ISHRANA RADNIKA KOJI RADE U NOĆNOJ SMENI – RAZLOG ILI IZGOVOR ZA NEPRAVILNU ISHRANU

PREGLEDNI RAD

REVIEW ARTICLE

DIETARY HABITS OF NIGHT SHIFT WORKERS – A REASON OR AN EXCUSE FOR POOR NUTRITION

Svetlana Anđelković[1], Maja Babić[2]

[1] Zavod za zdravstvenu zaštitu radnika Niš, Niš, Srbija

[2] Zavod za zdravstvenu zaštitu radnika „Železnice Srbije" Niš, Srbija

[1] *Institute for Workers' Health Protection "Niš", Niš, Serbia*

[2] *Institute for Workers' Health Protection "Železnice Srbije", Niš, Serbia*

SAŽETAK

Dostupnost veštačkog svetla i uređaja koji emituju svetlost promenili su ljudski život u smislu vremena, omogućavajući 24-časovnu zdravstvenu zaštitu, trgovinu i proizvodnju, kao i širenje društvenog života na dan i noć. U Evropi oko 21% radno aktivnog stanovništva čine radnici koji rade u smenama. 10% radne snage ima večernji ili noćni raspored, a 7% radnika u Evropi redovno radi noćnu smenu. Prema Birou za statistiku rada, više od 15 miliona Amerikanaca radi noćne smene. Smenski, a naročito noćni rad, ozbiljno utiče na ponašanje u vezi sa ishranom.

Zna se da noćni rad izaziva konflikt između društveno određenog ritma obedovanja i cirkardijalnih bioloških ritmova vezanih za osećaj gladi, sitosti, kao i za sam metabolizam. Noćni obroci izazivaju poremećaje intestinalnog motiliteta, utiču na digestiju, apsorpciju, ali i na iskoristljivost nutrijenata i eventualne medikamentozne terapije (ako je pojedinac uzima). Sa gledišta hronobiologije, ljudska vrsta je diurnalna, što unekoliko objašnjava zašto noćni radnici imaju smanjen apetit u toku noći, kada je ljudski organizam zapravo programiran za odmaranje, i gladovanje, kao i za endogenu mobilizaciju glikoze. Sa psihosocijalnog aspekta, smenski radnici obično doživljavaju razmimoilaženje izmedju svojih dnevnih rutina (uključujući i raspored obroka), kao i onih sa porodicom i prijateljima, što dalje dovodi do još težih poremećaja navika u ishrani.

Međutim, teško je dati dijetarne preporuke u vezi sa ishranom. Prvo, nema jasnog stava po pitanju toga da li noćni radnici treba da jedu u toku noćnih sati ili ne. Drugo, čak i da se podstakne noćno obedovanje, nedostaje krajnji dokaz o tome koja vrsta hrane treba da se konzumira, a koja da se izbegava. Treće, nutritivno vredna hrana možda neće biti dostupna u to doba noći. Najzad, ishrana u toku noći sigurno utiče na metabolizam. Imajući u vidu sve navedeno, pokušali smo da damo neke korisne smernice u vezi sa ovim pitanjima.

Ključne reči: cirkardijalni biološki ritam, hronobiologija, metabolizam

ABSTRACT

The availability of artificial light and light-emitting devices has changed human life in relation to time, enabling 24-hour health care, trade, and production, as well as the expansion of social life around the clock. In Europe, about 21% of the labor force consists of shift workers. 10% of the employed population work evening shifts or the night shift, and 7% of employees in Europe regularly work the night shift. According to the Bureau of Labor Statistics, more than 15 million Americans work the night shift. Shift work, especially night-time work, seriously affects dietary habits.

It is known that night-time work produces a conflict between the socially determined rhythm of eating and the circadian biological rhythms related to the feeling of hunger, satiety, as well as the metabolism itself. Night meals cause disorders of intestinal motility, affect digestion, absorption, but also the utilization of nutrients and possible medical therapy (if the individual has one). From the point of view of chronobiology, humans belong to diurnal species, which to a certain extent explains why night shift workers have a decreased appetite at night, when the human body is programmed for rest and fasting, as well as for endogenous mobilization of glucose. From the psychosocial aspect, shift workers usually experience a discrepancy between their daily routines (including the meal schedule) and those they have with family and friends, which further leads to even more severe disorders of dietary habits.

However, it is difficult to give dietary recommendations regarding nutrition. Firstly, there are no clear views on whether night shift workers should eat during the night hours or not. Secondly, even if night eating is encouraged, definitive evidence is lacking on which types of food should be consumed and which should be avoided. Thirdly, the most nutritious foods may not be available at that time of night. Finally, eating at night certainly has an impact on the metabolism. With all the above in mind, we have tried to provide some useful guidelines regarding these issues.

Keywords: circadian biological rhythm, chronobiology, metabolism

Autor za korespondenciju:
Svetlana Anđelković
Zavod za zdravstvenu zaštitu radnika Niš
Vojislava Ilića bb, 18000 Niš, Srbija
Elektronska adresa: sandjelkovic2012@gmail.com

Corresponding author:
Svetlana Anđelković
Institute for Workers' Health Protection "Niš"
Vojislava Ilića Street, 18000 Niš, Serbia
E-mail: sandjelkovic2012@gmail.com

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UVOD

U protekle tri do četiri milijarde godina, život na Zemlji je evoluirao prema predvidivom obrazcu solarnih dana, tj. izlaganju relativno jakoj svetlosti tokom dana i mraku tokom noći. Odavno je poznato da svi živi organizmi imaju unutrašnji biološki sat koji im pomaže da se prilagode ritmu dana. Takve ciklične promene nazivaju se bioritmovi. Najznačajniji primer bioritma je ljudski cirkadijalni ritam. Procesi i strukture koje stvaraju cirkadijalne ritmove nazivaju se cirkadijalni satovi. Primarni cirkadijalni sat kod ljudi je upareni skup od oko 20,000 nervnih ćelija u hipotalamusu u bazi mozga, nazvan suprahijazmatično jezgro (SCN) [1-2]. Dostupnost veštačkog svetla i uređaja koji emituju svetlost promenili su ljudski život i omogućili nam da budemo aktivni 24 h dnevno, 7 dana u nedelji, što dovodi do cirkadijalne neusklađenosti, a to sve u krajnjoj liniji dovodi do poremećaja u fiziološkom i bihejvioralnom funkcionisanju pojedinca. Noćna smena je neophodan deo redovnog radnog dana u mnogim delatnostima (pekar, lekar, policajac, noćni čuvar), ali i u mnoštvu drugih zanimanja često ne postoji „normalno" radno vreme, već se rad obavlja i u sitne sate. Kod nekih od ovih zanimanja, poput lekara i medicinskog osoblja, postoje rotacije, dok su kod nekih radnici „zaglavljeni" radeći tokom noći sve do jutra. U Evropi oko 21% radno aktivnog stanovništva čine radnici koji rade u smenama. 10% radne snage ima večernji ili noćni raspored, a 7% radnika u Evropi redovno radi noćnu smenu. Prema Birou za statistiku rada, više od 15 miliona Amerikanaca radi noćnu smenu. [3,4].

Rad u smenama Savet Evropske unije definiše [5] kao „bilo koji metod organizovanja rada u smenama pri čemu radnici smenjuju jedni druge na istim radnim mestima prema određenom šablonu". Tradicionalno, samo je ograničeni deo radne snage bio angažovan da radi u smenama. Međutim, poslednjih godina mnogi sektori su svoj rad organizovali na ovaj način.

