response relationship. Scand J Work Environ Health. 2018 May 1;44(3):229-238. doi: 10.5271/sjweh.3700. Epub 2017 Dec 16. PMID: 29247501.

3. Id.

4. Xiao Z, Xu C, Liu Q, et al. Night Shift Work, Genetic Risk, and Hypertension. Mayo Clinic Proceedings. 2022 Nov;97(11):2016-2027. DOI: 10.1016/j.mayocp.2022.04.007. PMID: 35995626.

Observational Study J Occup Environ Med. 2016 Sep;58(9):e325-34.
doi: 10.1097/JOM.0000000000000843.

Work Characteristics as Predictors of Correctional Supervisors' Health Outcomes

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Abstract

Objective: This study examined associations among health behaviors, psychosocial work factors, and health status.

Methods: Correctional supervisors (n = 157) completed a survey that assessed interpersonal and organizational views on health. Chi-square and logistic regressions were used to examine relationships among variables.

Results: Respondents had a higher prevalence of obesity and comorbidities compared with the general US adult population. Burnout was significantly associated with nutrition, physical activity, sleep duration, sleep quality, diabetes, and anxiety/depression. Job meaning, job satisfaction, and workplace social support may predict health behaviors and outcomes.

Conclusions: Correctional supervisors are understudied and have poor overall health status. Improving health behaviors of middle-management employees may have a beneficial effect on the health of the entire workforce. This paper demonstrates the importance of psychosocial work factors that may contribute to health behaviors and outcomes.

Figures

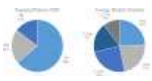

Figure 1 Distribution of shift and average...

Figure 2 Distribution of health behaviors (nutrition,...

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doi: 10.5271/sjweh.3700. Epub 2017 Dec 16.

Shift work and the risk of cardiovascular disease. A systematic review and meta-analysis including dose-response relationship

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PMID: 29247501 DOI: 10.5271/sjweh.3700

Free article

Abstract

Objectives The aim of this review was to assess the risk of cardiovascular disease (CVD) events associated with shift work and determine if there is a dose-response relationship in this association. Method Electronic databases (PubMed, Scopus, and Web of Science) were searched for cohort or case-control control study designs in any population, reporting exposure to shift work as the main contributing factor to estimate CVD risk. For each study, adjusted relative risk (RR) ratios and 95% confidence intervals (CI) were extracted, and used to calculate the pooled RR using random-effect models. Meta-regression analysis was conducted to explore potential heterogeneity sources. Potential non-linear dose-response relationships were examined using fractional polynomial models. Results We included 21 studies with a total of 173 010 unique participants. The majority of the studies were ranked low-to-moderate risk of bias. The risk of any CVD event was 17% higher among shift workers than day workers. The risk of coronary heart disease (CHD) morbidity was 26% higher (1.26, 95% CI 1.10-1.43, I^2= 48.0%). Sub-group analysis showed an almost 20% higher risk of CVD and CHD mortality among shift workers than those who did not work shifts (1.22, 95% CI 1.09-1.37, I^2= 0% and 1.18, 95% CI 1.06-1.32 I^2=0%; respectively). After the first five years of shift work, there was a 7.1% increase in risk of CVD events for every additional five years of exposure (95% CI 1.05-1.10). Heterogeneity of the pooled effect size (ES) estimates was high (I^2=67%), and meta-regression analysis showed that sample size explained 7.7% of this. Conclusions The association between shift work and CVD risk is non-linear and seems to appear only after the first five years of exposure. As shift work remains crucial for meeting production and service demands across many industries, policies and initiatives are needed to reduce shift workers' CVD risk.

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Night Shift Work, Genetic Risk, and Hypertension

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Abstract

Objective

To perform a prospective cohort study to investigate whether night shift work is associated with incident hypertension and whether this association is modified by genetic susceptibility to hypertension because evidence on the association between night shift work and hypertension is insufficient.

A total of 232,665 participants of UK Biobank who were recruited from 2006 to 2010 and observed to January 31, 2018, were included in this study. A Cox proportional hazards model with covariate adjustment was performed to assess the association between night shift work exposure and hypertension risk. We constructed a polygenic risk score (PRS) for genetic susceptibility to hypertension, which was used to explore whether genetic susceptibility to hypertension modified the effect of night shift work. The robustness of the results was assessed by sensitivity analysis.

