

**Faculdade de Saúde Pública
Universidade de São Paulo**

**Efeitos da urbanização nos ritmos biológicos e
repercussões metabólicas na saúde de trabalhadores de
uma comunidade amazônica.**

Andressa Juliane Martins

Tese apresentada ao Programa de Pós-Graduação em Saúde Pública para obtenção do título de Doutora em Ciências.

Área de Concentração: Saúde, Ciclos de Vida e Sociedade

Orientadora: Profª. Associada Claudia Roberta de Castro Moreno

**São Paulo
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Trecho do discurso “Cidadania em uma República” (ou “O Homem na Arena”), proferido na Sorbonne por Theodore Roosevelt, em 23 de abril de 1910.

Para Edu, Juquinha e Bolota.
A vida é melhor com vocês.

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RESUMO

Martins AJ. Efeitos da urbanização nos ritmos biológicos e repercussões metabólicas na saúde de trabalhadores de uma comunidade amazônica. [tese de doutorado]. São Paulo: Faculdade de Saúde Pública da USP; 2018.

Objetivo – Avaliar o sono, ritmos biológicos e metabolismo de trabalhadores de uma comunidade amazônica do Acre, segundo diferentes graus de urbanização das residências. **Métodos** – Foram executados três sub-estudos distintos. No primeiro estudo foram feitas análises de dados referentes às características sociodemográficas,

medidas antropométricas, hábitos de vida, características do sono e morbidades referidas de trabalhadores da reserva extrativista de Xapuri, Acre. Para o segundo estudo foi executada uma análise de dados alimentares de recordatório de 24 horas para obtenção de padrões alimentares e suas associações possíveis para variáveis de sono e sonolência em trabalhadores. Para o último estudo foram realizadas coleta e análise de dados alimentares, antropométricos, variáveis metabólicas, relacionados ao sono e aos hábitos de vida de trabalhadores residentes nas regiões rurais e urbanas de Xapuri.

Resultados – Foram produzidos três manuscritos que representaram os três sub-estudos distintos que compõe este trabalho múltiplo. O primeiro estudo avaliou os efeitos do tipo de trabalho (elevado ou baixo esforço físico) e o estilo de vida sobre o sono dos trabalhadores da reserva amazônica. O segundo estudo propôs uma nova abordagem na avaliação do consumo alimentar e suas relações com o sono e sonolência de trabalhadores, envolvendo a investigação dos padrões alimentares. O terceiro estudo apresentou os principais achados comparando trabalhadores rurais e urbanos da reserva amazônica no que tange estilo de vida, sono, exposição à luz, aspectos metabólicos, estado nutricional e consumo alimentar. **Conclusão** – No que tange aos aspectos metabólicos, destaca-se alta prevalência de sobrepeso e obesidade entre trabalhadores urbanos, bem como marcadores alterados para doenças metabólicas. No que se refere ao sono, trabalhadores rurais apresentam um alta prevalência de distúrbios de sono; entretanto, entre os residentes urbanos destacam-se uma redução da duração de sono, horário de sono tardio e menor exposição à luz. O estudo de padrões alimentares demonstrou-se possível e eficaz na avaliação de desfechos relacionados à alimentação e ritmos biológicos, em especial o sono.

Descritores: urbanização, sono, ritmos biológicos, doenças não-comunicáveis, parâmetros metabólicos.

ABSTRACT

Martins AJ. Effects of urbanization on biological rhythms and metabolic repercussions on the health of workers in an Amazonian community [PhD thesis]. São Paulo: School of Public Health of the USP; 2018.

Aim – To evaluate the sleep, biological rhythms and metabolism of workers of an Amazonian community of Acre, according to different degrees of urbanization of the residences. **Methods** - Three different sub-studies were performed. In the first study, data were analyzed regarding socio-demographic characteristics, anthropometric measurements, lifestyle, sleep characteristics and referred morbidity of workers from the Xapuri Extractive Reserve, Acre. For the second study, a 24 hour recall data analysis was performed to obtain dietary patterns and their possible associations for sleep and sleepiness variables in workers. For the last study were collected and analyzed food data, anthropometric, metabolic variables, related to sleep and living habits of workers residing in the rural and urban regions of Xapuri. **Results** - Three manuscripts were produced that represented the three distinct sub-studies that compose this multiple work. The first study evaluated the effects of the type of work (high or low physical effort) and the sleep lifestyle of the workers of the Amazon reserve. The second study proposed a new approach in the evaluation of food consumption and its relationships with sleep and drowsiness of workers, involving the investigation of dietary patterns. The third study presented the main findings comparing rural and urban workers in the Amazon Reserve in relation to lifestyle, sleep, light exposure, metabolic aspects, nutritional status and food consumption. **Conclusion** - Regarding the metabolic aspects, there is a high prevalence of overweight and obesity among urban workers, as well as altered markers for metabolic diseases. As far as sleep is concerned, rural workers have a high prevalence of sleep disorders; however, among urban residents, there is a reduction in sleep duration, late sleep time and less light exposure. The study of dietary patterns has proved to be possible and effective in evaluating outcomes related to diet and biological rhythms, especially sleep.

Keywords: urbanization, sleep, biological rhythms, non communicable diseases, metabolic parameters.

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1 APRESENTAÇÃO

Quero contar a você, leitor, uma breve história, aquela que nem sempre temos a oportunidade de contar em uma tese acadêmica. Mas que deve ser relatada sempre que possível e nos revela os bastidores do trabalho científico. Separe um pouco do seu tempo e fique à vontade.

O início da minha participação nesta jornada deu-se em 2013, após a conclusão do meu mestrado, no qual trabalhei com o consumo alimentar em trabalhadores de turno irregular (motoristas de caminhão).

Por ocasião, o projeto de pesquisa *A organização temporal do trabalho e exposição à luz e suas repercussões no ciclo vigília-sono e secreção de melatonina de trabalhadores de uma reserva extrativista amazônica*, coordenado por minha orientadora Claudia Moreno e executado pela doutoranda Suleima Pedroza Vasconcelos, estava em plena execução e com a oferta de uma bolsa de Treinamento Técnico nível 3 pela FAPESP. Esta bolsa em questão era destinada a um pesquisador que pudesse explorar dados referentes ao estilo de vida e saúde dos trabalhadores participantes do estudo previamente citado.

A curiosidade pelo tema e o local do estudo despertaram meu interesse. Passei a ser bolsista junto ao projeto e comecei a explorar os dados coletados previamente pela equipe. Parte dessas análises e resultados exploratórios deram origem ao meu projeto de doutorado, iniciado em abril de 2014. Apesar da grande quantidade de dados coletados por meio de questionários em uma amostra representativa, ao final do projeto, muitas dúvidas ainda permaneciam no ar em nosso grupo de pesquisa: além da organização

temporal do trabalho e da exposição a luz, quais outros fatores poderiam impactar na saúde desta população?

Tendo a minha formação enquanto nutricionista, eu tinha ânsia por saber como eram os hábitos alimentares entre aqueles trabalhadores, se os mesmos estavam sofrendo mudanças em função do avanço da vida moderna no interior do país e em caso positivo, como isso poderia impactar na saúde metabólica e também nos ritmos biológicos desses indivíduos? E foi assim, com tantas questões em minha mente e explanadas para minha orientadora Claudia e debatidas com a parceira de trabalho Suleima, que decidimos que este projeto deveria continuar como parte do meu doutorado, buscando responder novas perguntas, coletando novos dados, mas desta vez aliando investigação dos ritmos biológicos (cronobiologia), estudo dos hábitos alimentares e parâmetros metabólicos, de forma a comparar moradores da reserva com moradores da pequena cidade de Xapuri, no estado do Acre.

Em abril de 2014, viajei ao local em companhia da Suleima para um breve estudo piloto e reconhecimento de campo. Também era importante ter a certeza de que eu teria condições de executar uma coleta de dados estando tão distante de São Paulo e um local que eu ainda não tinha familiaridade. Mas uma vez lá, conhecendo rapidamente o local que seria meu campo de estudo, senti que de fato era o um projeto que eu deveria me engajar. Que esse era o tipo de estudo que me motivaria a seguir no doutorado e me moldar como futura pesquisadora, mas sobretudo, como ser humano. Ao retornar para São Paulo, após conversa com minha orientadora, efetivei minha matrícula oficialmente junto a universidade e iniciei meus estudos e a confecção do projeto.

Paralelamente à escrita do projeto, trabalhei com o banco de dados disponível do meu mestrado em uma nova abordagem para avaliação do consumo alimentar: a definição de padrões alimentares e seus possíveis efeitos no sono e sonolência em trabalhadores. Essa forma de avaliação do conteúdo alimentar, amplamente difundida e utilizada no campo da nutrição, até então era totalmente desconhecida entre pesquisadores dos ritmos biológicos. Mais uma vez, nos lançamos nessa abordagem buscando enriquecer a *crononutrição* (cronobiologia e nutrição) com alternativas variadas de análises. O resultado desse esforço pode ser visto no segundo manuscrito que compõe essa tese, que por si também fundamentará novas análises para novos periódicos a serem publicados por pesquisadores da *crononutrição* dentro do grupo de pesquisa.

No início as dificuldades de financiamento do estudo foram grandes. Pedidos de auxílio negados. Crise financeira no país dificultando ainda mais a execução da pesquisa limitaram bastante nosso orçamento disponível. Entretanto, após parcerias com pesquisadores internacionais e nacionais, conseguimos avançar e realizar a coleta dos dados em campo.

Toda coleta realizada em uma reserva amazônica exige uma logística de transporte complexa, com transporte adequado para estradas de terra, tempo para deslocamento entre uma propriedade e outra, cuidado no acondicionamento, transporte e conservação de amostras biológicas, contato com a comunidade local para convidar participantes para a pesquisa, cuidados com alimentação, saúde e segurança dos pesquisadores e equipe de voluntários envolvidos na pesquisa, desafios das relações humanas e claro, alguns imprevistos pelo caminho que exigem flexibilidade e capacidade de adaptação por parte de quem conduz um trabalho de campo.

Diante desta perspectiva e de uma intensa vivência do meu campo de pesquisa, do qual eu conheço e me recordo de cada um dos voluntários de meu estudo, não há como dizer que não me apropriei do mesmo. Ainda que se busque a imparcialidade das respostas pelo método científico e haja embasamento de uma abordagem de pesquisa quantitativa, não há dúvidas de que minha vivência e experiência também mudaram muitas perspectivas e crenças arraigadas em minha formação acadêmica.

Quando surgem limitações e dificuldades, aflora a criatividade para solução de desafios. A frase parece um clichê, porém é muito verdadeira e resume muito de minha experiência ao longo dessa jornada de 4 anos no doutorado. É com ela em mente que desejo que a pesquisa científica em nosso país avance: mais criativa. Menos engessada. A favor do desenvolvimento humano e com respeito ao humano também. Para isso é sempre necessário se reinventar e trilhar novos caminhos.

Após este breve relato, apresento ao leitor a organização desta tese, cujo os resultados são fruto de todo o trabalho desenvolvido ao longo de minha pesquisa de doutorado e seguem a diretriz para "*outra forma de apresentação de tese, conforme a deliberação da CPG em sua sessão 9ª/2008 de 05/06/2008*". Nessa forma de apresentação "*a tese de doutorado deve incluir, no mínimo, três manuscritos resultantes do projeto de pesquisa de doutorado, sendo que um deles não deve ter sido submetido ou publicado em periódico ou capítulo de livro. Os outros dois artigos devem ter sido submetidos ou publicados em periódicos.*"

Diante desses pressupostos, o presente trabalho foi estruturado com uma introdução dos conhecimentos científicos que estruturaram e justificaram a realização da pesquisa. Em seguida foram apresentados o objetivo geral e específicos, bem como

os materiais e métodos utilizados para a confecção deste trabalho múltiplo, que foi subdividido em três sub-estudos distintos. Os resultados obtidos em cada dos estudos foram organizados no formato de três artigos científicos.

O primeiro artigo avalia os efeitos do tipo de trabalho (elevado ou baixo esforço físico) e o estilo de vida sobre o sono dos trabalhadores da reserva amazônica. Este trabalho já publicado foi o pioneiro e deu origem as bases que fundamentaram as novas coletas de dados no campo.

O segundo artigo traz uma nova abordagem na avaliação do consumo alimentar e suas relações com o sono e sonolência de trabalhadores, envolvendo a investigação dos padrões alimentares. Este manuscrito foi submetido recentemente e está em avaliação pelos revisores do periódico.