U Republici Srbiji noćni rad je definisan Članom 62 Zakona o radu [6], prema kojem se „svaki rad koji se obavlja u vremenu od 22 časa do 6 časova narednog dana smatra radom noću". Zaposlenom koji radi noću najmanje tri časa svakog radnog dana ili trećinu punog radnog vremena u toku jedne radne nedelje poslodavac je dužan da obezbedi obavljanje poslova u toku dana ako bi, po mišljenju nadležnog zdravstvenog organa, takav rad doveo do pogoršanja njegovog zdravstvenog stanja. Poslodavac je dužan da pre uvođenja noćnog rada zatraži mišljenje sindikata o merama bezbednosti i zaštite života i zdravlja na radu zaposlenih koji rad obavljaju noću.

Sa hronobiološkog stajališta, ljudska vrsta je diurnalna (aktivna u toku dana), što objašnjava činjenicu

INTRODUCTION

Over the past three to four billion years, life on Earth has evolved according to a predictable solar day pattern, i.e., being exposed to relatively bright light during the day and to darkness during the night. It has been known for quite some time that all living organisms have an internal biological clock that helps them adjust to the rhythm of the day. Such cyclic changes are called biorhythms. Human circadian rhythm is the most significant example of a biorhythm. The processes and structures that make up circadian rhythms are called circadian clocks. The master biological clock in humans is a cluster of about 20.000 nerve cells based in the hypothalamus and it is called suprachiasmatic nucleus (SCN) [1-2]. The availability of artificial light and light-emitting devices has changed human life by enabling us to be active 24/7, which leads to circadian misalignment and, eventually, to disturbances in physiological and behavioral functioning of an individual. In many professions (a baker, a doctor, a police officer, a night guard), the night shift is a necessary part of a regular working day, but many other occupations do not have regular hours either, but the work is done in the wee hours as well. In some professions, such as doctors or medical staff, there are rotation schedules, but in some other cases employees are "stuck" working at night, until the morning hours. In Europe, around 21% of the labor force consists of shift workers. 10% of all employees work evening shifts or the night shift, and 7% of European employees regularly work the night shift. According to the Bureau of Labor Statistics, more than 15 million Americans work the night shift [3,4].

According to the Council of the European Union, shift work is defined [5] as "any method of organizing work in shifts so that employees take turns on same job positions according to a determined schedule". In the past, only a limited number of employees were engaged in shift work. However, in recent years, many sectors have organized their work that way.

In the Republic of Serbia, night-time work is defined by Article 62 of the Employment Act [6], according to which "each work performed between 10 PM and 6 AM of the following day is deemed to be night-time work". An employer is bound to provide an employee who works at night for at least three hours every workday or one third of the full-time working hours in course of one working week, with the performance of jobs during daytime, should such work, according to the opinion of a competent health-service agency, cause deterioration of the employee's health condition. Before introducing night-time work, an employer is obliged to request an opinion of the trade union about the measures of safety and protection of life and health of employees who work during night-time.

da raspored rada u smenama, a naročito noćni rad, zahteva od ljudi da rade tokom biološke noći (kada cirkadijalni satovi podstiču san) i spavaju tokom biološkog dana (kada cirkadijalni satovi podstiču aktivnost), što može dovesti do promene u načinu ishrane, te menjaju nutritivne vrednosti hrane zahvaljujući širokom spektru bioloških, socijalnih i kulturoloških faktora. Na primer, zapaženo je da noćni rad dovodi do konflikta izmedju utvrđenog rasporeda obroka i cirkardijalnih ritmova koji se odnose na osećaj gladi, sitosti i metabolizam [7,8]. Pitanje ishrane uvek je uticalo na kvalitet rada i zdravlja zaposlenih radnika, uzimajući u obzir sledeće: različito fizičko opterećenje, različite energetske potrebe, i različite potrebe za gradivnim i energetskim materjalom. Međutim, teško je dati smernice za ishranu radnika koji rade u noćnoj smeni. Prvo, ne znamo da li radnici koji rade noću uopšte treba da jedu u toku noći ili ne. Drugo, nedostaje definitivni dokaz na koji bismo se pozvali u vezi sa tim šta treba jesti, a šta izbegavati. Treće, nutritivno vredna i kvalitetna hrana možda neće biti dostupna u toku noćnih radnih sati. Najzad, ishrana tokom noći može poboljšati blagostanje, ali oštetiti metabolizam.

Cirkadijalni ritam i enzimska sekrecija

Centralni sat tela koji se nalazi u suprahijazmatskom jezgru kontroliše metabolizam kružeći tokom 24 sata, dok su periferni satovi smešteni u tkivima širom tela sinhronizovani sa centralnim satom kada spoljni faktori (izloženost svetlosti, fizička aktivnost i unos hrane) prate dnevne obrasce.

Cirkadijalni procesi noću podstiču san i post kroz regulatorne hormone kao što su melatonin i insulin, dok hranjenje i aktivnost dominiraju dnevnim satima uz optimizaciju metaboličkih procesa za potrošnju energije, lučenje insulina i sintezu holesterola i glikogena koji se dešavaju tokom ranog dela dana. Noćno jedenje i izmenjeno vreme spavanja, što je tipično za radnike koji rade u smenama, ometaju sinhronizaciju centralnog i perifernog sata i utiču na hormone na koje utiče pogrešno spavanje i unos hrane.

Svakom stimulusu odgovara pokretanje enzimske sekrecije, koja je u savršenoj harmoniji sa energetskim i kalorijskim potrebama ljudskog bića, koje pak odgovaraju potrebama funkcionisanja njegovog organizma.

U jutarnjim časovima dešava se sekrecija proteaza da bi se matebolisali proteini, kao i jaka sekrecija lipaze kako bi se metabolisale masti, koje će biti korišćene tokom naredne noći za izgradnju ćelijskih zidova. Na metabolizam lipida utiču i cirkadijalne oscilacije. Studije pokazuju da mnogi proteini povezani sa metabolizmom lipida (npr. ApoB, ApoA1 i ApoA4), intestinalni mikrozomalni transportni protein triglicerida i protein

From a chronobiological point of view, the human species is diurnal (i.e., active during the day), which means that shift work, especially night-time work, requires people to work during the biological night (when circadian clocks promote sleep) and to sleep during the biological day (when circadian clocks promote activity), which may lead to a change in dietary habits and in the nutritive value of food owing to a broad spectrum of biological, social and cultural factors. For example, it was found that night-time work caused a conflict between the determined meal schedule and circadian biological rhythms related to the feeling of hunger, satiety, as well as the metabolism itself [7,8]. The issue of nutrition has always affected the quality of work and health of employees, taking the following into consideration: different workload, different energy requirements, and different nutrient requirements. However, it is difficult to provide dietary guidelines for night shift workers. Firstly, we do not know whether employees who work at night should eat at all when at work or not. Secondly, there is no definitive proof we would rely on concerning the food they should eat or avoid. Thirdly, the most nutritious foods may not be available at that time of night. Finally, eating at night may improve one's well-being, but damage their metabolism.

Circadian rhythm and enzyme secretion

The central biological clock based in the suprachiasmatic nucleus controls the metabolism by cycling over the period of 24 hours, whereas peripheral body clocks located in tissues throughout the body are synchronized with the master clock when external factors (exposure to light, physical activity, and food intake) follow daily patterns.

At night, circadian processes promote sleep and fasting by means of regulatory hormones such as melatonin and insulin, while feeding and activity dominate daytime hours with the optimization of metabolic processes for energy expenditure, insulin secretion, and cholesterol and glycogen synthesis that occur during the early part of the day. Nocturnal eating and altered sleep time, which are typical of night shift workers, disrupt the synchronization of the central clock and peripheral clocks and impact on the hormones that are affected by poor sleep and food intake.

Each stimulus corresponds to the initiation of enzyme secretion which is in perfect harmony with energy and caloric requirements of a human being, which in turn corresponds to the needs of functioning of their organism.