Results

Night shift workers had a higher hypertension risk than day shift workers, which increased with increasing frequency of night shift work (P_{trend}<.001). The association was attenuated but still remained statistically significant in the fully adjusted model. We explored the joint effect of night shift work and genetic susceptibility on hypertension. Permanent night shift workers with higher hypertension PRSs had higher risk of hypertension than day workers with low PRSs.

Conclusion

Night shift work exposure was associated with increased hypertension risk, which was modified by the genetic risk for hypertension, indicating that there is a joint effect of night shift work and genetic risk on hypertension.

Abbreviations and Acronyms

BMI (body mass index) · CVD (cardiovascular disease) · HR (hazard ratio) · OR (odds ratio) · PRS (polygenic risk score) · RERI (relative excess risk due to interaction) · SNP (single-nucleotide polymorphism)

References

1. Strohmaier, S. · Devore, E.E. · Zhang, Y. ...

   A review of data of findings on night shift work and the development of DM and CVD events: a synthesis of the proposed molecular mechanisms

   Curr Diab Rep. 2018; **18**(12):132

   Crossref Scopus (58) PubMed Google Scholar

2. Kecklund, G. · Axelsson, J.

   Health consequences of shift work and insufficient sleep

   BMJ. 2016; **355**:i5210

   Crossref Scopus (736) PubMed Google Scholar

3. Costa, G. · Haus, E. · Stevens, R.

   Shift work and cancer—considerations on rationale, mechanisms, and epidemiology

   Scand J Work Environ Health. 2010; **36**(2):163-179

   Crossref Scopus (208) PubMed Google Scholar

4. Shan, Z. · Li, Y. · Zong, G. ...

   Rotating night shift work and adherence to unhealthy lifestyle in predicting risk of type 2 diabetes: results from two large US cohorts of female nurses

   BMJ. 2018; **363**:k4641

   Crossref Scopus (184) PubMed Google Scholar

5. Cai, C. · Vandermeer, B. · Khurana, R. ...

   The impact of occupational shift work and working hours during pregnancy on health outcomes: a systematic review and meta-analysis

   Am J Obstet Gynecol. 2019; **221**(6):563-576

   Full Text Full Text (PDF) Scopus (177) PubMed Google Scholar

6. Hansen, J.

   Night shift work and risk of breast cancer

   Curr Environ Health Rep. 2017; **4**(3):325-339

   Crossref Scopus (123) PubMed Google Scholar

PLoS Med. 2011; **8**(12), e1001141

Crossref Scopus (605) PubMed Google Scholar

8. Maidstone, R.J. · Turner, J. · Vetter, C. ...

Night shift work is associated with an increased risk of asthma

Thorax. 2021; **76**(1):53-60

Crossref Scopus (52) PubMed Google Scholar

9. Archer, S.N. · Laing, E.E. · Moller-Levet, C.S. ...

Mistimed sleep disrupts circadian regulation of the human transcriptome

Proc Natl Acad Sci U S A. 2014; **111**(6):E682-E691

Crossref Scopus (280) PubMed Google Scholar

10. Ward, E.M. · Germolec, D. · Kogevinas, M. ...

Carcinogenicity of night shift work

Lancet Oncol. 2019; **20**(8):1058-1059

Full Text Full Text (PDF) Scopus (226) PubMed Google Scholar

11. Straif, K. · Baan, R. · Grosse, Y. ...

Carcinogenicity of shift-work, painting, and fire-fighting

Lancet Oncol. 2007; **8**(12):1065-1066

Full Text Full Text (PDF) PubMed Google Scholar

12. Wang, D. · Ruan, W. · Chen, Z. ...

Shift work and risk of cardiovascular disease morbidity and mortality: a dose-response meta-analysis of cohort studies

Eur J Prev Cardiol. 2018; **25**(12):1293-1302

Crossref Scopus (80) PubMed Google Scholar

13. Wang, N. · Sun, Y. · Zhang, H. ...

Long-term night shift work is associated with the risk of atrial fibrillation and coronary heart disease