O terceiro artigo traz os principais achados comparando trabalhadores rurais e urbanos da reserva amazônica no que tange estilo de vida, sono, exposição à luz, aspectos metabólicos, estado nutricional e consumo alimentar.

Ao final da tese são feitas as conclusões e as principais contribuições do presente estudo.

2 INTRODUÇÃO

Todos os seres vivos possuem sistemas de temporização que permitem sua sobrevivência no ambiente, que por si, é marcado por ciclos, como o do dia e noite e as mudanças nas estações do ano. Se há oscilação ambiental, as espécies também necessitam de uma oscilação, como uma capacidade de resposta antecipatória aos estímulos da natureza. Segundo MARQUES et al (2003), a harmonia entre esses as oscilações biológicas e ciclos ambientais consiste na chamada adaptação temporal.

De acordo MARQUES e MENNA-BARRETO (2003), ritmos biológicos são modificações fisiológicas, sobretudo endógenas, que ocorrem repetidamente em um mesmo intervalo temporal.

A harmonia entre os ciclos externos (ambientais) e os ritmos endógenos (organismos) ocorre pela chamada sincronização (MOORE, 1996). Esta harmonização é conseguida pelo arrastamento, processo pelo qual o ritmo, gerado pelo oscilador interno, tem sua fase e frequência ajustadas por um ou mais fatores cíclicos ambientais. É graças ao arrastamento que os ritmos endógenos se ajustam ao ciclo ambiental e passa a se expressar com um período de 24 horas caracterizando-os como ritmos circadianos (MARQUES, et al., 2003).

Grande parte dos ritmos biológicos está associado a um ciclo geofísico. Os fatores geofísicos ou bióticos que promovem o arrastamento são chamados de *zeitgeber*, que na língua alemã significa “doador de tempo” (ASCHOFF, 1960). São *zeitgebers*: o ciclo claro/escuro, o ciclo de temperatura, variações rítmicas de disponibilidade de alimento e água, de pistas sonoras e sociais (MOORE-EDE et al, 1982). Dentre eles, o ciclo claro/escuro é considerado um dos mais importantes sincronizadores ambientais envolvidos nos ajustamentos diários do sistema circadiano humano, influenciando na

ritmidade da síntese de hormônios, como a melatonina e no ciclo vigília-sono, entre outros (WARMAN et al, 2003).

Entretanto, os ritmos biológicos são gerados endogenamente, por estruturas que compõe o chamado sistema de temporização circadiana. Estas estruturas podem ser divididas basicamente em duas partes: o oscilador central, representado pelo núcleo supraquiasmático (NSQ) localizado no hipotálamo e os osciladores periféricos presentes nos tecidos e órgãos do organismo, como pâncreas, fígado, coração e rins (ALBRECHT, 2004; DIBNER et al, 2010).

Diversos pesquisadores ainda discutem a relação entre o oscilador central e osciladores periféricos. Uma das teorias, proposta por DIBNER et al. (2010), é o modelo de ‘orquestra’, no qual o oscilador central (NSQ) assume a função de condutor, de “maestro” dos demais osciladores periféricos. Estes todavia, como membros desta orquestra, podem adaptar seus próprios estímulos externos e internos, por pistas alimentares por exemplo, mas com a condução maior do NSQ baseado na principal pista temporal, do ciclo claro-escuro.

Se, por um lado, o ciclo claro-escuro é o principal sincronizador do oscilador central, por outro, a alimentação é descrita amplamente na literatura como um sincronizador fundamental para diversos osciladores periféricos, especialmente no que tange aos horários de alimentação (DAMIOLA et al, 2000; SCHIBLER et al, 2003; WU et al, 2010).

A seguir serão apresentados aspectos dos ritmos biológicos relacionados a alimentação.

2.1 Ritmicidade Biológica e Alimentação: o papel da dieta como sincronizador dos ritmos biológicos.

Estudos realizados com seres humanos em laboratório, por meio de modificações nos horários e composição das refeições, demonstram que diversos hormônios metabólicos como a leptina, enzimas e metabólitos exibem variações diárias em resposta aos horários das refeições (MORGAN et al, 2003; FOGTELOO et al, 2004).

A existência dos osciladores periféricos trabalhando alinhados ao oscilador central transforma o sistema de temporização interno em uma complexa rede multi-oscilatória, no qual a dessincronização ou desalinhamento dos mesmos, estão relacionados a doenças como câncer, doenças cardiovasculares, depressão, obesidade e síndrome metabólica (GARAULET et al, 2010; PEVET e CHALLET, 2011).

Por muitos anos, a ausência de luz artificial impôs ritmos diurnos na fisiologia e comportamento de seres humanos, de maneira que o alimento estivesse disponível para consumo apenas durante o dia. Entretanto, com a industrialização e o advento da luz artificial, a sociedade passou a prolongar a horas de iluminação e aumentar as janelas de oportunidade para o consumo de alimentos. O estilo de vida moderno trouxe uma perturbação do sistema circadiano humano em três aspectos: o trabalho em turnos, a exposição prolongada à luz artificial e padrões alimentares não saudáveis/inadequados (MATTSON et al, 2014).

No que tange aos padrões alimentares, escopo do presente trabalho, conforme citado anteriormente no texto, a industrialização levou ao consumo de alimentos com alta densidade calórica, como açúcar, grãos refinados entre outros alimentos ultraprocessados, os quais passaram a ser ingeridos em pelo menos três refeições

diárias, incluindo refeições noturnas. A associação destes hábitos com um estilo de vida mais sedentário, certamente contribuíram para o atual quadro de obesidade e doenças metabólicas na sociedade (TILLOTSON, 2004; MATTSON et al, 2014).

Pesquisas experimentais demonstram que a ingestão de alimentos em momentos (horários) impróprios, como o período diurno em roedores, pode levar a uma dessincronização circadiana, alterando as respostas do corpo na ingestão alimentar, com o desenvolvimento de distúrbios metabólicos (ARBLE et al, 2010; SALGADO-DELGADO et al, 2010). Em humanos, essa ingestão alimentar no período noturno, teria como consequência, o aumento do peso corporal que leva ao sobrepeso e obesidade e culminariam em doenças metabólicas (PEARSON, 2006; SPIEGEL et al, 2009).

GARAULET e GÓMEZ-ABELLÁN (2014) afirmam que estas mudanças nos horários do consumo de alimentos modificam a ritmicidade circadiana de diversos hormônios envolvidos no metabolismo, como por exemplo, insulina, glucagon, adiponectina e dos mecanismos de saciedade, como leptina, grelina, que por si, podem afetar a ingestão e gasto energético.

Estudos recentes em roedores evidenciaram que restrições no tempo de alimentos disponível parecem ter ações protetoras contra a obesidade, resistência insulínica, esteatose hepática e inflamação (ADAMOVICH et al, 2014; CHAIX et al, 2014).

Segundo ASHER e SASSONE-CORSI (2015), as evidências experimentais de que os horários das refeições possuem efeitos importantes no metabolismo levantam uma nova preocupação com relação às escolhas alimentares: a consideração não apenas do valor nutricional, mas também do momento “ideal” para o consumo de alimentos, inseridos no contexto de ritmicidade circadiana. Entretanto, são necessários estudos

conduzidos em humanos, uma vez que as evidências que suportam tal prerrogativa ainda são escassas da literatura.

Outro aspecto evidenciado na literatura é a possível modulação do conteúdo alimentar nos níveis de melatonina no organismo. A melatonina é um hormônio secretado pela glândula pineal predominantemente à noite. Tem sua secreção inibida pela presença de luz, de forma que o ciclo claro/escuro atue como principal *zeitgeber* e seu ritmo seja controlado pelo NSQ, por meio da informação luminosa captada pela retina (ARENDE e SKENE, 2005). Dentre as diversas funções da melatonina está seu papel regulador do ciclo vigília-sono. Entretanto, são descritas outras ações, como atividade antioxidante, imunomoduladora e possível proteção contra alguns tipos de câncer, como o de mama (ZAWILSKA et al, 2009; MEDIAVILLA et al, 2010; GRANT et al, 2009).

O principal precursor para a síntese de melatonina no organismo é o triptofano, aminoácido essencial obtido pela dieta. A restrição deste nutriente na dieta reduz significativamente a síntese de melatonina (ZIMMERMANN et al, 1993). Raros estudos em humanos exploram essa relação, entre disponibilidade de nutrientes da dieta e síntese deste hormônio, entretanto PEUHKURI et al (2012) afirmam que dietas ricas em vegetais, frutas e grãos integrais parecem ter influências positivas na síntese de melatonina, porém este efeito é menor comparado ao poder do ciclo claro-escuro, para síntese deste hormônio e seu papel regulador no ciclo vigília-sono.

Em um estudo de laboratório sob condições constantes de ciclo vigília-sono e ciclo regular de claro e escuro, KRAUCHI et al (2002) observaram uma associação entre o consumo de um refeição enriquecida com carboidratos pela manhã a um avanço de fase de 1 hora no ritmo diário da temperatura corporal. Entretanto, não foram observadas mudanças no ritmo da melatonina salivar. A literatura não apresenta dados

consistentes em relação aos possíveis efeitos dos horários das refeições na secreção de melatonina, uma vez que os ritmos de síntese da glândula pineal é guiada exclusivamente pelo NSQ, de maneira que o estímulo fótico se sobrepõe ao da alimentação (MISTLBERGER e SKENE, 2005).

Neste panorama, insere-se o presente estudo, com a investigação de uma população inserida em um contexto muito peculiar, de trabalhadores de uma reserva extrativista, em especial seringueiros, que possuem características únicas, como a ingestão alimentar em um menor número de refeições, consumo de alimentos em horários diferenciados, maior exposição à luz natural, menor exposição aos padrões alimentares promovidos pela dieta ocidental, atividades diárias integradas aos ritmos da natureza e em relativa conformidade com o ciclo claro-escuro. Tais aspectos permitiram uma oportunidade ímpar para realização de uma pesquisa de campo visando verificar as repercussões dos horários e do padrão da alimentação em marcadores biológicos para ritmicidade circadiana, como a secreção de melatonina e o ciclo vigília-sono, bem como possíveis associações às doenças metabólicas e obesidade na saúde de indivíduos que residem e trabalham na região urbana em comparação aos indivíduos que residem e trabalham no espaço rural, localizado na reserva extrativista.

2.2 A transição nutricional decorrente da globalização e os “povos da floresta” da região Norte do Brasil.

Ao longo dos últimos 50 anos, o Brasil passou por mudanças econômicas, históricas e culturais em função do processo mundial de globalização (BATISTA FILHO e RISSIN, 2003). Dessa forma, o estilo de vida da população brasileira sofreu intensas modificações, marcadas por alterações nos perfis demográficos, epidemiológicos, assim como na industrialização e urbanização (MORENO, FISCHER

e ROTENBERG, 2003). Na prática, observou-se a passagem de um período de atraso econômico e social para um momento de desenvolvimento, dentro do contexto da civilização ocidental, com modificações importantes no acesso à habitação, saneamento básico, escolaridade, uso dos serviços de saúde, migrações da região rural e crescimento das cidades (MONTEIRO et al, 2000). A mudança de uma estrutura econômica pré-industrial e agrária para uma industrializada e predominantemente urbana ocorrida no país tem íntima relação com a mudança no perfil de morbimortalidade e consequentemente, com processo de transição nutricional, caracterizada por modificações no perfil das carências nutricionais, como o declínio da desnutrição a aumento da prevalência de sobrepeso e obesidade, comum em países em desenvolvimento (POPKIN, 2001; KIMANI-MURAGE et al, 2010; CUSTODIO et al 2010).

Neste contexto, observam-se as intensas modificações dos padrões alimentares dos brasileiros em virtude desse novo estilo de vida. MONTEIRO, MONDINI e COSTA (2000), ao analisarem dados da Pesquisa de Orçamento Familiar (POF) de áreas metropolitanas brasileiras (1988-1996), destacaram o aumento do consumo de gorduras saturadas e açúcares simples em todas as regiões do país em detrimento da redução da ingestão de frutas, verduras, legumes, leguminosas e dos carboidratos complexos na dieta.

Dados recentes da POF 2008-2009 revelam que esse padrão se manteve. Além disso, observa-se a redução de alimentos considerados básicos do hábito alimentar brasileiro, como o feijão, arroz e farinha de mandioca e uma ampliação da ingestão de alimentos processados, como refrigerantes, embutidos, biscoitos, refeições prontas entre outras (IBGE, 2010).