In the morning, protease secretion occurs to metabolize proteins, as well as lipase secretion which is of importance for metabolizing lipids that will be used

koji vezuje masne kiseline creva pokazuju promene tokom dana [25-27]. Pored toga, studije na miševima pokazuju da je apsorpcija holesterola i lipida u tamnoj fazi veća nego u svetloj fazi. Neki proizvodi metabolizma lipida takođe pokazuju cirkadijalni ritam. Na primer, cirkulišuće neesterifikovane masne kiseline kod ljudi su više noću zbog povećane lipolitičke aktivnosti [9]. Ovim dvema sekerecijama predhodi lučenje kortizola koji je takođe pod kontrolom suprahijazmatskog jedra (SCN) koje je smešteno u hipotalamusu. Kortizol je steroidni hormon koji se luči iz nadbubrežnih žlezda. Reguliše mnoge metaboličke procese kao što su glikogenoliza, lipoliza i proteoliza. Količina i učestalost lučenja kortizola regulišu se preko cirkadijalnog ritma [10,11]. Koncentracija kortizola u cirkulaciji dostiže najviši nivo neposredno pre jutarnjeg buđenja (između 7 i 8 časova). Kortizol postepeno opada tokom dana. Najniži nivo dostiže tokom sna posle ponoći, između 2 i 4 časa ujutru. Kortizol je glavni hormon koji reguliše metaboličke događaje u telu. Visok nivo kortizola funkcioniše kao katabolički hormon koji smanjuje čistu telesnu i mišićnu masu i povećava potrošnju energije.

Potom dolazi do lučenja insulina, koji pred kraj sna, omogućava početak korišćenja sporih šećera kako bi se omogućio priliv energije potrebne za funkcionisanje svih organa koji rade, i to za ceo dan. Pored toga, tolerancija na glukozu i lučenje insulina variraju tokom dana. U prirodnom toku metabolizma, osetljivost na insulin i lučenje insulina se smanjuju noću (naročito između 3 i 5 časova ujutru) u poređenju sa jutarnjim satima. Ovaj metabolički proces, „fenomen zore", naglašava uticaj cirkadijalne kontrole na metabolizam glukoze. U prirodnim fiziološkim procesima u telu, hormoni koji rade kao antagonisti insulina (posebno hormona rasta) ispoljavaju hiperinsulinemičnu aktivnost zbog smanjenja lučenja insulina između 3 i 5 časova ujutru, tako da se nivo šećera u krvi vraća u normalu. Ovo se suprotstavlja dodatnom fiziološkom lučenju insulina kod nedijabetičara ili insulin zavisnih osoba. Nasuprot tome, kada je poremećeno oslobađanje insulina, efekat hormona rasta koji se oslobađa tokom noći, posebno kod pacijenata sa dijabetesom, možda neće biti ublažen. Ovo dovodi do patološkog cirkadijalnog ritma, koji može dovesti do jutarnje hiperglikemije nezavisno od načina ishrane [12]. U podne dolazi do sekrecija proteaza i amilaza [13,14] kako bi se obezbedila asimilacija namirnica. Popodne se javlja pojava višeg kortizola, nekih pet sati od prethodnog obroka, što izaziva sekreciju insulina, koji pak zahteva korišćenje brzih i polubrzih šećera kako bi se izbeglo oslobađanje uskladištenih proteina i kompenzovao zamor povezan sa funkcionisanjem organa.

U večernjim satima praktično više nema digestivne sekrecije, što znatno usporava asimilaciju namirnica,

during the following night for building cell walls. Circadian oscillations affect lipid metabolism as well. It has been concluded that many proteins associated with lipid metabolism (e.g., ApoB, ApoA1, and ApoA4), intestinal microsomal triglyceride transfer protein and intestinal fatty acid binding protein undergo changes during the day [25-27]. Moreover, mouse studies show that the absorption of cholesterol and lipids is greater in the dark phase than in the light phase. Some products of lipid metabolism also exhibit a circadian rhythm. For example, the level of circulating non-esterified fatty acids in humans is higher at night due to increased lipolytic activity [9]. These two secretions are preceded by cortisol secretion which is also controlled by the suprachiasmatic nucleus (SCN) located in the hypothalamus. Cortisol is a steroid hormone secreted by the adrenal glands. It regulates many metabolic processes such as glycogenolysis, lipolysis, and proteolysis. The amount and frequency of cortisol secretion are regulated by the circadian rhythm [10,11]. Circulating cortisol levels are at their highest immediately before waking (between 7 AM and 8 AM). Cortisol level gradually declines during the day, and it is at its lowest during sleep, after midnight (between 2 AM and 4 AM). Cortisol is the key hormone which regulates metabolic events in the body. Elevated levels of cortisol act as a catabolic hormone which reduces lean body mass and increases energy expenditure.

Then there is insulin secretion towards the end of sleep which enables the start of using slow-digested sugars in order to enable the flow of energy necessary for the functioning of all organs throughout the day. Besides, glucose tolerance and insulin secretion vary during the day. In the natural course of metabolism, insulin sensitivity and insulin secretion decrease at night (especially between 3 AM and 5 AM) in comparison with the morning hours. This metabolic process, "the dawn phenomenon", emphasizes the impact of circadian control on glucose metabolism. In natural physiological processes in the body, hormones that function as insulin antagonists (especially growth hormone) exert hyperinsulinemic activity due to a decrease in insulin secretion between 3 AM and 5 AM, so blood sugar levels return to normal. This is in contrast with the additional physiological insulin secretion in non-diabetics or in insulin-dependent individuals. On the other hand, when insulin release is impaired, the effect of growth hormone released at night, especially in patients with diabetes, may not be attenuated. This leads to a pathological circadian rhythm which may lead to hyperglycemia in the morning regardless of the dietary habits [12]. At noon, proteases and amylases are secreted [13,14] to ensure the assimilation of food. In the after-

odnosno organizam više neće moći da metaboliše prevelik unos hrane, kako kvalitativno tako i kvantitativno. Noću mora biti prisutna katabolička aktivnost vezano za potebu mobilizacije endogene energije za vreme spavanja i gladovanja, ali su takođe prisutni i anabolički restorativni procesi. Tokom noći, hormon rasta (oslobođen u ovoj fazi dubokog sna) i kortizol [15-17] dovode do interne energetske mobilizacije serumske glikoze. Dostupni nivoi glikoze su smanjeni tokom noći i glukoza se „štedi" tako da obezbedi energiju za CNS, što dovodi do rezistentnosti za noćnu energiju u mišićnim tkivima. To se smatra razlogom za oštećenu toleranciju glikoze kod radnika koji rade u noćnoj smeni.

Nespavanje i noćni rad takođe utiču na metabolizam dva važna hormona u našem telu i to na hormon gladi i sitosti (leptin i grelin) koji zavise od cirkadijalnog ritma, tako da pospešuju noćno gladovanje i spavanje. Ovo može uticati na poremećaj apetita koji se često zapaža kod radnika koji rade noću.

Leptin ima endokrine i parakrine efekte i učestvuje u regulaciji telesne mase, metabolizma i reproduktivnih funkcija. Porast nivoa leptina daje informaciju da je organizam sit i apetit se smanjuje, i obrnuto. Leptin je hormon koji se proizvodi u masnom tkivu; nakon što se leptin izluči iz adipocita, on prelazi krvno-moždanu barijeru, odlazi do mozga i vezuje se za njegov receptor LepR. Disregulacija ili disfunkcija receptora (nedostatak receptora za leptin) može dovesti do prejedanja i debljanja. Cirkadijalni ritam utiče na nivo koncentaracije leptina, pa je najniža koncentracija u ranim jutarnjim satima, a tokom dana se povećava i na svom je najvišem nivou kasno uveče. Ono što utiče na nivo leptina tokom 24 sata jeste gubitak sna ili produženi san, cirkadijalna faza, prekomerni unos hrane, ili ograničenje kalorija. Leptin i insulin utiču na osetljivost mozga na signale sitosti [18,19].