Eur Heart J. 2021; **42**(40):4180-4188

Crossref Scopus (96) PubMed Google Scholar

14. Oparil, S. · Acelajado, M.C. · Bakris, G.L. ...

Crossref Scopus (700) PubMed Google Scholar

15. Rapsomaniki, E. · Timmis, A. · George, J. ...

Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people

Lancet. 2014; **383**(9932):1899-1911

Full Text Full Text (PDF) Scopus (1210) PubMed Google Scholar

16. Forouzanfar, M.H. · Liu, P. · Roth, G.A. ...

Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990-2015

JAMA. 2017; **317**(2):165-182

Published correction appears in JAMA. 2017;317(6):648

Crossref Scopus (1550) PubMed Google Scholar

17. GBD 2017 Risk Factor Collaborators

Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017

Lancet. 2018; **392**(10159):1923-1994

Published correction appears in Lancet. 2019;393(10167):132

Full Text Full Text (PDF) Scopus (3402) PubMed Google Scholar

18. GBD 2017 Causes of Death Collaborators

Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017

Lancet. 2018; **392**(10159):1736-1788

Published correction appears in Lancet. 2019;393(10190):e44; Lancet. 2018;392(10160):2170

Full Text Full Text (PDF) Scopus (5216) PubMed Google Scholar

19. Poulter, N.R. · Prabhakaran, D. · Caulfield, M.

Hypertension

Lancet. 2015; **386**(9995):801-812

Full Text Full Text (PDF) Scopus (554) PubMed Google Scholar

20. Borgi, L. · Rimm, E.B. · Willett, W.C. ...

Crossref Scopus (76) PubMed Google Scholar

21. Forman, J.P. · Bischoff-Ferrari, H.A. · Willett, W.C. ...

Vitamin D intake and risk of incident hypertension: results from three large prospective cohort studies

Hypertension. 2005; **46**(4):676-682

Crossref Scopus (127) PubMed Google Scholar

22. Chen, H. · Burnett, R.T. · Kwong, J.C. ...

Spatial association between ambient fine particulate matter and incident hypertension

Circulation. 2014; **129**(5):562-569

Crossref Scopus (172) PubMed Google Scholar

23. Bakris, G. · Ali, W. · Parati, G.

ACC/AHA versus ESC/ESH on hypertension guidelines: JACC guideline comparison

J Am Coll Cardiol. 2019; **73**(23):3018-3026

Crossref Scopus (195) PubMed Google Scholar

24. Williams, B. · Mancia, G. · Spiering, W. ...

2018 Practice Guidelines for the management of arterial hypertension of the European Society of Hypertension and the European Society of Cardiology: ESH/ESC Task Force for the Management of Arterial Hypertension

J Hypertens. 2018; **36**(12):2284-2309

Published correction appears in J Hypertens. 2019;37(2):456

Crossref Scopus (599) PubMed Google Scholar

25. Whelton, P.K. · Carey, R.M. · Aronow, W.S. ...

2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Hypertension. 2018; **71**(6):1269-1324

Published correction appears in Hypertension. 2018;71(6):e136-e139

Crossref Scopus (2593) PubMed Google Scholar

26. Hublin, C. · Partinen, M. · Koskenvuo, K.

Crossref Scopus (81) PubMed Google Scholar

27. Sfreddo, C. · Fuchs, S.C. · Merlo, A.R. ...

Shift work is not associated with high blood pressure or prevalence of hypertension

PLoS One. 2010; **5**(12), e15250

Crossref Scopus (47) PubMed Google Scholar

28. Kubo, T. · Fujino, Y. · Nakamura, T. ...

An industry-based cohort study of the association between weight gain and hypertension risk among rotating shift workers

J Occup Environ Med. 2013; **55**(9):1041-1045

Crossref Scopus (37) PubMed Google Scholar

29. Guo, Y. · Rong, Y. · Huang, X. ...

Shift work and the relationship with metabolic syndrome in Chinese aged workers

PLoS One. 2015; **10**(3), e0120632

Crossref Scopus (69) Google Scholar

30. Crump, C. · Sundquist, J. · Winkleby, M.A. ...

Interactive effects of physical fitness and body mass index on the risk of hypertension

JAMA Intern Med. 2016; **176**(2):210-216

Crossref Scopus (88) PubMed Google Scholar

31. Färbom, P. · Wahlstrand, B. · Almgren, P. ...

Interaction between renal function and microalbuminuria for cardiovascular risk in hypertension: the Nordic Diltiazem Study

Hypertension. 2008; **52**(1):115-122

Crossref Scopus (48) PubMed Google Scholar

32. Evangelou, E. · Warren, H.R. · Mosen-Ansorena, D. ...

Genetic analysis of over 1 million people identifies 535 new loci associated with blood pressure traits

Nat Genet. 2018; **50**(10):1412-1425

Published correction appears in Nat Genet. 2018;50(12):1755

Crossref Scopus (817) PubMed Google Scholar

Curr Hypertens Rep. 2017; **19**(3):23

Crossref Scopus (37) PubMed Google Scholar

34. Sung, Y.J. · de Las Fuentes, L. · Schwander, K.L. ...

Gene-smoking interactions identify several novel blood pressure loci in the Framingham Heart Study

Am J Hypertens. 2015; **28**(3):343-354

Crossref Scopus (41) PubMed Google Scholar

35. Collins, R.

What makes UK Biobank special?