A substituição dos alimentos ricos em fibras, vitaminas e minerais por alimentos processados (ricos em gordura, açúcar e sal), associada ao sedentarismo favorecido pelas mudanças na estrutura de trabalho e por avanços na tecnologia compõem os principais fatores etiológicos do sobrepeso e obesidade entre indivíduos adultos no Brasil (MINISTÉRIO DA SAÚDE, 2006; SARTORELLI e FRANCO, 2003).

Dados de inquéritos nacionais destacam que o excesso de peso entre brasileiros aumenta continuamente desde a década de 1970 e atualmente atinge metade da população. Os resultados comparativos da POF 2008-2009 e 2002-2003 indicam aumento de 1% ao ano, de forma que o sobrepeso possa atingir dois terços da população brasileira em dez anos (IBGE, 2010). Especificamente na região Norte do país, as pesquisas de âmbito nacional revelam a mesma tendência do aumento de sobrepeso e obesidade, mesmo nas regiões menos desenvolvidas marcadas pela persistência de quadros de desnutrição e carências nutricionais, como anemia ferropriva e hipovitaminose A (IBGE, 2004; INSTITUTO NACIONAL DO CÂNCER, 2004 e MINISTÉRIO DA SAÚDE, 2009).

Entretanto, as pesquisas de abrangência nacional não abrangem a área rural da região Norte, bem como populações residentes em regiões de florestas, dado à imensa extensão territorial da região Amazônica. Desta forma, nota-se um vazio de informações científicas acerca das condições de saúde e nutrição dessas populações.

É sabido que embora existam sociedades que mantêm o modo tradicional de viver, a exemplo de algumas sociedades indígenas isoladas, há um abandono massivo por parte dos chamados “povos da floresta” das práticas de cultivo e caça em função da exposição dos mesmos as transformações socioeconômicas e culturais, que por si, afetam diretamente a cultura alimentar.

Estudos comparativos entre aldeias que passaram por modificações culturais e aquelas que mantêm o modo nutricional, demonstram maior prevalência de morbidades nutricionais nas aldeias que passaram por transição (SANTOS, 1993; MARTINS e MENEZES, 1994; GUGELMIM e SANTOS, 2006). Na comunidade de índios Xavante, na região central, observa-se uma queda no consumo de alimentos cultivados e provenientes da caça, e aumento dos industrializados como açúcar, café, farinha de trigo, sal, refrescos em pó, refrigerantes e balas. Além disso, entre os indivíduos adultos, 70% obtiveram um aumento de sobrepeso e obesidade, enquanto um terço das crianças estava em quadro de desnutrição, fatos estes que apontam para um quadro de transição nutricional vivido por essas comunidades (SANTOS et al, 1997; LEITE et al, 2006; GUGELMIM e SANTOS, 2006).

Todo este processo de aculturação e consequentemente de transição alimentar, tornam estas populações vulneráveis diante de problemas de ordem alimentar e nutricionais, de grande impacto no estado de saúde em geral. A partir da transição de uma atividade de subsistência baseada no extrativismo e caça para a incorporação de alimentos industrializados e migração para a produção de culturas comerciais voltados para o lucro, ocorre uma ruptura cultural, especialmente no que tange o contato da mente, corpo e alma com a natureza, essência das sociedades da floresta (MOURA, BATISTA e MOREIRA, 2010; COIMBRA e SANTOS, 2000).

Diante do contexto supracitado, encontra-se o presente projeto, com o foco na população de seringueiros residente na Reserva Extrativista Chico Mendes, no município de Xapuri, Acre. Do ponto de vista histórico, o seringueiro é o sujeito de relevância tanto para a construção do estado do Acre como para a produção econômica que inseriu o estado no cenário produtivo nacional. Ademais, é o portador da identidade de trabalhador e morador da floresta e com uma organização de vida baseada em um

forte vínculo com a natureza, do qual, supre suas necessidades básicas (PONTE e THOMAZ JR, 2012).

A diversidade produtiva dos seringueiros e sua íntima relação com a natureza se expressa nas atividades extrativistas realizadas conforme os ciclos naturais, portanto sazonais, e que por si influenciam seus hábitos alimentares. Os seringueiros trabalham durante o dia, em jornadas que se iniciam por volta das 5 horas da manhã com término no final da tarde, tendo, de forma que a distribuição das refeições é bastante peculiar: o desjejum é substituído por uma espécie de almoço caracterizado por alimentos de maior densidade calórica como aipim, farofa, banana frita e cozida, fruto da pupunha, carne de caça e café com leite, em virtude do intenso trabalho braçal a ser desempenhado na retirada do látex no seringal.

Vivem basicamente da produção de castanha, borracha, madeira manejada e outros produtos da agricultura de subsistência (roçado) e extrativismo (ALECHANDRE et al, 1999; SECRETARIA DO ESTADO E DO PLANEJAMENTO, 2010). Entretanto, observa-se uma tendência de redução das atividades extrativistas em função do aumento de atividades prestação de serviços, especialmente a criação de gado e exploração madeireira, na composição da renda familiar. Ou seja, em algumas comunidades, iniciou-se um processo de venda da força de trabalho, muitas vezes assalariada ou em troca de produtos, para adquirir suprimentos como café, açúcar, óleo de cozinha, alimentos processados, eletrodomésticos e outras ferramentas de trabalho. Dessa maneira, modificam-se as formas de se relacionar com o trabalho, bem como a remuneração, que passa a ser regulada pelo tempo do relógio e não mais pelos ritmos impostos pela natureza, como ocorre com atividades de caça, pesca, extração da castanha e látex (NEGRET, 2010). Somado a isso, as atividades de pecuária e extração madeireira afastam o seringueiro das atividades produtivas dentro na própria colocação

(unidade produtiva e familiar do seringal), como o roçado e a caça, diminuindo a ingestão de alimentos tradicionais podendo levar ao comprometimento do estado nutricional e de saúde dessas comunidades.

2.3 Estudos de padrões alimentares

Conforme amplamente relatado anteriormente, mudanças no estilo de vida e a intensa urbanização da população nas últimas décadas também afetaram os hábitos alimentares. A preferência por alimentos processados sobre alimentos ricos em fibras e vitaminas, juntamente com o sedentarismo e as mudanças nos horários de sono promovido por mudanças na estrutura do trabalho e pelos avanços tecnológicos, representam os principais fatores etiológicos de sobrepeso e obesidade entre adultos (MINISTÉRIO DA SAÚDE, 2014; POPKIN et al, 2012; SARTORELLI e FRANCO, 2003; MONTEIRO et al, 1995).

Vários estudos relatam uma associação entre a restrição do sono e mudanças na ingestão alimentar, levando ao ganho de peso (CRISPIM et al, 2007; DEPNER et al, 2014; DASHTI et al, 2015). MARKWALD et al (2013) encontraram um aumento na ingestão de alimentos durante períodos de duração reduzida do sono e, consequentemente, ganho de peso entre os voluntários do estudo. Segundo os autores, essa resposta parece ser uma adaptação fisiológica do organismo para suprir a energia necessária devido ao maior tempo de vigília. Além disso, quando a quantidade de sono é restaurada, há uma redução no consumo de energia, especialmente carboidratos e gorduras na amostra analisada.

Evidências da literatura afirmam que a ingestão de refeições com alto teor de gorduras e açúcares pode predispor à sonolência diurna excessiva. De acordo com PANOSIAN e VEASEY (2012), a sonolência induzida por alimentos poderia ser

possível devido à resposta hormonal e neuroendócrina causada por este tipo de nutriente, caracterizado por aumento de glicose, leptina, colecistocinina, peptide YY, citoquinas inflamatórias, redução de noraepinefrina e diminuição do sinal de vigília neuronal.

A análise exclusiva da ingestão de nutrientes, entretanto, não permite a identificação de certas associações e desfechos relacionados à dieta mais específicos (CUNHA et al, 2010). Por essa razão, decidimos investigar os padrões alimentares, em vez de priorizar o efeito de um único nutriente.

Diante desse cenário, a metodologia empregada na análise de padrões alimentares permite a investigação de relações plausíveis entre variáveis alimentares e um certo número de condições de saúde. As vantagens desse método residem no fato de que a avaliação global da dieta habitual, em oposição à avaliação específica de nutrientes, é a maior capacidade de prever o risco de doenças devido a vários aspectos, como menores chances de erro devido a associações errôneas, confusão reduzida. efeitos por variáveis relacionadas ao estilo de vida e por englobar interações complexas e correlações entre nutrientes que podem alterar sua ação de biodisponibilidade com o organismo (JACQUES e TUCKER, 2001; ALVES et al, 2006; LENZ et al, 2009; HU, 2002).

3 HIPÓTESE GERAL

Trabalhadores e moradores de da região com maiores níveis de urbanização apresentam menor duração de sono, menor exposição a luz natural, menor nível de atividade, bem como indicadores de saúde metabólica pior quando comparados aos moradores da zona rural de uma mesma região amazônica.

4 OBJETIVOS

4.1 OBJETIVO GERAL

Avaliar o sono, ritmos biológicos e metabolismo de trabalhadores de uma comunidade amazônica do Acre, segundo diferentes graus de urbanização das residências.

4.2 OBJETIVOS ESPECÍFICOS

4.2.1 Estudo 1

- Avaliar os efeitos da atividade física no trabalho e estilo de vida no sono de trabalhadores com elevada e baixa/moderada demanda física vivendo na mesma comunidade amazônica de Xapuri;

4.2.2 Estudo 2

- Identificar padrões alimentares e sua relação com ritmos biológicos, particularmente sono e sonolência em diferentes populações.

4.2.3 Estudo 3

- Caracterizar o grupo de rurais e o grupo de residentes urbanos do município de Xapuri quanto aos aspectos socioeconômicos e hábitos de vida;
- Avaliar o estado nutricional de residentes rurais e do grupo de residentes urbanos do município de Xapuri;

- Descrever as principais diferenças no sono, exposição à luz, níveis de atividade, parâmetros metabólicos e consumo alimentar entre residentes urbanos e rurais (seringueiros) de uma comunidade amazônica.

5 MATERIAIS E MÉTODOS

5.1 ESTUDO 1

5.1.1 Tipo de Estudo

Trata-se de um estudo epidemiológico transversal de abordagem quantitativa desenvolvido pela análise de dados secundários provenientes do projeto *A organização temporal do trabalho e exposição à luz e suas repercussões no ciclo vigília-sono e secreção de melatonina de trabalhadores de uma reserva extrativista amazônica*".

5.1.2 Local do Estudo

O estudo foi conduzido na cidade de Xapuri/Acre. O município localiza-se a sudoeste do estado do Acre (Latitude – S 10°, 39', 06"; Longitude – O 68°, 30', 16"), na mesorregião do Vale do Acre, regional do Alto Acre.

O povoado surgiu logo depois de Volta da Empresa (Rio Branco), no ano de 1883, em um local estratégico na confluência do rio Xapuri com o rio Acre. A localidade tornou-se um dos principais entrepostos comerciais do Acre no Ciclo da Borracha. Durante o período da Revolução Acreana, Xapuri foi ocupada por autoridades bolivianas que passaram a chamá-la de Mariscal Sucre. Oficialmente, Xapuri tornou-se um município em 22 de março de 1904 e, atualmente, 16.091 habitantes ocupam uma área de 5.347,446 km², sendo 5.761 habitantes da área rural e 10.330 da área urbana (IBGE, 2010).

Vale ressaltar que grande parte da extensão territorial do município de Xapuri pertence à Reserva Extrativista Chico Mendes, que também compreende áreas de outros municípios como Rio Branco, Brasiléia, Assis Brasil, Sena-Madureira e Capixaba. A

reserva foi criada pelo Decreto nº 99.144 de 12 de março de 1990, com uma área de 931.062 hectares, sendo categorizada como uma Unidade de Conservação de Uso Sustentável, com uma população estimada de 9.000 pessoas distribuídas em 48 seringais com 1.100 colocações (unidade produtiva e familiar de um seringal) (ALECHANDRE et al., 1999). Segundo o Plano de Manejo de 2006, são quase 2000 famílias organizadas em 15 associações, 5 cooperativas e 54 núcleos de base (IBAMA, 2006)

5.1.3 Amostra

A população do estudo foi constituída por 340 seringueiros moradores da Reserva Extrativista Chico Mendes e 148 trabalhadores da fábrica de preservativos masculinos de Xapuri.