Grelin ima strukturu peptida, sastoji se od 28 aminokiselina i naziva se hormonom gladi, jer ima jako važnu ulogu u regulaciji apetita. Grelin proizvode P/D1 ćelije u stomaku i to je hormon koji povećava apetit. Prazan želudac luči grelin koji informiše endokrine žlezde mozga o nedostatku hrane u sistemu za varenje i javlja se osećaj gladi. Grelin deluje kratkoročno i utiče na svakodnevni osećaj gladi. Kod zdravih odraslih, 24-časovni obrazac se javlja u cirkulišućim nivoima grelina u uslovima energetskog balansa, tako da se nivoi grelina povećavaju između obroka, smanjuju posle obroka, povećavaju pre i tokom prvih nekoliko sati sna i smanjuju tokom druge polovine epizode spavanja. U stalnim rutinskim uslovima, cirkadijalni ritam grelina se povećava tokom biološkog dana i smanjuje tokom biološke noći [20,21]. U uslovima kontrolisanog unosa energije ili energetske ravnoteže kod zdravih odraslih

noon, high levels of cortisol occur, approximately five hours after the last meal, which causes insulin secretion, which in turn requires the use of fast-acting and medium-acting sugars in order to avoid the release of stored proteins and compensate the fatigue associated with the functioning of the organs.

In the evening there is practically no digestive secretion, which significantly slows down the assimilation of food, or in other words, the body will no longer be able to metabolize excessive food intake, both qualitatively and quantitatively. At night, catabolic activity must be present related to the need to mobilize endogenous energy during sleep and fasting, but restorative anabolic processes are also present. During the night, growth hormone (released in this deep sleep phase) and cortisol [15-17] lead to internal energy mobilization of serum glucose. Available glucose levels are reduced at night and glucose is "spared" so as to provide energy for CNS, which leads to the resistance to nocturnal energy in muscle tissues. This is considered to be the reason for impaired glucose tolerance in night shift workers.

A lack of sleep and night-time work also influence the metabolism of two important hormones in our body – hunger and satiety hormones (leptin and ghrelin) which depend on the circadian rhythm promoting nocturnal fasting and sleep. This may affect appetite disturbance, which is often the case in employees who work the night shift.

Leptin has endocrine and paracrine effects, and it takes part in the regulation of body mass, metabolism and reproductive functions. Increased leptin provides the information that the organism is full, and appetite thus decreases, and vice versa. Leptin is a hormone produced in the adipose tissue; after leptin has been secreted from adipocytes, it crosses the blood-brain barrier, goes to the brain, and is bound to its receptor LEPR. Dysregulation or dysfunction of the receptor (leptin receptor deficiency) may lead to overeating and gaining weight. The circadian rhythm affects leptin levels, so its concentration is lowest in the morning, and it increases during the day being at its highest late in the evening. What affects the 24-hour leptin levels is as follows: a lack of sleep or prolonged sleep, circadian phase, excessive food intake, or calorie restriction. Leptin and insulin affect the brain's sensitivity to satiety signals [18,19].

Ghrelin has the structure of a peptide; it consists of 28 amino acids and it is called hunger hormone as it plays an important role in the regulation of appetite. Ghrelin is produced by P/D1 cells in the stomach, and it is an appetite-increasing hormone. An empty stomach secretes ghrelin which informs endocrine glands of

osoba, prijavljeno je da cirkadijalna neusklađenost ima minimalan uticaj na ukupne cirkulišuće nivoe grelina. Hormon grelin je povezan sa hormonom rasta pa tako podstiče telo na fizički razvoj, a takođe je dokazano da visoka koncentacija grelina pojačava memoriju i koncentraciju [22].

Homocistein je pseudo-aminokiselina koja u našem telu učestvuje u izgradnji tkiva. Viši nivoi homocisteina su nađeni kod radnika koji rade u smenama, koji su stariji od 40 godina i koji imaju probleme sa spavanjem. Homocistein pokazuje cirkadijalni noćni pik koji je povišen usled konzumiranja proteina životinjskog porekla u obroku tokom noći i smatra se vodećim uzrokom srčanih i moždanih udara [23,24].

Ishrana radnika koji rade u smenama

Imajući u vidu kako cirkadijalni ritam utiče na naš metabolizam, još 1960. godine počelo je da raste interesovanje za ishranu radnika koji rade u smenama. Studija koju je sproveo Derbi sa saradnicima [25] bila je jedna od prvih koja je pokazala da ukupni energetski unos kod zaposlenih koji rade u smenama jeste sličan onom kod radnika koji rade danju, ali da se značajno razlikuju po distribuciji/dinamici tih obroka tokom 24 časa. Međutim, ishrana radnika koji rade po smenama pokazala se bogatijom životinjskim mastima i proteinima. U istraživanjima koja su kasnije sprovedena takođe je uočeno da unos energije nije veći kod radnika koji rade u smenama i koji već imaju cirkadijalnu neusklađenost u odnosu na radnike koji ne rade u smenama. Međutim, izbor hrane može biti manje zdrav, a stopa gojaznosti je veća. Ovi rezultati upućuju na to da, čak i bez promena u unosu energije, može doći do povećanja telesne težine kada se energija troši u neodgovarajuće cirkadijalno vreme. Potrošnja energije raste nakon jutarnjeg obroka, i tada dolazi do većeg sagorevanja kalorija i veće iskoristljivosti hranljivih materija u odnosu na noćno obrokovanje [26,27]. Iako je u okviru sistematskih pregleda i u meta-analizama ranije prijavljivano da je ukupni energetski unos radnika koji rade u smenama sličan onom kod radnika koji rade danju i ovde su se pojavile nedoumice oko dokazaivanja ove tvrdnje. Razlog za to je najpre ograničen broj studija, tj. mali broj studija koje se fokusiraju isključivo na radnike koji menjaju smene (kao na vrstu rasporeda smena) i na rotirajući unos energije u „noćnoj" smeni, a ne na unose koji su reprezentativniji za promenu rasporeda smena. Ono što je manje poznato je kako individualni rasporedi smena, posebno rotirajući rad u smenama, mogu uticati na unos energije i obrasce ishrane. Do danas, studije retko razlikuju tipove radnog rasporeda osim „dnevne smene" ili „noćne smene" i često u analizama kombinuju raspored smena sa rotacijom i bez rotacije.

the brain about the lack of food in the digestive system and the feeling of hunger occurs. Ghrelin has a short-term effect, and it affects the daily feeling of hunger. In healthy adults, a 24-hour pattern occurs in circulating ghrelin levels if there is energy balance – ghrelin levels increase between meals, decrease after meals, increase before and during the first few hours of sleep, and decrease during the second half of the sleep episode. Under constant routine conditions, the circadian rhythm of ghrelin increases during the biological day and decreases during the biological night [20,21]. Under conditions of controlled energy intake or energy equilibrium in healthy adults, circadian misalignment has been reported to have a minimal effect on total circulating ghrelin levels. The hormone ghrelin is related to growth hormone, so it encourages physical development, and high concentrations of ghrelin have been proven to enhance memory and concentration [23].

Homocysteine is a pseudo-amino acid which participates in tissue building in our body. Elevated homocysteine levels are found in night shift workers, those who are over 40 years of age, and who have sleep problems. Homocysteine has circadian nocturnal peak that is elevated due to animal protein consumption in a night-time meal and is considered to be a leading cause of myocardial infarction and stroke [23,24].