Lancet. 2012; **379**(9822):1173-1174

Full Text Full Text (PDF) Scopus (649) PubMed Google Scholar

36. Fry, A. · Littlejohns, T.J. · Sudlow, C. ...

Comparison of sociodemographic and health-related characteristics of UK Biobank participants with those of the general population

Am J Epidemiol. 2017; **186**(9):1026-1034

Crossref Scopus (1894) PubMed Google Scholar

37. Sudlow, C. · Gallacher, J. · Allen, N. ...

UK Biobank: an open access resource for identifying the causes of a wide range of complex diseases of middle and old age

PLoS Med. 2015; **12**(3), e1001779

Crossref Scopus (5816) PubMed Google Scholar

38. Vetter, C. · Dashti, H.S. · Lane, J.M. ...

Night shift work, genetic risk, and type 2 diabetes in the UK Biobank

Diabetes Care. 2018; **41**(4):762-769

Crossref Scopus (196) PubMed Google Scholar

39. Lane, J.M. · Vlasac, I. · Anderson, S.G. ...

Genome-wide association analysis identifies novel loci for chronotype in 100,420 individuals from the UK Biobank

Nat Commun. 2016; **7**:10889

Crossref Scopus (218) PubMed Google Scholar

Nature. 2018; **562**(7726):203-209

Crossref Scopus (3994) PubMed Google Scholar

41. Michailidou, K. · Lindstrom, S. · Dennis, J. ...

Association analysis identifies 65 new breast cancer risk loci

Nature. 2017; **551**(7678):92-94

Crossref Scopus (907) PubMed Google Scholar

42. Vujkovic, M. · Keaton, J.M. · Lynch, J.A. ...

Discovery of 318 new risk loci for type 2 diabetes and related vascular outcomes among 1.4 million participants in a multi-ancestry meta-analysis

Nat Genet. 2020; **52**(7):680-691

Crossref Scopus (385) PubMed Google Scholar

43. Gamboa Madeira, S. · Fernandes, C. · Paiva, T. ...

The impact of different types of shift work on blood pressure and hypertension: a systematic review and meta-analysis

Int J Environ Res Public Health. 2021; **18**(13):6738

Crossref Scopus (34) PubMed Google Scholar

44. Lunn, R.M. · Blask, D.E. · Coogan, A.N. ...

Health consequences of electric lighting practices in the modern world: a report on the National Toxicology Program's workshop on shift work at night, artificial light at night, and circadian disruption

Sci Total Environ. 2017; **607-608**:1073-1084

Crossref Scopus (274) PubMed Google Scholar

45. Haus, E.L. · Smolensky, M.H.

Shift work and cancer risk: potential mechanistic roles of circadian disruption, light at night, and sleep deprivation

Sleep Med Rev. 2013; **17**(4):273-284

Crossref Scopus (362) PubMed Google Scholar

46. Shea, S.A. · Hilton, M.F. · Hu, K. ...

Existence of an endogenous circadian blood pressure rhythm in humans that peaks in the evening

Circ Res. 2011; **108**(8):980-984

47. Douma, L.G. · Gumz, M.L.

Circadian clock–mediated regulation of blood pressure

Free Radic Biol Med. 2018; **119**:108-114

Crossref Scopus (162) PubMed Google Scholar

48. Curtis, A.M. · Cheng, Y. · Kapoor, S. ...

Circadian variation of blood pressure and the vascular response to asynchronous stress

Proc Natl Acad Sci U S A. 2007; **104**(9):3450-3455

Crossref Scopus (316) PubMed Google Scholar

49. Zuber, A.M. · Centeno, G. · Pradervand, S. ...

Molecular clock is involved in predictive circadian adjustment of renal function

Proc Natl Acad Sci U S A. 2009; **106**(38):16523-16528

Crossref Scopus (224) PubMed Google Scholar

50. Vukolic, A. · Antic, V. · Van Vliet, B.N. ...

Role of mutation of the circadian clock gene Per2 in cardiovascular circadian rhythms