5.1.4 Execução do Estudo

A coleta foi realizada no período de setembro a novembro de 2011. Foram analisados dados referentes às características sociodemográficas, medidas antropométricas, hábitos de vida, características do sono e morbidades referidas da população.

5.1.5 Instrumentos de coleta de dados

Detalhes dos instrumentos utilizados para a coleta podem ser vistos na seção 5.1 da presente tese.

5.1.6 Aspectos éticos

Os aspectos éticos foram baseados na normatização do Conselho Nacional de Saúde em sua Resolução nº 196 de 10 de Outubro de 1996 (BRASIL, 1996). O projeto foi devidamente aprovado pelo Comitê de Ética da Faculdade de Saúde Pública da USP

(protocolo nº2273) e todos os participantes assinaram o termo de consentimento livre e esclarecido.

5.1.7 Análises Estatísticas

Detalhes das análises estatísticas empregadas podem ser vistas na seção 5.1 da presente tese.

5.1.8 Financiamento do estudo

O presente estudo foi financiado pelo Conselho Nacional de Desenvolvimento Científico e Tecnológico/CNPq - Edital Universal processo número 471085/2010-3; Fundação de Amparo à Pesquisa do Estado de São Paulo/FAPESP - Auxílio Regular à Pesquisa processo número 2011/19563-0; e pela Fundação de Tecnologia do Estado do Acre/FUNTAC - Programa de Formação de Pesquisas Locais Modalidade: Apoio a Projetos de Pesquisa processo número 7526180171/2011.

5.2 ESTUDO 2

5.2.1 Tipo de Estudo

Trata-se de um estudo transversal de abordagem quantitativa desenvolvido pela análise de dados secundários provenientes do projeto *Sonolência e consumo de carboidratos entre motoristas de caminhão*".

5.2.2 Local do Estudo

O estudo foi realizado em uma empresa transportadora localizada na zona norte do município de São Paulo.

5.2.3 População e Amostra

Dos 248 motoristas contratados, 110 compreendiam motoristas urbanos, responsáveis pelas entregas e coletas de mercadorias apenas na região metropolitana; 98 motoristas carreteiros, responsáveis por entregas no interior do estado e interestaduais em carretas; 24 motoristas manobristas alocados no pátio da empresa; 16 motoristas bitrem (carretas com duas carrocerias), responsáveis por entregas interestaduais.

Dos 120 motoristas sorteados inicialmente, 71 indivíduos aceitaram participar da pesquisa e responder ao questionário. Devido a perdas da amostra o número final de participantes nesta etapa foi de 52. Para mais detalhes checar seção 6.2 da tese.

5.2.4 Execução do Estudo

A coleta dos dados do projeto pioneiro foi executada entre maio e setembro de 2012. Foi desenvolvido por meio da análise de dados alimentares de recordatório de 24 horas, antropométricos, relacionados ao sono e sonolência de motoristas de caminhão.

5.2.5 Instrumentos de coleta de dados

Detalhes dos instrumentos utilizados para a coleta podem ser vistos na seção 6.2 da presente tese.

5.2.6 Aspectos éticos

A pesquisa recebeu aprovação do Comitê de Ética em Pesquisa da Faculdade de Saúde Pública da Universidade de São Paulo (FSP/USP), número 2313/2012. Todos os participantes assinaram o termo de consentimento livre e esclarecido.

5.2.7 Análises Estatísticas

Detalhes das análises estatísticas empregadas podem ser vistas na seção 6.2 da presente tese.

5.2.8 Financiamento do estudo

O projeto não recebeu investimentos de agências de fomento.

5.3 ESTUDO 3

5.3.1 Tipo de Estudo

A presente pesquisa consistiu em um estudo observacional e quantitativo desenvolvido por meio de coleta e análise de dados alimentares, antropométricos, variáveis biológicas, relacionados ao sono e aos hábitos de vida.

5.3.2 Local do Estudo

O estudo foi conduzido na cidade de Xapuri/Acre, conforme previamente descrito na seção 5.1.2 da presente tese.

5.3.3 População e Amostra

A população do estudo foi constituída por seringueiros, residentes na parte da reserva extrativista de Chico Mendes localizada no município de Xapuri e moradores da região urbana da mesma cidade.

Foram estimados para o estudo 51 indivíduos que morassem e trabalhassem na parte urbana da cidade de Xapuri (urbanos) e 51 seringueiros (rurais) da reserva Extrativista Chico Mendes, os quabhis integram a cooperativa de extração de látex, totalizando uma amostra de 102 participantes do estudo. O cálculo do tamanho da amostra foi estimado pelo software G*Power 3.1.6, com tamanho de efeito de amostra de 0,50, nível de significância de 5% e poder estatístico de 80% (UNIVERSIDADE DE DÜSSELDORF, 2013).

A amostra final de participantes foi de 42 voluntários, sendo 22 rurais e 20 urbanos. O número reduzido da amostra em comparação ao planejamento inicial justifica-se pela desistência de alguns participantes recrutados ($n=8$) e também pela dificuldade de obter auxílios e recursos financeiros para custear uma coleta de dados na zona rural no Norte do país. Trata-se de um trabalho de campo que exige custos mais elevados para transporte da equipe de pesquisa, bem como transporte adequado de material biológico até a capital e posteriormente até São Paulo (no caso das amostras de saliva).

Diante das dificuldades de financiamento agravados pela crise financeira e corte de gastos em pesquisa no país, optou-se por encerrar os ciclos de novas coletas, de forma a garantir tempo hábil para a análise dos dados coletados no prazo estipulado pelo doutorado da pesquisadora principal.

Os critérios de inclusão para moradores da região urbana eram: ser do sexo masculino, residir e trabalhar na cidade, ter horários de trabalho diurnos e ter o ensino fundamental I (até 4^a série) completo. Para critérios de exclusão do mesmo grupo foram definidos: ser do sexo feminino, iletrado, trabalhar em turnos e/ou período noturno e apresentar distúrbios de sono.

Para moradores da reserva extrativista, os critérios de inclusão eram: ser seringueiro e, portanto, residir e trabalhar na reserva extrativista. Serão excluídos do grupo indivíduos do sexo feminino, que não possuem luz elétrica na residência e que apresentavam algum distúrbio de sono.

5.3.4 Execução do Estudo

A coleta de dados do projeto ocorreu em 2015 e 2016, conforme a descrição detalhada a seguir.

- *Coleta 2015*

A coleta ocorreu entre setembro e outubro de 2015 e foi o primeiro momento para execução da pesquisa de campo propriamente dita. Além da pesquisadora principal, participaram da equipe de pesquisa uma aluna de doutorado Universidade de Surrey na Inglaterra (cooperação entre os grupos de pesquisa), uma professora da Universidade Federal do Acre (cooperação entre grupos de pesquisa), um médico e professor da Universidade Federal do Acre, dois alunos de graduação do Instituto Federal do Acre (pesquisadores voluntários), um técnico de enfermagem disponibilizado pela secretaria municipal de saúde de Xapuri e um motorista para o transporte (quando necessário).

A primeira semana foi voltada para a busca ativa de participantes residentes na cidade e na zona rural (reserva extrativista Chico Mendes). Como estratégia foram contatados órgãos públicos, secretaria de educação, sindicatos dos professores a também moradores da cidade trabalhavam na prestação de serviços. Dessa forma, após recrutamento, 11 voluntários do sexo masculino aceitaram participar do estudo.

Como estratégia de recrutamento dos participantes da zona rural foi contatada a associação de seringueiros com sede na cidade, que permitiu um mapeamento dos moradores da zona rural que atuassem tanto extração do látex, coleta da castanha quanto na agricultura de subsistência.

A partir deste contato foram feitas incursões pela reserva extrativista, ao longo das propriedades rurais, para recrutamento dos participantes. Ao final, aceitaram participar da pesquisa 8 voluntários rurais do sexo masculino. Destaca-se que para a realização dessas incursões na reserva foi necessário o aluguel de caminhonete com tração e a contratação de motorista experiente nas estradas de terra da região, para acessar os locais mais distantes.

A coleta dos dados seguiu o mesmo protocolo para ambos os grupos (rurais e urbanos) e consistiu em:

- 1) Aferição das medidas antropométricas, entrega de actímetros e protocolos de atividades diárias para coleta dos dados de sono e coleta dos dados cadastrais na primeira visita de recrutamento;
- 2) *1^a coleta* de saliva na primeira segunda-feira das 16:30h até 20:00h. Durante este encontro eram feitas as entrevistas com os questionários estruturados bem como a aplicação dos recordatórios alimentares de 24h referentes ao consumo do final de semana (1 dia);
- 3) *2^a coleta* de saliva no sábado seguinte, das 16:30h até 20:00h. Durante este encontro eram aplicados os recordatórios alimentares de 24h referentes ao consumo da semana de trabalho (2 dias). Além disso, 3 horas antes do início da coleta o médico da equipe fazia o atendimento clínico dos participantes da pesquisa e de suas famílias, fazendo encaminhamentos ao posto de saúde do município quando necessário;
- 4) *Último encontro*: coleta de sangue para avaliação dos parâmetros bioquímicos e entrega dos actímetros e protocolos de atividades diárias. Este encontro ocorria na terça-feira após final de semana de coleta de saliva, na parte da manhã, de forma a garantir o jejum necessário para coleta de sangue.

Na cidade o esquema de coletas seguia o mesmo padrão, com exceção do horário de início da coleta de saliva que tinha início as 18:00h e era finalizado as 22:00h, uma vez que os estudos indicam que moradores de cidades iniciam sua secreção de melatonina mais tarde quando comparados aos rurais.

Para que não ocorresse a supressão de melatonina pela luz, os sujeitos permaneceram penumbra durante todo o período de coleta. Os indivíduos permaneceram em um ambiente cuja iluminação não ultrapassava 50 lux. As amostras

foram coletadas em intervalos regulares de 30 minutos, totalizando 9 amostras coletadas para cada participante.

Cabe salientar que os participantes foram orientados a não fumar, não ingerir bebidas (exceto água) e alimentos pelo menos 15 minutos antes de cada coleta. Além disso, foram orientados a não realizar tratamento dentário nas 24 horas prévias a coleta.

Com relação à coleta de dados de sono, os actímetros (Cambridge®) utilizados em campo foram devidamente calibrados para a obtenção de registros dos níveis de atividades em intervalos de 1 minuto por 10 dias, conforme protocolo planejado.

- ***Coleta 2016***

A segunda coleta ocorreu entre julho e agosto de 2016 e teve por objetivo aumentar o número de participantes da amostra. Compôs a equipe de pesquisa local nessa etapa a doutoranda responsável pelo projeto, uma professora da Universidade Federal do Acre (cooperação entre grupos de pesquisa), um médico e professor da Universidade Federal do Acre, dois alunos de graduação do Instituto Federal do Acre (pesquisadores voluntários), um técnico de enfermagem disponibilizado pela secretaria municipal de saúde de Xapuri e um motorista para o transporte (quando necessário). Todo o protocolo de coleta descrito anteriormente relacionado à primeira etapa foi executado novamente. Os actímetros utilizados nesta etapa foram da marca Condor. Ao final, participaram desta etapa 14 voluntários da zona rural e 9 voluntários residentes da zona urbana.

5.3.5 Instrumentos de coleta de dados

Questionário sóciodemográfico e de hábitos de vida

Foi utilizado um questionário para coletar dados referentes aos aspectos sóciodemográficos (idade, sexo, renda, escolaridade, estado conjugal, número de

pessoas na residência, presença de filhos menores de 18 anos, renda mensal, ingestão de bebida alcoólica e fumo) e hábitos de vida (atividade física, fumo e ingestão de álcool) (ANEXO I).

Consumo Alimentar

Para a avaliação do consumo alimentar foi utilizado o recordatório alimentar de 24 horas (R24h), um instrumento que permite quantificar o consumo de alimentos nas 24 horas do dia anterior à entrevista, durante 3 dias: 2 dias de trabalho e 1 dia de folga (ANEXO II).

Como vantagens do método podem ser citadas a fácil e rápida aplicação, mesmo em populações não alfabetizadas, menor influência sobre o comportamento alimentar e a recordação do consumo alimentar recente que por si, diminui o viés da memória (COSTA et al, 2006). Todavia, a aplicação de um único recordatório não corresponde à ingestão habitual do entrevistado, devido à chamada variabilidade intrapessoal, que consistem em flutuações alimentares diárias, influenciadas pela sazonalidade, dia da semana, aspectos socioculturais, econômicos e ecológicos (MARIMOTO et al, 2011; HOFFMANN et al, 2002).