Dietary habits of night shift workers

Bearing in mind the impact of the circadian rhythm on our metabolism, as early as 1960 an interest in dietary habits of night shift workers was increased. The study conducted by Derby et al. [25] was among the first to show that the total energy intake in employees who worked shifts was similar to that of employees who worked daytime shifts, but that they differed significantly in distribution/dynamics of meals over the course of 24 hours. However, the diet of shift workers was found to be richer in animal fats and proteins. Subsequent studies also found that energy intake was not higher in shift workers who already suffered from circadian misalignment compared to those who did not work shifts. However, they may choose less healthy foods, and obesity rates could be higher. These results suggest that, even with no changes in energy intake, weight gain may occur if energy is expended at an inappropriate circadian time. Energy expenditure increases after the morning meal and this is when more calories are burnt and more nutrients are used compared to night-time eating [26,27]. Although it was previously reported in regular medical check-ups and meta-analyses that the total energy intake in shift workers was similar to that of daytime workers, doubts have arisen concerning this claim. The primary reason for this is

Dakle, uticaj rotirajućeg rasporeda smena na obrasce ishrane nije dobro utvrđen. Ovo je veoma važno s obzirom na rotaciju radnika u smenama koji menjaju sate rada iz dana u noć i povezanost sa lošijim metaboličkim zdravstvenim rezultatima i jedenjem noću [28].

S druge strane, primećena je i razlika u unosu mikronutrijenata [29-31] između radnika koji rade noću i radnika koji rade u dnevnoj smeni. Od desetak studija koje su ispitivale unos makronutrijenata, sedam studija je prijavilo značajnu razliku u unosu proteina kod radnika koji rade noćnu smenu uključujući niži unos proteina kod žena u odnosu na muškarce. Što se tiče unosa masti postoje oprečna mišljenja, ali je dokazano da se ipak značajno više masti unese tokom noćne smene, kao i da postoji značajno viši unos ugljenih hidrata u noćnoj smeni u odnosu na dnevnu.

Knutson i saradnici [32] su 90-ih godina ustanovili da radnici koji rade noću unose manje dijetalnih vlakana 6 meseci nakon početka rada u noćnoj smeni. Takođe, u studijama koje su sprovedene kasnije primećeno je da radnici koji rade u smenama, a naročito noću, unose manje dijetetskih vlakana. Za to se uglavnom krivi smanjen unos zelenog povrća, veća konzumacija krompira, manji unos voća i povećan unos glukoze zahvaljujući većem unosu gaziranih i energetskih pića, kofeina, kao i većem unosu zasićenih masti [33-35]. Linseisen i saradnici [36] ustanovili su da je unošenje dijetetskih vlakana, cinka i vitamina A i D bilo manje i ispod dnevnih preporučenih vrednosti u grupi radnika koji stalno rade u noćnoj smeni. Pored toga, u studiji Przeora i saradnika [37] ukazano je na to da radnici koji rade u smenama unose hranu koju karakteriše nizak nivo hranljivih materija kao što su vlakna, Ca, Mg, Fe, vitamin D, folna kiselina. Pored toga, hrana kod žena koje su učestvovale u studiji, kao i kod muškaraca, imala je nepovoljno visok sadržaj natrijuma i fosfora. Razlog za visok unos gore navedenih materija možda leži u tome što su ovi radnici unosili veću količinu prerađevina od mesa [38,39]. Poslednjih godina sprovode se ispitivanja koncentaracije vitamina D u ishrani kod radnika koji rade noću. Došlo se do zaključka da radnici koji rade u smenama, a naročito noću, imaju niži nivo vitamina D nego radnici koji rade u dnevnoj smeni. Uzrok je taj što su noćni radnici manje izloženi sunčevoj svetlosti u odnosu na radnike koji nemaju smenski rad [40,41]. Pored toga, radnici u noćnoj smeni pokazuju tendenciju ka neredovnom rasporedu obroka, jedenju noću i većem unosu nezdrave hrane, što sve može dovesti do smanjenog unosa vitamina D. Takođe je poznato da radnici koji rade u smenama, a naročito oni koji rade noću imaju tendenciju ka većem BMI (indeksu telesne mase) od opšte populacije, što je faktor koji može dovesti do povećane sekvestracije vitamina D u

the limited number of studies, i.e., a small number of studies focusing exclusively on shift workers (as in shift schedule) and the rotating energy intake in the night shift rather than intakes that are more representative of shift work. What is not well known is how individual shift schedules, especially shift rotations, may affect energy intake and dietary patterns. To date, studies have rarely distinguished between the types of work schedule other than "the day shift" and "the night shift" and they have often mixed rotating and non-rotating shift schedule in their analyses. So, the impact of rotating shift schedules on dietary patterns has not been well established. This is very important considering the fact that some shift workers change work hours from daytime to night-time and that it is associated with poorer metabolic health results and night-time eating [28].

On the other hand, there is a difference between micronutrient intake [29-31] between employees who worked during the night-time and those who worked the day shift. Seven out of a dozen studies that explored macronutrient intake reported a significant difference in protein intake in night shift workers, including a lower protein intake in women compared to men. Regarding fat intake, there are conflicting opinions, but it has been proven that significantly more fat is consumed during the night shift, as well as that there is significantly higher intake of carbohydrates during the night shift in comparison with the day shift.

In the 1990s, Knutson et al. [32] found that night shift workers consumed less dietary fiber 6 months after they had started working the night shift. Also, in studies conducted later, it was noticed that night shift workers consumed less dietary fiber especially at night. This is mainly due to reduced intake of green vegetables, higher potato consumption, lower fruit intake and increased glucose intake because of higher intake of carbonated and energy drinks and caffeine and higher intake of saturated fats [33-35]. Linseisen et al. [36] found that the intake of dietary fiber, zinc and vitamins A and D was lower and below the recommended values in a group of workers who constantly worked the night shift. Moreover, in a study conducted by Przeor et al. [37] it was pointed out that shift workers consumed foods characterized by a low level of nutrients such as fiber, Ca, Mg, Fe, vitamin D, folic acid. In addition, the diets of the women who participated in the study, as well as those of the men who participated in it, were unfavorably high in sodium and phosphorus. The reason behind the high intake of the abovementioned substances may lie in the fact that these workers consumed a larger amount of meat products [38,39]. In recent years, tests have been conducted on the concentration of vitamin D in the diets of night shift work-

masnom tkivu i posledično do niže vrednosti vitamina D u cirkulaciji [42]. Usled smanjenog unosa vitamina D dolazi do poremećaja metabolizma kostiju i nastanka osteoporoze. Rizik od povećanog preloma kostiju kod radnika koji rade noćnu smenu nisu istraživana sve do Bukovske-Damske i saradnika [43] koji su sproveli studiju koja je pokazala veću stopu naprsnuća i preloma kostiju kod radnica koje rade noćnu smenu u odnosu na radnice koje rade danju, što ukazuje na potencijalnu vezu između osteoporoze i smenskog rada. Pored toga, nekoliko studija je pokazalo povezanost između niskog nivoa vitamina D i nastanka drugih bolesti, kao sto su autoimuni poremećaji, kardiovaskularne bolesti, dijabetes melitus tip 2, zarazne bolesti, rak, neurološki i neuropsihijatrijski poremećaji, kao što su šizofrenija, demencija i depresija [44]. Na osnovu dosadašnjih saznanja o unosu vitamina D kod radnika koji rade noću otvara se čitav niz pitanja. Heterogenost među studijama bila je visoka, nije objašnjena godinama, polom, BMI i metodama merenja nivoa 25-OH-D u serumu i veći broj studija sproveli su Koreanci, pa je potrebno sprovesti veće epidemiološke studije u drugim populacijama, kako bi se ove tvrdnje dokazale.Verovatno je da karakteristike smenskog rada, posebno broj odrađenih noći na mesečnom nivou, igraju ključnu ulogu u koncentraciji vitamina D kod ovih radnika, pa bi iz tog razloga bilo poželjno da se u okviru periodičnih pregleda određuje i koncentracija vitamina D i na osnovu rezultata sprovede brza korekcija nedostataka vitamina D radi sprečavanja rizika od preloma [45].