Am J Physiol Regul Integr Comp Physiol. 2010; **298**(3):R627-R634

Crossref Scopus (69) PubMed Google Scholar

51. Stow, L.R. · Richards, J. · Cheng, K.Y. ...

The circadian protein period 1 contributes to blood pressure control and coordinately regulates renal sodium transport genes

Hypertension. 2012; **59**(6):1151-1156

Crossref Scopus (121) PubMed Google Scholar

52. Kala, R. · Fyhrquist, F. · Eisalo, A.

Diurnal variation of plasma angiotensin II in man

Scand J Clin Lab Invest. 1973; **31**(4):363-365

Crossref Scopus (50) PubMed Google Scholar

53. Isobe, S. · Ohashi, N. · Fujikura, T. ...

Disturbed circadian rhythm of the intrarenal renin-angiotensin system: relevant to nocturnal hypertension and renal damage

Clin Exp Nephrol. 2015; **19**(2):231-239

54. Doi, M. · Takahashi, Y. · Komatsu, R. …

Salt-sensitive hypertension in circadian clock–deficient Cry-null mice involves dysregulated adrenal Hsd3b6

Nat Med. 2010; **16**(1):67-74

Crossref Scopus (358) PubMed Google Scholar

55. Lusardi, P. · Zoppi, A. · Preti, P. …

Effects of insufficient sleep on blood pressure in hypertensive patients: a 24-h study

Am J Hypertens. 1999; **12**(1, pt 1):63-68

Crossref Scopus (289) PubMed Google Scholar

56. Grassi, G. · Seravalle, G. · Quarti-Trevano, F. …

Adrenergic, metabolic, and reflex abnormalities in reverse and extreme dipper hypertensives

Hypertension. 2008; **52**(5):925-931

Crossref Scopus (178) PubMed Google Scholar

57. Reppert, S.M. · Weaver, D.R.

Molecular analysis of mammalian circadian rhythms

Annu Rev Physiol. 2001; **63**:647-676

Crossref Scopus (1260) PubMed Google Scholar

58. Reiter, R.J.

Pineal melatonin: cell biology of its synthesis and of its physiological interactions

Endocr Rev. 1991; **12**(2):151-180

Crossref Scopus (2100) PubMed Google Scholar

59. Skene, D.J.

Optimization of light and melatonin to phase-shift human circadian rhythms

J Neuroendocrinol. 2003; **15**(4):438-441

Crossref Scopus (69) PubMed Google Scholar

60. Burgess, H.J. · Sharkey, K.M. · Eastman, C.I.

Bright light, dark and melatonin can promote circadian adaptation in night shift workers

Sleep Med Rev. 2002; **6**(5):407-420

Crossref Scopus (211) PubMed Google Scholar

Light suppresses melatonin secretion in humans

Science. 1980; **210**(4475):1267-1269

Crossref Scopus (1542) PubMed Google Scholar

62. Rahman, S.A. · St Hilaire, M.A. · Lockley, S.W.

The effects of spectral tuning of evening ambient light on melatonin suppression, alertness and sleep

Physiol Behav. 2017; **177**:221-229

Crossref Scopus (95) PubMed Google Scholar

63. Gooley, J.J. · Chamberlain, K. · Smith, K.A. ...

Exposure to room light before bedtime suppresses melatonin onset and shortens melatonin duration in humans

J Clin Endocrinol Metab. 2011; **96**(3):E463-E472

Crossref Scopus (368) PubMed Google Scholar

64. Simko, F. · Paulis, L.

Melatonin as a potential antihypertensive treatment

J Pineal Res. 2007; **42**(4):319-322

Crossref Scopus (188) PubMed Google Scholar

65. Możdżan, M. · Możdżan, M. · Chałubiński, M. ...

The effect of melatonin on circadian blood pressure in patients with type 2 diabetes and essential hypertension

Arch Med Sci. 2014; **10**(4):669-675

Crossref Scopus (39) PubMed Google Scholar

66. Cipolla-Neto, J. · Amaral, F.G. · Afeche, S.C. ...

Melatonin, energy metabolism, and obesity: a review

J Pineal Res. 2014; **56**(4):371-381

Crossref Scopus (432) PubMed Google Scholar

67. Li, Y. · Ma, J. · Yao, K. ...

Circadian rhythms and obesity: timekeeping governs lipid metabolism

J Pineal Res. 2020; **69**(3), e12682

Genetic contribution to the variance of blood pressure and heart rate: a systematic review and meta-regression of twin studies

Twin Res Hum Genet. 2015; **18**(2):158-170

Crossref Scopus (36) PubMed Google Scholar

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