Os dados do consumo alimentar coletados por R24h foram previamente checados quanto à qualidade das informações. Foi realizada uma quantificação padronizada (crítica) dos alimentos e bebidas em gramas, miligramas e mililitros. A crítica dos recordatórios foi embasada em livros de conversão de medidas caseiras em padrão (PINHEIRO et al., 2008; FISBERG e MARCHIONI, 2014).

Posteriormente a etapa de crítica, os dados foram digitados e convertidos em energia e nutrientes pelo uso do software *Nutrition Data System for Research version*

2007 (NUTRITION COORDINATING CENTER, UNIVERSITY OF MINNESOTA, 2007), que apresenta como principal base de dados a tabela norte-americana do *United States Department of Agriculture*. Alimentos e preparações tipicamente brasileiras que não constavam no programa tiveram seus valores nutritivos inseridos de acordo com informações da tabela nacional (TACO).

Todas as atividades de checagem dos dados, quantificação padronizada dos alimentos e a atual digitação dos dados no software foram executadas por uma acadêmica de Nutrição da Faculdade de Saúde Pública da USP, bolsista de iniciação científica PIBIC, sob a orientação e auxílio da doutoranda.

Antropometria

As medidas antropométricas foram realizadas por pesquisadores, devidamente treinados para coletar dados de massa corporal (em Kg), estatura (em metros) e circunferência da cintura, conforme técnica e instrumentos abaixo relacionados:

1. **Massa corporal (M)** – os indivíduos foram aferidos em balanças digitais (Tanita BC543®) com capacidade para 150 Kg e precisão de 0,1 Kg. Os indivíduos foram convidados a subirem na balança, descalços, com o mínimo de roupas possível e após esvaziarem a bexiga.
2. **Estatura (E)** – Os participantes foram medidos descalços em estadiômetro (Sanny ES 2060) com precisão de 0,5 cm. Os indivíduos foram orientados a estarem em posição ereta, braços estendidos ao longo do corpo e olhar fixado em um ponto no horizonte.
3. **Circunferência da Cintura (CC)** - Foi utilizada uma fita métrica inextensível de 1 cm de largura, em dupla medição para todas as medições. Para aferição, o

examinado permaneceu de pé, ereto, sem camisa, com os braços estendidos ao longo do corpo e os pés juntos. A fita foi posicionada na cintura natural ou na menor curvatura localizada entre o último arco costal e a crista ilíaca.

Foi adotado o índice de massa corporal ($IMC = P/A^2$), recomendado pela Organização Mundial de Saúde (WHO, 2000), para avaliação do estado nutricional da população do estudo. O IMC foi categorizado de acordo com as preposições da WHO (2000), sendo utilizados os seguintes pontos de corte para a classificação dos indivíduos: baixo peso ($IMC < 18$); eutrofia $\geq 18,5$ e < 25 ; sobre peso ≥ 25 e < 30 ; obesidade ≥ 30 . Como informações complementares ao diagnóstico de obesidade na população foram utilizados os pontos de corte para circunferência da cintura (CC) proposta pela Sociedade Brasileira de Cardiologia (2013), que define como risco para morbidades metabólicas, portanto obesidade abdominal para $CC \geq 90$ cm em homens. Para a aferição das medidas índice de gordura corporal, índice de gordura visceral, idade metabólica foram utilizados os valores fornecidos pela balança digital da marca Tanita® modelo BC 543.

Ciclo Sono-Vigília

Para avaliação do ciclo sono-vigília foram utilizados actímetros (*Cambridge e Condor*) devidamente calibrados para a obtenção de registros dos níveis de atividades em intervalos de 1 minuto por 10 dias.

A actimetria é um método prático e simples de monitoramento da atividade motora geral e que permite estimar o período de sono e vigília de cada indivíduo pelo auxílio de um algoritmo (ANCOLI-ISRAEL et al, 2003; LEMKE et al, 2001).

O actímetro é um equipamento que atua como um acelerômetro que estima a frequência de movimentos. Possui um cristal pizoeletrico, que atua semelhante a um

sensor bilaminado, cuja voltagem é proporcional a mudança de direção do movimento, de forma que cada movimento gera uma voltagem específica. Este sinal é comparado a uma voltagem de referência e depois transformado em uma representação digital, composta por agrupamentos em intervalos de um minuto constantes armazenados na memória do aparelho.

O protocolo de atividades diárias consistiu em uma grade horária de 24 horas e dividida em intervalos de 15 minutos, possui informações acerca do início e término de todos os episódios de sono, despertar, alimentação, lazer e exposição à luz natural, auxiliando como complemento das informações obtidas pela actimetria (ANEXO III).

Os dados brutos do equipamento foram verificados e corrigidos quanto a quaisquer inconsistências conforme as informações contidas nos protocolos de atividades e posterior edição no software *Philips Respirationics®*.

Após essa etapa foi gerado um actograma individual para cada participante do estudo, no qual era possível identificar os episódios de sono (marcação em verde claro), exposição à luz (linhas amarelas) e períodos de atividade (linhas pretas). As marcações em azul escuro correspondem a períodos descartados da análise no qual o equipamento não foi utilizado (Figura 1).

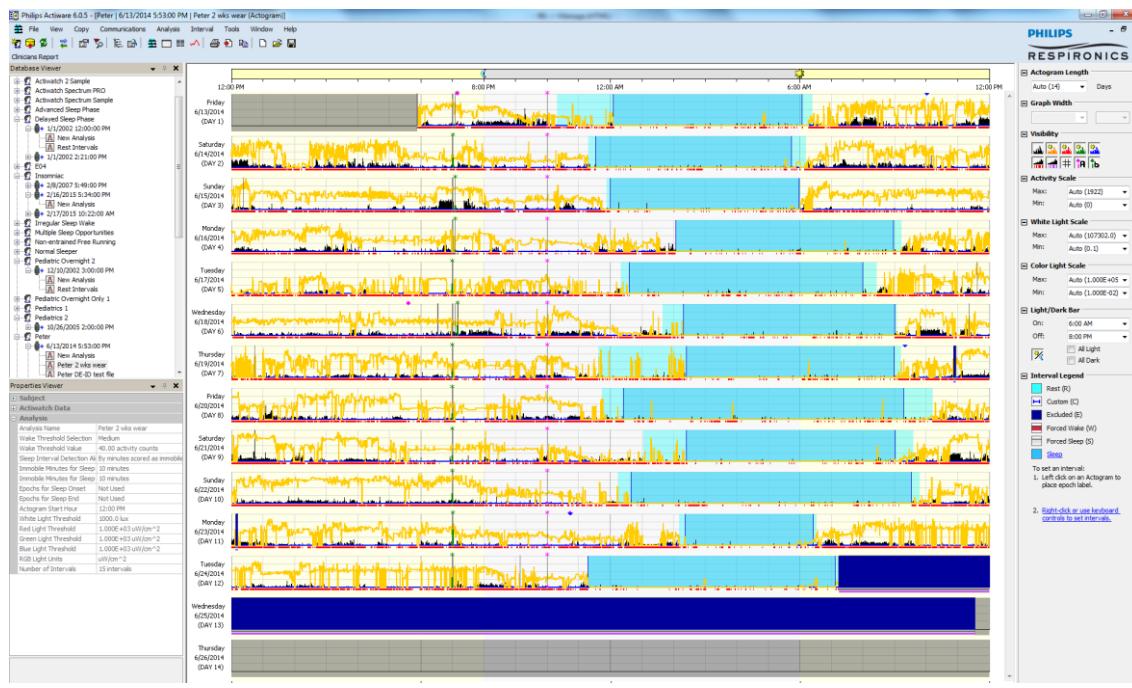


Figura 1. Exemplo de um actograma editado no software *Philips Resironics®*. Suécia, 2017.

Após a edição de todos os actogramas foi possível estimar as variáveis relacionadas ao sono principal para dias de trabalho e folga. As variáveis analisadas foram: horário de início do sono (*sleep onset*), horário do fim do sono (*wake up time*), duração do sono (*sleep length*), e meia fase do sono (*midsleep*) calculada pela soma do horário de início do sono com duração total do sono dividido por 2.

Variáveis Biológicas

Parâmetros Bioquímicos

Foram realizados exames bioquímicos por coleta de amostra de sangue por enfermeiro devidamente treinado, com o participante em jejum de 8 horas. Os exames analisados no presente estudo foram: glicemia de jejum, insulina de jejum, triglicérides, colesterol total e frações. As amostras de sangue coletadas foram transportadas sob refrigeração para análise por laboratório autorizado em Rio Branco.

Melatonina Salivar (Dim Light Melatonin Onset- DLMO)

A secreção desse hormônio é minimamente afetada ou mascarada por outros ritmos circadianos como o ciclo vigília/sono, temperatura corporal e cortisol. Outra vantagem desse marcador é que a concentração sérica de melatonina pode ser determinada com alto grau de resolução, especialmente seu início diário (SACK et al. 1992; SKENE e ARENDT, 2006).

Para que não ocorresse a supressão de melatonina pela luz, os sujeitos permaneceram sob *dim light* (penumbra) durante todo o período em que as amostras foram coletadas. As coletas foram realizadas separadamente em cada grupo (rurais e urbanos). As amostras foram em intervalos regulares de 30 minutos, durante dois dias não consecutivos (trabalho e folga).

A melatonina foi mensurada na saliva, segundo orientações do consenso estabelecido em 2005 em *Workshop da Associated Professional Sleep Societies* (BENLOUCIF, 2008). Para a obtenção da amostra, os trabalhadores depositaram a saliva em um tubo de poliéster (tubo tipo *Falcon* de 15ml) que foram congeladas e posteriormente armazenadas em um refrigerador a uma temperatura de -20°Celsius. As amostras de melatonina salivar foram enviadas para São Paulo para análise, segundo o método *Enzyme-Linked Immuno Sorbent Assay* (ELISA).

Convém ressaltar que o segundo lote de amostras coletadas em 2016 não puderam ser analisadas a tempo para a utilização dos resultados nos manuscritos apresentados neste trabalho. Os mesmos serão utilizados na elaboração de outro manuscrito posterior a publicação da tese.

5.3.6 Aspectos Éticos

Conforme a normatização do Conselho Nacional de Saúde em sua Resolução nº 466 de 12 de dezembro de 2012 (BRASIL, 2012) o projeto foi aprovado pelo Comitê de Ética em Pesquisa (COEP) da Faculdade de Saúde Pública da Universidade de São Paulo (FSP/USP) (CAAE: 44860515.0.0000.5421). Além disso, os participantes voluntários, após serem esclarecidos sobre os objetivos da pesquisa, assinaram o Termo de Consentimento Livre e Esclarecido previamente aprovado pelo COEP da FSP/USP.

5.3.7 Análises Estatísticas

A distribuição das variáveis foi avaliada pelo teste de Shapiro Wilk. O teste Exato de Fisher foi utilizado para verificar as associações entre as variáveis categóricas a seguir: estado conjugal, escolaridade, presença de filhos menores de 18 anos, ingestão de álcool, fumo, atividade física, IMC, CC, glicose de jejum, triglicérides, colesterol total, LDL-colesterol e HDL-colesterol.

Foi realizado teste t de Student (e seu equivalente não paramétrico) para amostras independentes de forma a comparar dados entre os dois grupos estudados (urbanos e rurais) para as seguintes variáveis: idade, IMC, CC, índice de gordura corporal, índice de gordura visceral, massa muscular, idade metabólica, glicose de jejum, insulina de jejum, triglicérides, colesterol total, LDL-colesterol, HDL-colesterol.

Foram executados testes de correlação de *Spearman* entre as variáveis *social jetlag*, *midsleep* (MSFc), IMC e a ingestão de energia (Kcal) dos participantes rurais e urbanos. Para todas as análises estatísticas foi utilizado o software STATA 14 (Stata Corporation, College Station, TX, USA).

5.3.8 Financiamento do Estudo

O custeio da coleta de dados foi financiado pela cooperação entre o grupo de pesquisa da Universidade de São Paulo, Universidade Federal do Acre e Universidade de Surrey na Inglaterra.

A parceria entre o grupo de pesquisa a qual a doutoranda pertence e a Universidade de Surrey na Inglaterra sob a coordenação da Profa Dra. Debra Jean Skene permitiu a realização da primeira etapa da coleta de dados em 2015. Foram custeadas as passagens áreas dos pesquisadores envolvidos, diárias, carro de transporte e pagamento dos exames bioquímicos dos participantes da pesquisa.