Nekoliko studija je takođe izvestilo da radnici u noćnim smenama imaju tendenciju da jedu češće [46,47], jedu manje sa više užina nego što je uobičajeno („faktor grickanje") tokom noćnih smena umesto jednog većeg obroka, što se moze opisati kao konzumiranje „mnogo hrane putem nekoliko obroka".

Pored toga, ostaje da se utvrdi da li ponovljena izloženost cirkadijalnoj neusklađenosti (na primer, tokom rada u noćnoj smeni) i usklađivanju (slobodni dani) hronično menja hormone apetita i unos energije, odnosno treba istražiti san kod ovih radnika jer postoje studije koje pokazuju štetne efekta lošeg kvaliteta sna i kratkog trajanja sna jer ova uloga još uvek nije kvantifikovana. Potrebne su dalje studije koje bi ispitale individualne razlike između polova i potvrdile vezu između obrazaca spavanja i buđenja i faktora načina života, kao što su navike u ishrani, fizička aktivnost i navika pušenja [48,49].

Efekat rada u smenama na zdravlje zaposlenih

Svako prisilno narušavanje normalnih obrazaca spavanja, kao što je rad u smenana, a naročito rad noću, može dovesti do cirkadijalne neusklađenosti i veruje se da je

ers. It has been concluded that shift workers, especially those who work the night shift, have a lower level of vitamin D compared to those who work the day shift. This is because night shift workers are less exposed to sunlight than those who do not work shifts [40,41]. In addition, night shift workers tend to adopt irregular meal schedules, eat at night, and consume more unhealthy food, which can lead to reduced vitamin D intake. It is also known that shift workers, especially those who work the night shift, tend to have a higher BMI (body mass index) than the general population, which may lead to increased sequestration of vitamin D in adipose tissue and consequently to lower levels of circulating vitamin D [42]. Due to reduced intake of vitamin D bone metabolism disorders and osteoporosis occur. The risk of increased incidence of bone fractures had not been researched until Bukowska-Damska et al. [43] conducted a study which showed a higher rate of fissures and fractures in female night shift workers compared to those female workers who worked the day shift, suggesting a potential link between osteoporosis and shift work. In addition, several studies have showed a link between low levels of vitamin D and the occurrence of other diseases, such as autoimmune disorders, cardiovascular disease, diabetes mellitus type 2, infectious diseases, cancer, neurological and neuropsychiatric disorders (e.g. schizophrenia, dementia, and depression) [44]. Based on the current knowledge about vitamin D intake in night shift workers, a series of questions opens. There was high heterogeneity not explained by age, gender, BMI, and methods of measuring 25-OH-D levels and a large number of studies were conducted by Koreans, so it is necessary to conduct larger epidemiological studies in order to prove the statements. It is likely that the characteristics of shift work, especially the number of working nights on a monthly basis, play a vital role in vitamin D concentrations in these workers, and for this reason it would be desirable to determine vitamin D concentration as part of check-ups and based on the results carry out a rapid correction of vitamin D deficiency in order to prevent the risk of bone fractures [45].

Several studies have also reported that night shift workers have a tendency to eat more frequently [46,47], eat less with more snacks than usual ("snacking factor") during the night shift instead of a single large meal, which can be described as consuming "a lot of food in several meals".

Apart from this, it remains to be determined whether repeated exposure to circadian misalignment (for example, when working the night shift) and alignment (days off) chronically alters appetite hormones and energy intake, i.e., sleep should be examined in these

to delimično odgovorno za nastanak metaboličkog sindroma i hroničnih bolesti [50]. Metabolički sindrom karateriše istovremna pojava hipertenzije, dijabetesa, gojaznosti i dislipidemije, i utvrđen je kao glavni uzročnik morbititeta i mortaliteta od kardiovaskularnih bolesti. Hronični metabolički poremećaj predstavlja veliki zdravstveni problem širom sveta. U poređenju sa osobama koje rade danju, radnici koji rade noću imaju veći rizik od niza metaboličkih poremećaja i bolesti, kao posledice poremećenog cirkadijalnog ritama i spavanja, izloženosti psihosocijalnom stresu, fizičke neaktivnosti i nedovoljno vremena za odmor i revitalizaciju. Uprkos tome što imaju isti dnevni unos energije kao radnici koji rade danju, radnici koji rade noću imaju za 23% povećan rizik od razvoja prekomerne težine/gojaznosti i 35% povećan rizik od razvoja abdominalne gojaznosti u poređenju sa dnevnim radnicima. Pored toga, kod ovih radnika dolazi do upalnih reakcija, kao i do narušene tolerancije na glukozu i osetljivosti na insulin [51,52].

Cirkadijalni ritmovi imaju važnu ulogu u regulaciji kardiovaskularne fiziologije i zdravlja. Periferni satovi su prisutni u svakom od tipova kardiovaskularnih ćelija, regulišući njihovu funkciju, krvni pritisak, rad srca, cirkulišuće kateholamine, markere koagulacije krvi i funkciju vaskularnog endotela. Rizik od koronarne bolesti srca može biti povećan izlaganjem noćnom svetlu zbog poremećaja cirkadijalnih ritmova, koji utiču na funkciju endotela, što dovodi do aterosklerotičnih promena na krvnim sudovima, formiranja tromba i izazivanja inflamatornih odgovora [53,54].

Usled metaboličkih poremećaja, naročito u odnosu na lipidnu i glikoznu intoleranciju, imaju 9% veću mogućnost za razvoj dijabetesa tipa 2, 23% povećan rizik od infarkta miokarda i 5% povećan rizik od moždanog udara [55]. Javljaju se problemi sa uspavljivanjem i dolazi do razvoja mentalnih bolesti poput anksioznosti i depresije, kao i do uticaja na kognitivne performanse (smanjenje pažnje i otežano izvršavanje zadataka), promenu raspoloženja i budnost [56].

Svetska zdravstvena organizacija i Međunarodna agencija za istraživanje raka [57] zaključuju da je noćni rad verovatno kancerogen za ljude. Smanjenje nivoa lučenja melatonina dovodi do imunosupresije uključujući smanjenu aktivnost prirodnih ćelija ubica što može dovesti do kolorektalnog karcinoma, karcinoma dojke i karcinoma prostate [58]. Analizom 31 kohortne studije dolazi se do saznanja da izloženost noćnom radu značajno povećava rizik od oboljevanja od raka dojke za 2,9%, a za 8,6% za grupu radnika koja radi više od 10 godina u noćnoj smeni i 5,3% za radnike kod kojih se smene rotiraju. [59]. Međutim, rezultati istraživanja su kontroverzni, jer 26 meta-studija koje su prihvaćene

workers as there are studies showing harmful effects of poor sleep quality and short sleep duration considering this role has not been quantified yet. Further studies are needed to examine individual differences between the sexes and confirm the relationship between sleep-wake patterns and lifestyle factors, such as dietary habits, physical activity and smoking habit [48,49].