A colaboração com a Universidade Federal do Acre (UFAC), através do projeto “*Saúde das populações tradicionais da Amazônia e populações em situação de vulnerabilidade social*” (Edital PPSUS/FAPAC - Projeto no: EFP_00011906) sob a coordenação da Profa Dra Suleima Pedroza Vasconcelos viabilizou em 2016 a segunda visita da doutoranda para a coleta de novos dados entre populações rurais e urbanas na região, juntamente com a equipe de pesquisa local.

Posteriormente, a partir de fevereiro de 2017, a pesquisa passou a contar com o apoio financeiro do Auxílio Regular FAPESP (Processo no 2016/11155-3) por integrar parte do projeto “*Saúde, alimentação e estilo de vida de seringueiros e trabalhadores diurnos e noturnos que vivem em ambientes urbanos*”, com a coordenação da Profa Claudia Roberta de Castro Moreno.

5.3.9 Estágio Sanduíche

A pesquisadora foi contemplada com uma Bolsa de Estágio Sanduíche pelo programa de cooperação CAPES/STINT (Processo no 99999.000303/2016-00). O estágio foi desenvolvido no *Stress Research Institute* na Universidade de Estocolmo, na

Suécia, sob a orientação do Prof. Dr. Arne Lowden, de dezembro de 2016 a abril de 2017.

Durante os quatro meses de estágio foram organizados os bancos de dados referentes aos dados de sono, luz e atividade coletados por actimetria. Após a edição e categorização dos dados em software apropriado disponibilizado pelo laboratório de sono da instituição, foram realizadas as primeiras análises inferenciais, bem como uma análise comparativa entre grupos trabalhadores rurais e urbanos da amostra, incluindo também variáveis sociodemográficas, antropométricas e parâmetros bioquímicos.

6 RESULTADOS E DISCUSSÃO

6.1 Artigo 01 - Effects of physical activity at work and life-style on sleep in workers from an Amazonian Extractivist Reserve (*Publicado no periódico Sleep Science*).

Nesta seção apresentamos o primeiro manuscrito produzido com dados coletados na comunidade amazônica. Nele podemos identificar quais os efeitos do tipo de trabalho no que tange ao grau do esforço físico bem como o estilo de vida em relação ao sono dos trabalhadores.

Effects of physical activity at work and life-style on sleep in workers from an Amazonian Extractivist Reserve.

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Abstract

Background: Physical activity has been recommended as a strategy for improving sleep. Nevertheless, physical effort at work might be not the ideal type of activity to promote sleep quality. *Aim:* The aim of this study was to evaluate the effects of type of job (low versus high physical effort) and life-style on sleep of workers from an Amazonian Extractivist Reserve, Brazil. *Methods:* A cross-sectional study of 148 low physical activity (factory workers) and 340 high physical activity (rubber tappers) was conducted between September and November 2011. The workers filled out questionnaires collecting data on demographics (sex, age, occupation, marital status and children), health (reported morbidities, sleep disturbances, musculoskeletal pain and body mass index) and life-style (smoking, alcohol use and practice of leisure-time physical activity). Logistic regression models were applied with the presence of sleep disturbances as the primary outcome variable. *Results:* The prevalence of sleep disturbances among factory workers and rubber tappers was 15.5% and 27.9%, respectively. The following independent variables of the analysis were selected based on a univariate model ($p < 0.20$): sex, age, marital status, work type, smoking, morbidities and musculoskeletal pain. The predictors for sleep disturbances were type of job (high physical effort); sex (female); age (> 40 years), and having musculoskeletal pain (≥ 5 symptoms). *Conclusion:* Rubber tapper work, owing to greater physical effort, pain and musculoskeletal fatigue, was associated with sleep disturbances. Being female and older than 40 years were also predictors of poor sleep. In short, these findings suggest that demanding physical exertion at work may not improve sleep quality.

Keywords: sleep disturbances, work, life style, musculoskeletal pain, physical activity.

Introduction

In recent years, sleep disturbances have been extensively reported in the literature, affecting all age groups. Numerous studies have reported a high prevalence of sleep problems in the general population with rates varying between 10-48% [1-4]. In Brazil, studies carried out in São Paulo city identified a prevalence of objective insomnia of 32% [5]. Moreover, it was found a marked increase in sleep-related complaints, such as difficulties initiating and maintaining sleep [6].

Sleep deprivation negatively impacts quality of life, affecting the health of the population, and is associated with increased overweight and obesity, higher risk of cardiac and metabolic diseases, as well as greater risk of accidents in the workplace and higher health costs [7-9]. Studies have highlighted the practice of physical exercise as a factor that can enhance sleep quality and duration and reduce the prevalence of sleep disorders [10-12]. However, it has been suggested that not all physical activities improve sleep quality. Highly intense physical activity may have a negative effect on sleep when it is work-related. Geroldi et al. [13] reported that individuals with an occupational history of low physical effort exhibited better sleep quality compared to workers with physically demanding jobs. These findings suggest that physical activity is a way of improving sleep quality, provided these activities are moderate and taken during leisure rather than demanding and work-related.

Brazil has undergone an intense restructuring of the production chain involving the replacement of human labor by mechanized and technology-based work, where this has had a major impact on the lives of the population. These changes in the work sphere have led to shifts in the epidemiologic profile of the workers, with the emergence of

new risks to health, such as an increase in neuromuscular diseases, psychosocial problems, among other health issues [14]. Nevertheless, few studies have explored the possible effects of changes in the physical characteristics of work, activity and life-style on sleep quality of workers, particularly in rural regions of the country. In this context, two occupational categories were investigated in this study: 1) rubber tappers, who work in an activity with high physical demand; 2) workers from a factory, who work in activities with low or moderate physical activity.

Rubber tappers are forest workers and dwellers living closely with nature and from which they derive their basic needs. Thus, rubber tappers live off brazil nuts, rubber and sustainable lumber and other subsistence-based agriculture (small scale farming) and extractivism (hunting and fishing) [15]. The daily working life of rubber tappers entails vigorous physical activity involving long treks carrying the material collected (latex, Brazil nuts) and substantial expenditure of energy. Fishing, hunting, playing football and meeting friends were some of the leisure activities observed among rubber tappers. By contrast, factory workers perform more static repetitive activities involving long periods standing and have access to electronic devices (television sets, computers etc.) as a form of leisure, factors that reduce their overall energy expenditure in their daily lives.

The aim of the present study was to assess the effects of physical activity at work and life-style on sleep of workers with high and low/moderate physical demands living on the same Amazonian Extractivist Reserve.

Methods

A cross-sectional study of a typical rural population represented by a group of rubber tappers with known high physical workload was undertaken. Another group from a similar cultural background and state of Brazil were represented by factory workers with low or moderate physical workload living in a small town (also in the Amazonian Extractivist Reserve). Thus, the population comprising rubber tappers from the Amazon forest and factory workers of a rubber factory (where the latex was refined into rubber for commercial processing) located in Xapuri, Acre state. The study was carried out between September and November 2011 (Figure 1) [16].

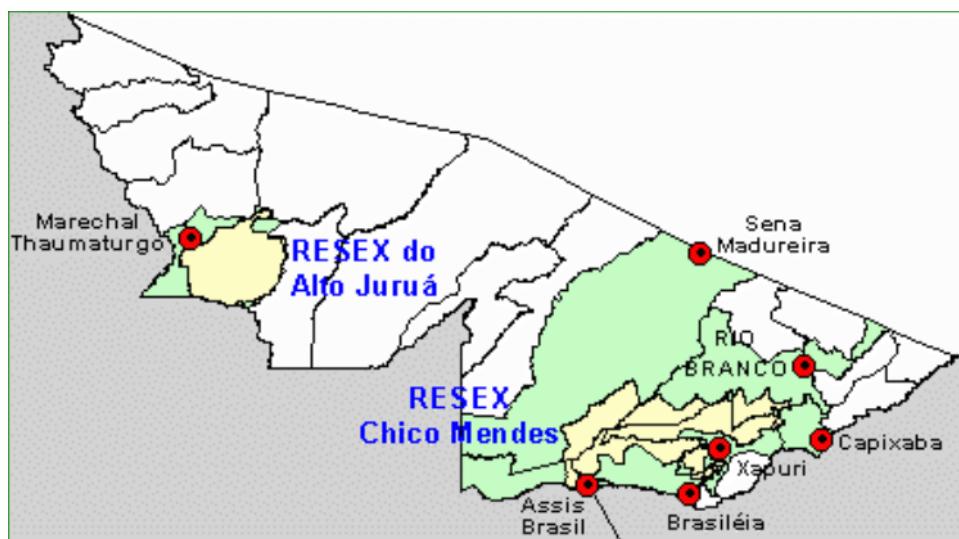


Fig. 1 Map of Acre state and location of the Chico Mendes Extractivist Reserve (RESEX). Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Não Renováveis [IBAMA], 2006.

Sample characteristic

At the time of the study, 712 rubber tappers were registered at the factory as suppliers of latex. However, during the period of data collection, only 398 rubber tappers had active registrations, i.e. were effectively supplying the raw material. Of this total, 340 workers were interviewed at the places in the forest where the cooperative

collects the latex. The remaining workers could not be contacted, mainly owing to difficulties accessing the rubber plantations during the rainy season. The number of rubber tappers interviewed represented 85.4% of the target population of 14 rubber plantations, thereby ensuring representativeness of the sample.

In addition, 160 workers at the cited factory were included, 148 (92.5%) of whom were interviewed. The workers were drawn from the following sectors: packing, electrical testing, maintenance, production, administration and cleaning. Besides the rubber tappers, only the administrative personal used to work in permanent day shift. All the other categories had to work in a rotating shift work.

All interviews took place at the factory during work hours at a venue which provided comfort and privacy. Therefore, the sample is representative and accurately reflect the characteristics of the population studied (Table 1) [17].

Table. 1 Shift type and working times of study participants (n=488).

Type of work	Tipo de Atividade*	Sector	Shift type	Work hours	n
Urban (factory)	Moderate	Electrical testing and packing	Rotating	14:00 – 23:00h 06:00 – 15:00h 22:00 – 07:00h	70
Urban (factory)	Moderate	Production	Rotating	06:00 – 18:00h 18:00 – 06:00h	10
Urban (factory)	Moderate	Maintenance	Rotating	08:00 – 20:00h 20:00 – 08:00h	11
Urban (factory)	Low	Administrative	Diurnal	08:00 – 18:00h	46
Urban (factory)	Moderate	Cleaning	Rotating	06:00 – 14:00h 14:00 – 22:00h	11
Rural (rubber tapper)	High	Extractivism	Diurnal	05:00 – 17:00h	340

*Classification by metabolic rate according to Brazilian Bylaws nº15 (BRASIL, 1978).

Variables

Data on sociodemographic characteristics, anthropometry (body mass and height), life-style, sleep, self reported morbidities, musculoskeletal pain and occupation type were reported by the workers.

Sociodemographic data, life habits and morbidity

The following sociodemographic aspects were included: age, sex, marital status and presence of children at home. The variables related to life-style were: smoking, alcohol use and practice of physical exercise outside work hours.

The information on practice of physical exercise was collected through the following questions: “Do you practice physical exercise during your free time?” (No; yes); “If yes, which exercises?” and “How many times a week?” (once a week, 2-3 times a week and over 3 times a week).

In order to identify the frequency of morbidities, the items from the Work Ability Index (WAI) questionnaire [18,19] were included, collecting information on the occurrence of clinician-diagnosed diseases in the past 12 months.

Karolinska Sleep Questionnaire

The Karolinska Sleep Questionnaire (KSQ) was used to assess sleep disturbances reported by the workers over the past six months. The KSQ contains 15 questions on sleep problems covering three dimensions: sleep disturbances; fatigue/non-restorative sleep and waking difficulties. This KSQ is a Likert type scale containing five responses alternatives ranging from 1 to 5 with verbal anchors (never, rarely, sometimes, frequently and always) [20]. Each dimension was categorized after

classification as "yes" for frequently/always or "no" for never/rarely/never. In this study we analyzed sleep disturbances, which were comprised difficulties initiating asleep; waking several times and difficulty getting back to sleep; too early final waking; disturbed sleep.

The internal reliability of the instrument in this study was 0.81 according to Cronbach's Alpha.

Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms

The Nordic Questionnaire was used to assess musculoskeletal pain [21]. This questionnaire comprises questions on work-related musculoskeletal pain/discomfort reported over the previous 12-month period. The general questionnaire assesses the following body regions: neck, shoulder, upper part of the back, lower part of the back, knuckles and hands, hips and thighs, knees, ankles and feet. The internal reliability of the questionnaire was tested using Cronbach's Alpha, yielding 0.93 in the present study. The figure of a human being highlighting parts of body was shown to the participant in order to help him/her to identify the body regions.

Body Mass Index (BMI)

For the assessment of nutritional status, data on reported body mass and height were self-reported to calculate body mass index (BMI) based on the formula: BMI = body mass/height². The workers were classified using the reference values published by the World Health Organization [22], according to the criteria: < 18.5 kg/m² for "underweight"; 18.5-24.9 kg/m² for "normal"; 25.0-29.9 kg/m² for "overweight"; and > 30 kg/m² for "obesity". The dichotomous variable "overweight or obesity" was

employed for analyses. Participants were classified into “normal” ($BMI < 25 \text{ kg/m}^2$) or “overweight or obesity” ($BMI \geq 25 \text{ kg/m}^2$).

Statistical analysis

A logistic regression model was estimated based on the stepwise forward method, with the outcome variable “presence of sleep disturbances”, a dimension from the previously cited KSQ. The independent variables were selected using the Pearson’s Chi-squared test, selecting variables with a p-value < 0.20 . Variables attaining a p-value < 0.05 were retained in the final model. The Stata13 software program (Stata Corporation, College Station, TX, USA) was used for all analyses.

Ethical Aspects

The ethical aspects were based on the norms of the National Health Council in Resolution nº 196 of 10th October 1996 [23], in compliance with the ethical standards of the Declaration of Helsinki. The project was approved by the Research Ethics Committee of the School of Public Health of the University of São Paulo (Protocol no. 2273) and all participants signed an informed consent form in duplicate, with one copy retained by the participant and the other filed by the researcher.

Results

The data revealed the rubber tappers (high physical activity) group to be predominantly male (91.5%), with mean age of 42 years ($SE=0.76$) and age range of 18-72 years. Notably, 27.3% of the rubber tappers were illiterate and 64.7% had not completed primary education.

Among the factory workers (low/moderate physical activity), there was an equal proportion of males (52%) and females (48%), and 68% of interviewees had completed secondary education. These workers had a mean age of 27.1 years (SE=0.5) and age range of 18-55 years.

The two groups (high vs. low/moderate physical activity) were different in all analyzed variables excepted for alcohol use. There was a significant age difference between the groups, rubber tappers being older than the factory workers (Table 2).

Table 2. Socio-demographic, life-style and health characteristics according to degree of physical activity (n = 488).

Variable	Categories	High physical activity (rubber tappers)		Low/moderate physical activity (factory workers)		p (χ^2)
		N	%	N	%	
Sex	Male	311	91.5	77	52	p<0.001
	Female	29	8.5	71	48	
Age	18-30 years	82	24.1	116	78.4	p<0.001
	31-40 years	85	25.0	26	17.6	
Marital Status	> 40 years	170	50.0	6	4.1	p<0.001
	Single	92	27.1	91	61.5	
Practice physical exercise	Married/ live with partner	248	72.9	57	38.5	p<0.001
	Yes	127	37.4	90	60.8	
Smoking	No	213	62.6	58	39.2	p<0.001
	Yes	169	49.7	19	12.8	
Alcohol use	No	171	50.3	129	87.2	p<0.001
	Yes	173	50.9	88	59.5	
Nutritional Status	No	167	49.1	60	40.5	n.s.
	Normal	240	72.3	83	57.2	
	Overweight/Obesity	92	27.7	62	42.8	p=0.001

The prevalence of sleep disturbances among high vs. low/moderate physical activity workers was 27.9% and 15.5%, respectively (p=0.003). No statistically significant difference was found between the groups for reported morbidities.

Workers with high physical activity with more than five musculoskeletal

complaints were twice the number of those with low/moderate physical activity at work ($p<0.001$) (Figure 2).

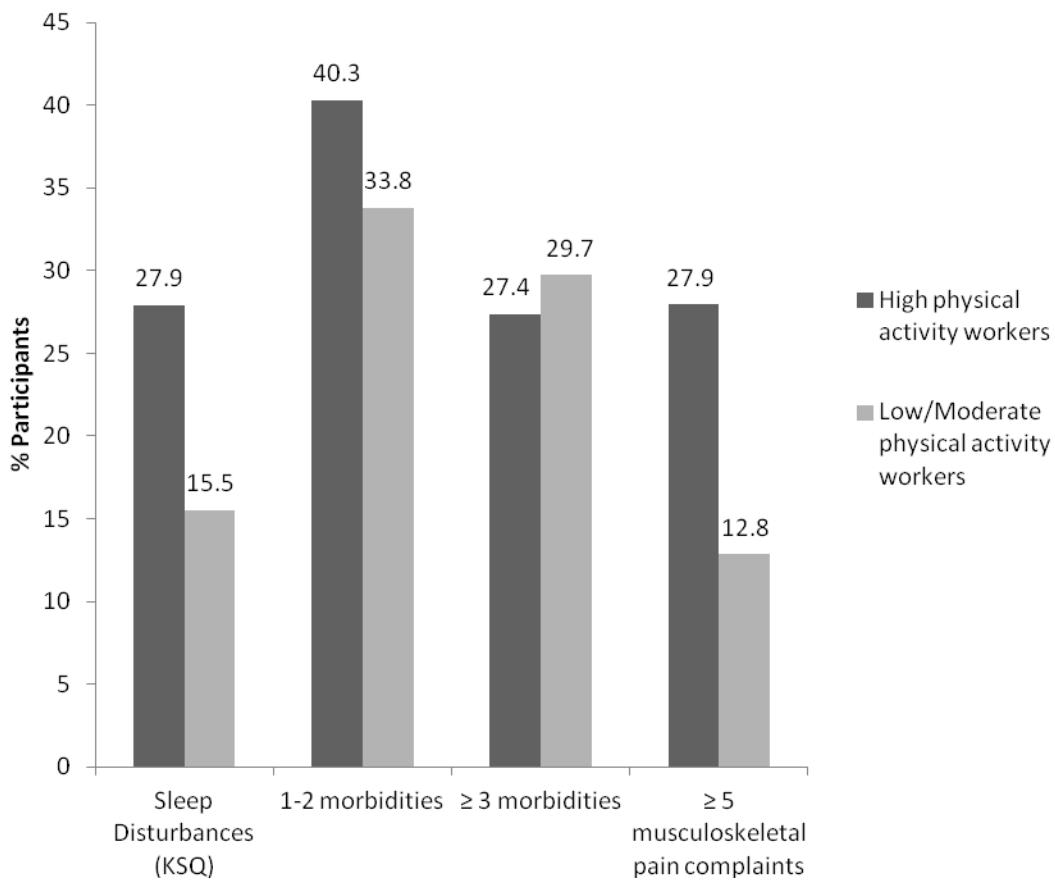


Fig. 2 Frequency of sleep disturbances (KSQ), reported morbidities and musculoskeletal pain among high and low/moderate physical activity (n=488). Pearson's Chi-square test, * $p<0.05$

The following factors were associated with the presence of sleep disturbances according to Pearson's Chi-squared test ($p<0.20$): sex ($p=0.074$), marital status ($p=0.014$), age > 40 years ($p<0.001$), type of job – with high physical activity ($p<0.003$), smoking ($p<0.006$), 5 or more musculoskeletal complaints ($p<0.001$), presence of 3 or more reported morbidities ($p=0.002$). These variables were selected as independent variables for the logistics regression model.

Multiple regression analysis identified the following predictors for sleep disturbances (presented in the order of entrance in the model): sex (female); age (> 40 years), having musculoskeletal pain (≥ 5 symptoms); type of job (high physical activity). The variables marital status, smoking and presence of ≥ 3 reported morbidities were no longer significant in the final model (Figure 3).

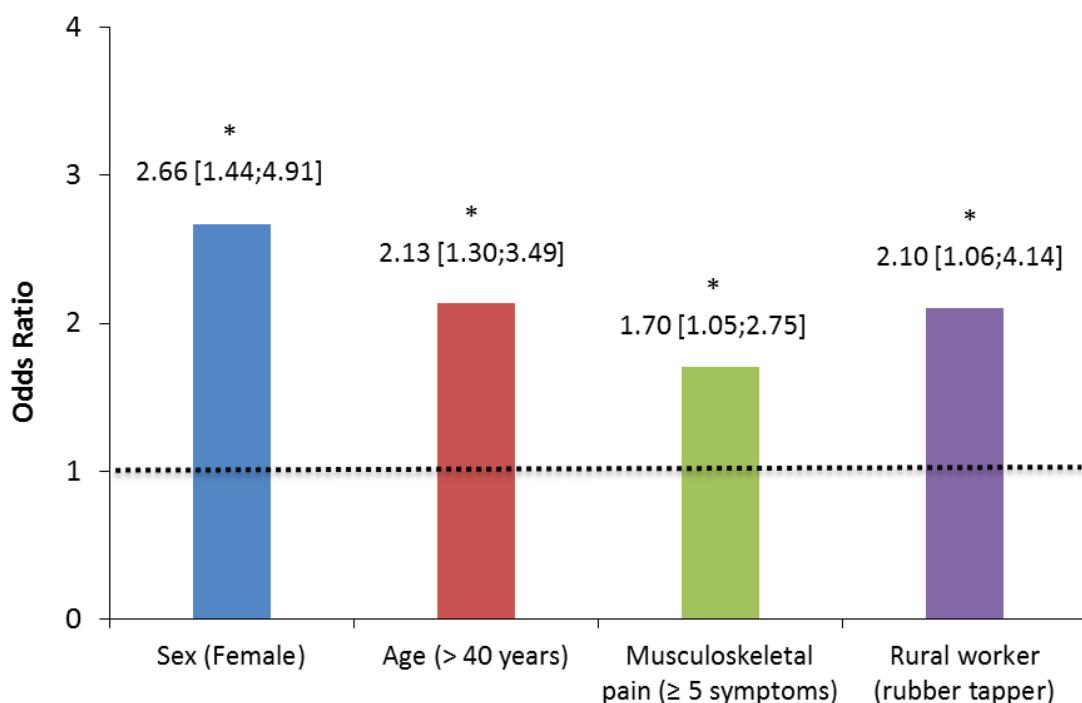


Fig. 3 Final logistic regression model according to presence of sleep disturbances (KSQ) in the study sample ($n = 488$). Dashed line at 1 means reference cut-off.
* $p < 0.05$ OR [CI95%]

Discussion

The results of this study revealed a high prevalence of sleep disturbances among rubber tappers – with high physical activity (27.9%) - compared to factory workers – with low/moderate physical activity (15.5%). This finding corroborates the results of the study by Moreno et al [24] in which rubber tappers' job was associated with insomnia.

One hypothesis to explain our findings is that the intense physical effort of the work may lead to musculoskeletal pain and in turn to sleep disturbances. In addition, we should consider the age differences between groups, which also may contribute for sleep disturbances. However, the cross-sectional nature of this study precluded the establishment of a cause and effect relationship for the results outlined.

Findings reported in the literature regarding the effects of physical exercise during leisure time on sleep quality have shown an opposite effect [25, 26]. Vuori et al [27], for instance, have shown that mild-to-moderate activities exert a positive effect on sleep quality. On the other hand, the same authors found a negative impact of vigorous physical exercise on sleep. Perhaps this is similar to what occurs during intense physical effort at work. A study by Marqueze et al [28] of workers of the ceramic industry showed a tendency for worse sleep quality indexes in the presence of greater energy expenditure of the workers, particularly in the case of physically demanding labor activities. Soltani et al [29] suggested that work requiring intense physical effort may constitute an independent factor influencing sleep quality although this relationship has not yet been fully elucidated.

Physical inactivity, however, is considered one of the main risk factors for the development of a number of chronic noncommunicable diseases, such as cardiovascular diseases, diabetes, osteoporosis and some types of cancer [30]. Pursuing a physically active life, especially during leisure time, substantially reduces the risk for these diseases and promotes many health benefits such as lower corporal adiposity; improved cardiovascular and musculoskeletal health; reduced levels of anxiety and depression, among others [31].