The effect of shift work on workers' health

Any forced disruption of normal sleep patterns, such as shift work (especially working at night), can lead to circadian misalignment and it is believed that this is partly to be blamed for the development of metabolic syndrome and chronic diseases [50]. Metabolic syndrome is characterized by the simultaneous occurrence of hypertension, diabetes, obesity, and dyslipidemia, and it has been marked as the leading cause of cardiovascular morbidity and mortality. Chronic metabolic disorder is a major health problem worldwide. Compered to people who work the day shift, night shift workers have a higher risk of a number of metabolic disorders and diseases as a consequence of disturbed circadian rhythm and sleep, exposure to psychosocial stress, physical inactivity and insufficient time for rest and revitalization. Despite having the same daily energy intake as people who work the day shift, night shift workers have a 23% increased risk of becoming overweight/obese and a 35% increased risk of developing abdominal obesity compared to daytime workers. Moreover, inflammatory reactions occur in these workers, as well as impaired glucose tolerance and insulin sensitivity [51,52].

Circadian rhythms play an important role in the regulation of cardiovascular physiology and health. Peripheral clocks are present in each type of cardiovascular cells, and they regulate their functioning, blood pressure, the functions of the heart, circulating catecholamines, blood coagulation markers, and the vascular endothelium. The risk of coronary heart disease may be increased by exposure to light during the night due to the disruption of circadian rhythms, which affects the endothelial function leading to atherosclerotic changes in blood vessels, thrombus formation and the induction of inflammatory responses [53,54].

Due to metabolic disorders, especially in relation to lipid and glucose intolerance, they are 9% more likely to develop diabetes type 2, they have a 23% increased risk of myocardial infarction, and a 5% increased risk of stroke [55]. There are problems with falling asleep and with the development of mental disorders such as anxiety and depression, and there is an impact on cognitive performances (decreased attention span and difficulty completing tasks), mood swings and alertness [56].

nije otkrilo povećanje oboljevanja od raka kod radnika koji dugo rade u noćnoj smeni [60] tako da predstoje dalja istraživanja u ovom smeru.

Saveti za zdraviju ishranu tokom noćne smene

Radnici koji rade noću suočeni su sa brojnim izazovima, naročito kada je u pitanju njihovo zdravlje i način ishrane. Za njih zdrava ishrana predstavlja pravi izazov. Postoje brojne preporuke kako da radnici koji rade noću obezbede svom telu uravnoteženu i zdravu ishranu [61], što smo mi u ovom preglednom članku pokušali da predstavimo.

Posle smene i pre spavanja treba izbegavati kofein najmanje 6 sati, a 1-2 sata pre spavanja treba doručkovati, pri čemu treba izbegavati „velike/obilne obroke". Doručak je neophodan kako ne bi dolazilo do prerano buđenja zbog gladi.

Nakon spavanja sledi ručak koji bi trebao da obiluje povrćem, posnim mesom i obaveznom salatom, kako bi se obezbedila energija za ceo dan.

Nekoliko sati pre odlaska na posao, savetuje se glavni obrok (večera u krugu porodice ili prijatelja). Hrana koja se teško vari sigurno nije pogodna za noćne obroke, kao na primer gotovo sve prženo, ali zato lako svarljivi obroci poput supe, čorbe, jogurta i pirinča neće opteretiti stomak. Kako ne bi dolazilo do prejedanja jako je bitna i veličina tanjira. Naime, jelo iz manjeg tanjira može da prevari naš mozak da pomisli da je obrok veći nego što jeste. Tanjir treba popuniti tako da polovina tanjira sadrži raznobojno povrće (povrće spremiti na pari, isitniti i preliti sosom), a jedna četvrtina tanjira treba da bude popunjena niskokaloričnim belančevinama (najbolje je izabrati posna (mršava) mesa bez kože, uključujući i biljne proteine od mahunarki i tofua). Preostala četvrtina tanjira može se ispuniti skrobnim povrćem ili integralnom hranom.

Odlaskom na posao (treća smena podrazmeva rad od 22h do 6h) rano u smeni neminovno će se osetiti glad koju treba zavarati malim obrokom ili užinom. Ovaj obrok bi trebalo da sadrži, na primer, kuvana jaja, tunjevinu, pečeno ćureće ili pileće belo meso, badem i kikiriki (može i u obliku putera). Može se napraviti sendvič od navedenog i svemu tome dodati neko voće. Kasno u smeni slede dopunski obroci (mali zalogaji na svakih nekoliko sati kako bi se očuvala koncentracija i energija), otprilike na svaka 3 sata. Savetuje se izbegavanje obrokovanja ili ako se baš mora, unositi hranu koja je energetski siromašna i to između ponoći i 6 sati ujutru, ili probati da se jede na početku i na kraju smene.

Mnogo je zdravije ako hranu ponesemo sa sobom (zdrava hrana i zdrave grickalice). Mnogi zaposleni nemaju organizovane restorane (kantine) za ishranu, a

The World Health Organization and the International Agency for Research on Cancer [57] have concluded that night work is probably carcinogenic to humans. Decreased levels of melatonin secretion lead to immunosuppression including decreased activity of natural killer cells which can in turn lead to colorectal cancer, breast cancer and prostate cancer [58]. An analysis of 31 cohort studies revealed that exposure to light during the night significantly increased the risk of breast cancer by 2.9%, in the group of workers who had been working the night shift for more than 10 years by 8.6%, and in workers who rotated shifts by 5.3% [59]. However, the research results are controversial as 26 accepted meta-studies did not notice an increase in cancer incidence in workers who had been working the night shift for a long time [60], so further research in this field is expected.

Tips for healthier dietary habits in the night shift

Night shift workers face many challenges, epecially concerning their health and dietary habits. To them, healthy eating is a real challenge. There are numerous recommendations on how night shift workers may have a balanced and healthy diet [61], which we have tried to present in this review article.

Caffeine should be avoided for at least 6 hours after the night shift and before going to sleep, and it is recommended to have breakfast 1–2 hours before going to bed avoiding "large/extra large meals". It is necessary to have breakfast to avoid waking up too early due to hunger.

After sleeping it is lunch time and lunch should be rich in vegetables, lean meat and inevitable salad in order to provide the organism with energy for the entire day.

A few hours before going to work it is recommended to have the main meal (dinner with family or friends). Foods that are difficult to digest are certainly not suitable for night meals (e.g., almost anything fried), but easy-to-digest foods such as soups, cream soups, yogurt, and rice will not cause stomach heaviness. In order to avoid overeating, it is also important to pay attention to the size of the plate. In other words, eating from a smaller plate can trick our brain into thinking that the meal is bigger than it really is. The plate should be filled in the following way: a half of the plate should contain vegetables in different colors (the vegetables should be steamed, cut, and seasoned with a dressing), and a quarter of the plate should be filled with low-calorie proteins (it is best to choose lean meat with no skin, including protein-rich vegetables such as legumes or tofu). The remaining quarter of the plate should be filled with starchy vegetables or whole-grain food.

i ako ih imaju one nude brzu nezdravu hranu. Većina radnika na poslu nema pristup frižideru gde bi mogli da ostave svoju hranu. Zato radnici treba da budu kreativni u načinu pripremanja i čuvanja hrane [62].

Savetuje se da se tokom noćnog rada izbegava konzumacija slatkih grickalica. Hrana sa visokim sadržajem šećera kao što je čokoladica ili bezalkoholno piće može obezbediti kratak nalet energije, ali kasnije se može javiti osećaj usporenosti. Kada počne da se javlja osećaj umora i gladi, užina sa malo proteina cobezbediće dovoljnu energiju.

Često pitanje koje se javlja među radnicima u noćnoj smeni je: "Šta treba konzumirati od napitaka?". Osnovna životna namirnica je voda. Bez nje organizam ne može da funkcioniše pravilno i zato je neophodno unositi dovoljnu količinu vode. Potrebno je piti svakog dana od 1,5–2 litra tečnosti. U vodu se može dodati sveže začinsko bilje poput nane ili voće. Unos tečnosti može biti i veći u zavisnosti od potreba organizma, npr. kod intenzivnih fizičkih napora ili kad su velike vrućine. Vodu treba uzimati između obroka, a ne u toku obroka kada uzimanje vode razređuje želudačnu kiselinu neophodnu za normalno varenje hrane.

Treba smanjiti unos kofeina. Kako bi ostali budni, radnici u noćnoj smeni često posežu za napicima koji su bogati kofeinom (kafa i energetski napici). Male količine kofeina, deluju kao stimulans i mogu pomoći mentalnoj budnosti. Tokom noćne smene preporučene su dve manje šoljice kafe (200 mg), 30–60 minuta pre početka smene. Međutim, ne sme se konzumirati više od 600 mg kofeina dnevno i treba prekinuti sa unosom 4–6 sati pre planiranog spavanja. Previše kofeina može prekinuti san i učiniti da se osoba oseća anksiozno ili mrzovoljno. Zato se radnicima koji rade noću savetuje da izbegavaju napitke bogate kofeinom i da pređu na čaj ili kafu bez kofeina [63].

Takođe je važno razmotriti ulogu koju ima socijalni kontekst u ishrani, pa se preporučuje da se radnicima obezbediti adekvatan prostor za večeru (obedovanje u opuštenoj atmosferi koja promoviše aktivaciju anti-stres sistema) i da se obrok pojede daleko od radnog mesta sa kolegama, u prijatnom okruženju ukoliko je to moguće.

Pored toga, radnicima koji rade noću savetuje se da prave aktivne pauze. Tokom pauze pored ishrane savetuje se da se ostavi deo vremena kako bi se sprovele vežbe istezanja, otišlo u brzu šetnju ili vodio opuštajući razgovor sa kolegama. Sve ovo doprineće tome da radnik dobije dodatnu energiju kako bi mogao da završi smenu, poboljšaće njegovo raspoloženje i doprineće boljem snu nakon smene [64].

Da bi radnici koji rade noću ostali zdravi trebalo bi da praktikuju zdrav način života van radnog mesta: do-

Once at work (the night shift means working from 10 PM to 6 AM), early through the shift you will certainly feel hunger which you should deceive with a small meal or snack. For example, this meal should contain boiled eggs, tuna fish, grilled turkey or chicken meat, almond and peanuts (even as peanut butter). A sandwich can be made with the listed ingredients and some fruit could be added to it. Late in the shift, there are additional meals (small bites every few hours to maintain concentration and energy), approximately every 3 hours. It is recommended to avoid food completely, but if there is a need for food then food that is low in energy should be taken between midnight and 6 AM, or food should be consumed at the very beginning and the very end of the shift.

It is much healthier to take food with us (healthy food and healthy snacks). Many employees do not have access to organized restaurants (canteens), or even if they do these restaurants offer fast food. Most employees cannot use a refrigerator at work where they could keep their food. This is why employees should be creative when preparing and keeping food [62].

It is advised to avoid the consumption of sweets on the night shift. Foods that are high in sugar, such as a chocolate bar or a soft drink, could provide a short burst of energy, but later you may feel sluggish. When there are feelings of fatigue and hunger, a snack containing a small portion of proteins will provide enough energy.

A question that is frequently posed by night shift workers is: "Which drinks should I consume?" Water is the basic foodstuff. The organism cannot function properly without water, so it is necessary to take in a sufficient amount of it. It is necessary to drink 1.5–2 liters of liquid every day. Herbs such as mint or fruit can be added to water. Fluid intake can be even higher depending on the needs of the body, e.g., during intense physical efforts or when it is very hot. Water should be taken between meals, not during meals when water that is taken dilutes gastric acid that is necessary for normal digestion.

Caffeine intake should be reduced. In order to stay awake, night shift workers often choose drinks that are rich in caffeine (coffee and energy drinks). Small amounts of caffeine have a stimulating effect and can help mental alertness. During the night shift, it is recommended to consume two small cups of coffee (200 mg), 30–60 minutes before the shift. However, no more than 600 mg a day should be consumed, and the intake should be stopped 4–6 hours before going to sleep. Too much caffeine can disrupt sleep and make a person feel anxious or ill-humored. This is why night shift workers are advised to avoid caffeine-rich drinks and to take tea or decaffeinated coffee instead [63].

voljno odmora i sna, dobro izbalansiranu ishranu, fizičku aktivnost, održavanje zdrave telesne težine, izbegavanje pušenja, ograničavanje ili izbegavanje alkohola i očuvanje mentalnog zdravlja.

ZAKLJUČAK

Radnici koji rade noću suočavaju se sa jedinstvenim izazovima po svoje zdravlje na biološkom, psihološkom i socijalnom nivou. Hrana i piće koje se biraju tokom rada igraju važnu ulogu u održavanju nivoa zdravlja i energije, pa u tom smislu treba raditi na podizanju svesti o pravilnoj ishrani kako kod radnika tako i kod njihovih poslodavaca u smislu promocije zdravlja na radnom mestu. Poslodavci bi trebalo da preuzmu odgovornost za edukaciju radnika o prednostima zdrave ishrane jer bi to uticalo na bolje zdravlje zaposlenih i smanjilo troškove zdravstvene zaštite, dovelo do smanjenja izostanaka sa posla i do povećanja produktivnosti i bolje koncentracije zaposlenih, što u krajnjoj liniji dovodi do povećanja prihoda. Sam poslodavac umnogome može uticati na način ishrane radnika tako što bi noćna smena počinjala pre ponoći i ne bi trebalo da traje duže od 11 sati u kontinuitetu. Poželjno bi bilo da se u okviru fabrika naprave kantine (gde će se prodavati zdravi obroci i zdrave grickalice), te da poslodavac angažuje nutricionistu koji bi na radnom mestu održao seminar o ishrani. Nutricionista može zaposlenima da pruži dragocene savete o tome kako ishrana može da spreči zdravstvene probleme i poboljša njihov kvalitet života. Bolja kultura kompanije i bolje radno okruženje (kultura zdravlja na radnom mestu) može privući najbolje kandidate i pomoći poslodavcu da zadrži najbolje zaposlene.

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It is also important to consider the role of the social context in nutrition, so it is recommended to provide employees with an adequate dining space (dining in a relaxed atmosphere which promotes the activation of the anti-stress system) and to dine away from the workplace with colleagues, in a pleasant environment, if possible.

In addition, night shift workers are advised to take active breaks. During the break, besides nutrition, it is advisable to leave some time for stretching, a quick walk or a relaxed conversation with colleagues. This will contribute to some extra energy that will enable the employee to round the shift, improve their mood and sleep better after the shift [64].

To stay healthy, night shift workers should have a healthy lifestyle outside work – they should have enough rest and sleep, eat well-balanced food, have physical activity, maintain healthy body weight, avoid smoking, reduce or avoid alcohol consumption and preserve mental health.

CONCLUSION

Night shift workers face unique challenges to their health on the biological, psychological, and social level. The food and drink choices they make at work play an important role in maintaining health and energy levels, so awareness should be raised of proper nutrition in both employees and their employers in terms of health promotion at work. Employers should take responsibility for educating employees about the benefits of a healthy diet as this would lead to better health of employees and a decrease in healthcare costs, reduce absenteeism, increase productivity and bring about better concentration in employees, which ultimately leads to increased income. Employers could greatly influence their employees' dietary habits by deciding to start the night shift before midnight and make it last for not more than 11 hours continuously. It would be desirable to organize canteens within factories (where healthy meals and healthy snacks would be sold) and for the employer to hire a nutritionist who would organize a seminar on nutrition. A nutritionist can provide employees with valuable advice on how nutrition may prevent health problems and improve the quality of life. Better company culture and work environment (a culture of health at the workplace) may attract the best candidates and help the employer keep the best employees.

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