According to data from the 2008 National Households Survey (PNAD), one out of every five Brazilians practiced no physical activity. Moreover, particularly in the North and Northeast regions of the country, physical activity is performed in the process of travelling to work among younger men with lower educational level, and thus is practiced out of necessity rather than as an option for improving quality of life [32].

Another aspect evident in our findings was the association between musculoskeletal pain symptoms and sleep disturbances among the workers. Rural work that is physically demanding is known to promote musculoskeletal injuries, where pain can become more serious and debilitating health issues, such as repetitive strain injury (RSI) and work-related musculoskeletal disorders (WMSD), caused by poor posture, long periods standing, heat discomfort and long work shifts [33].

Moreno et al [24] also highlighted that the presence of organic and mental diseases can lead to more musculoskeletal complaints. According to Lima et al [34], in a study of rural workers engaged in coffee harvesting, the field work involves dangerous and stressing working conditions which, together with musculoskeletal pain, can lead to the development of anxiety and depression as well as to a decline in the quality of sleep.

The work activity of rubber tappers is integrated with nature. In general this group has no direct contact with modern society's life-style such as access to the internet and/or television, since most of them do not even have electricity at home [35]. These workers start working at around 05:00 h and end in the late afternoon. The factory workers, on the other hand, although living in the same region, have incorporated some of the characteristics of modern society into their everyday lives, since they work shifts (including night work). There has been a change in the relationship with work, as well as in remuneration, which is dictated by the social clock as opposed to the rhythms

imposed by nature, as is the case for activities of hunting, fishing and Brazilian nut and latex extraction [36]. Thus, an important aspect to consider is that the workers involved in this study have different living and work conditions.

In this scenario, the relationship between exhausting physical effort and musculoskeletal pain may be one of possible explanations for the findings concerning predictors of risk for sleep disturbances among the workers studied. This is particularly true for rubber tappers, providing an intriguing contrast with factory workers: despite working in a setting of sedentary, factory and shift-based work (including nights), factory workers showed lower risk of developing sleep disturbances.

However, we must emphasise that the rubber tappers were mostly older than the factory workers. Being older than 40 was found as risk factor for sleep disturbances as well as work in a high physical activity. A relationship between sleep disorders and advanced age has been reported, with a reduction in total time and sleep efficiency as we age [37, 38]. On the other hand, Grandner et al [39] after analyzing the United States Behavioral Risk Surveillance System Factor data found that older individuals were less likely to report problems related to sleep when compared to young and middle-aged adults. The authors thus suggested that the increased reporting of sleep disorders with age is not a linear phenomenon, and can be mediated by factors other than aging such as general health and presence of morbidities.

These present findings suggest that the variables related to age, life-style and work should be analyzed together, i.e. the working times and physical work conditions in general constitute part of the individual's life-style. Physical effort at work may have a deleterious effect on sleep, particularly when associated with life-style characteristics which reduce sleep quality, such as the environment for sleeping. There is still a gap in

the literature regarding the sleep of workers living in remote areas, although recent studies have shown sleep habits in hunter-gatherers [40].

Being female was also identified as a predictor of sleep disturbances. This result corroborates previous findings in the literature on this subject [41, 42]. In a study of sleep disturbances among adults, Zanutto et al [43] also found greater occurrence among women. This phenomenon may be explained based on two different perspectives: from a biological standpoint females have more fragmented sleep than males [44]; also socially, women are subject to multiple responsibilities involving work, family etc., creating stress which can negatively impact sleep [45]. In conclusion, rubber tappers reported a high prevalence of sleep disturbances, partly a result of demanding physical work, age, pain and musculoskeletal fatigue.

Conflicts of interest statement:

We declare no conflicts of interest.

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6.2 Artigo 02 – Prudent diet is associated with low sleepiness among short-haul truck drivers (*Submetido ao periódico Nutrition*).

O manuscrito apresentado a seguir aborda uma nova metodologia baseado na identificação de padrões alimentares, de maneira a relacionar o consumo alimentar aos ritmos biológicos, particularmente o sono.

Prudent diet is associated with low sleepiness among short-haul truck drivers.

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Abstract

Background: The lifestyle of post-industrial society has undergone major shifts, characterized by changes in demographic and epidemiologic profiles, eating habits and in job structures with irregular working hours, particularly night shifts. The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general particularly due to the increased sleepiness reported during night work. *Objective:* To determine the association between dietary patterns of Brazilians truck drivers and sleepiness levels, according to the work shift. *Methods:* A cross-sectional study of 52 drivers (25 long-haul and 27 short-haul) at a freight company was carried out. This study entailed application of a structured questionnaire collecting sociodemographic, lifestyle, and nutritional status. Assessment of dietary intake using a 24h dietary recall and evaluation of sleepiness was made by the Karolinska Sleepiness Scale. The principle components of the diet were analysed by factor analysis to derive dietary patterns. The Linear Mixed Model was then applied to determine a model for sleepiness levels of the drivers as a function of dietary pattern, day, time, and work shift. *Results:* Three intake patterns were derived: Traditional, Prudent and Western. Effects of time of day and shift type on sleepiness were found. An association between diet and sleepiness was also evident, where the Prudent pattern was associated with low sleepiness among short-haul truck drivers. *Conclusions:* The results of the present study revealed an association between dietary patterns and short-haul drivers, in which the healthy pattern showed low sleepiness during the day. Long-haul drivers appear to have a masking effect on their sleepiness, probably due to their irregular working time.

Keywords: dietary patterns, sleepiness, truck drivers, shiftwork, eating behavior, food consumption

Introduction

Over the last 50 years, the lifestyle of post-industrial society has undergone major shifts, characterized by changes in demographic and epidemiologic profiles as well as in industrialization and urbanization. Some of the changes in job structures include irregular working hours, particularly involving nightshifts [1].

Shift work, especially night shifts, is associated with fatigue, stress, lower performance in activities, greater risks of accidents, and early functional disability [2,3]. These characteristics are linked to poor working conditions and deregulation of biological rhythms due to hours in which workers perform their activities [1,4].

In addition, changes in the lifestyle of the population over recent decades have also affected eating habits. Preference for processed food products over foods rich in fibre and vitamins, together with sedentarism promoted by changes in the structure of work and by advances in technology, represent the main etiological factors of overweight and obesity among adults [5-8].

Night workers are no exception to this change in dietary intake, indeed, the more ready availability of processed foods has facilitated night-time snacking, a common practice in this population. The dietary behavior of this group of workers is heavily influenced by the working times. The consumption of snacks with a high energetic value yet low nutritional value in terms of micronutrients and fiber during work time has led to increased rates of overweight and obesity among these individuals [9- 13].

Several studies report an association between sleep restriction and changes in dietary intake leading to weight gain [14-16]. Markwald et al. [17] found an increased food intake during periods of reduced sleep duration and, consequently, weight gain among study volunteers. According to the authors, this response seems to be a

physiological adaptation of the organism to supply the needed energy due to the longer waking period. In addition, when the amount of sleep is restored there is a reduction in energy consumption, especially carbohydrates and fats in the sample analyzed.

A study by Nehme [18] involving night security guards found an interaction between obese individuals and increased sleep duration after a 30% increase in carbohydrate content in the caloric value of nighttime meals, suggesting possible mediation by obesity of the effect of carbohydrate intake on sleep of night workers. The effects of carbohydrate intake during night shifts have been studied since the 1980s. These studies suggest that carbohydrate consumption is a factor that changes body mass and influences psychophysiological variables such as mood [19-22]. Dye et al. [23] affirmed that carbohydrate-rich meals reduced mental performance and promoted increased levels of sleepiness compared to meals rich in fats. According to Linder [24], the effect of carbohydrate intake in promoting sleepiness occurs as a result of serotonin production, potentialized by meals rich in this nutrient. One study showed that greater consumption of carbohydrates compared to other macronutrients such as lipids was associated with greater sleepiness [10].

Evidences from literature claim that the ingestion of meals with high content of fats and sugars may predispose to excessive daytime sleepiness. According to Panossian and Veasey [25], the food-induced sleepiness could be possible owing to the hormonal and neuroendocrine response caused by this kind of nutrient, characterized by increase glucose, leptin, cholecystokinin, peptide YY, inflammatory cytokines, reduction of norepinephrine and decrease of neuronal wake sign.

The main sleep problems reported by shift workers are related to complaints of excessive sleepiness [3]. According to Arkesteed and Wright [26], the misalignment

between the endogenous circadian rhythms and the work schedules established by night shift work lead to sleepiness and sleep disorders and increase the risk of accidents.

Several studies investigate the effects of shift work on sleepiness levels. A study of truck drivers in Belgium found the prevalence of high sleepiness in 18% of respondents [27]. Another study conducted with drivers in Finland showed that about 40% of long-haul drivers and 21% of short-haul drivers reported problems in staying alert during the work period [28].

However, exclusive analysis of nutrient intake does not allow the identification of certain more specific dietary-related associations and outcomes [29]. For this reason, we decided to investigate dietary patterns instead of prioritize the effect of a single nutrient.

Drivers, as being shift workers, are also characterized by a poor diet in nutrients and for changes in eating behavior. The studies carried out in this population highlight the reduction of fruit and vegetable consumption, lower fiber intake, high consumption of processed foods, fried foods and excessive sodium in meals [13, 30-32].

The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general. The present study involved truck drivers, a group of workers exposed to long periods of night work and static activity, which can lead to irritability, insomnia, reduced alertness, sedentarism, intake of alcoholic beverages, overweight, obesity and unhealthy eating habits [33-35]. Thus, the hypothesis of this study is that the healthy eating pattern is associated with low sleepiness during the day. The premise behind this hypothesis is that healthy food intake habits lead to good sleep quality which in turn would reduce diurnal sleepiness. Therefore, the aim of this study was to determine the association

between dietary patterns of Brazilians truck drivers with sleepiness levels, according to work shift.

Methods

Study sample and design

The present cross-sectional study was conducted in a freight company as part of an institutional program promoting health and quality of life. The company in question has been operating for 35 years and possesses branches in all the capital cities of Brazil.

The company had 248 drivers (110 short-haul and 138 long-haul) on its staff at the time of data collection (May and September 2012). An initial total of 120 drivers were randomly selected (40 short-haul males, 40 long-haul males, 20 short-haul females and 20 long-haul females) of which only 71 individuals agreed to take part in of the study (29 long-haul and 42 short-haul).

Short-haul drivers worked a fixed day-time schedule of 09:00 to 17:00h, Monday to Friday, with Saturday and Sunday off. Depending on seasonal demands, overtime during the week and on Saturdays was common. Long-haul drivers worked irregular hours on predominantly long distance trips often made during the night (from 23:00h) and early hours. Periods off were not systematically scheduled in advance.

The following exclusion criteria were applied: use of medications causing changes in sleep, presence of psychiatric, hormonal or sleep disturbances, and having a second job. After losses from the sample, the final number of participants that has measured sleepiness and answered the 24-hour dietary recall was 52 (n=27 short-haul and n=25 long-haul). The sampling power calculated *a posteriori* was 0.95 (95%), with

an effect of 21.4% according to calculations performed using the Stata statistical software.

Ethical Aspects

The study was approved by the Research Ethics Committee of the School of Public Health of the University of São Paulo (COEP FSP/USP), under approval number 2313/2012. All drivers randomly selected were asked to take part in the study and agreed voluntarily after being explained the objectives of the study and signing the Free and Informed Consent Form, previously approved by the COEP of the FSP/USP as stipulated in resolution 196/96, of the Ministry of Health National Board of Health [36].

Data collection and processing

This study was performed with the application of a structured questionnaire collecting data on sociodemographic (gender, age, educational level, marital status) and lifestyle habits (drinking, smoking). Data were also collected for self-reported body mass and height to assess study participants' nutritional status. Studies suggest the use of self-report measurements as a rapid, economical and reliable alternative for monitoring nutritional status of the population in situations when direct measurements are not feasible [37-40].

The 24-hR was conducted on three non-consecutive days, comprising two working days and one day off, to minimize the influence of intrapersonal variability on dietary intake of the sample studied. A photograph album illustrating serves of the most common foods in the Brazilian diet was employed as an aid during interviews [41].

The data collected by the 24hR were previously checked for quality of the information. Standardized quantification of foods and beverages in grams, milligrams

and milliliters was performed. Data were keyed into the software Nutrition Data System for Research version 2007 [42], whose main database is the Food Composition table of the United States Department of Agriculture. Nutritional values of traditional Brazilian preparations and foods not included in the software program were input based on information from the Brazilian Food Composition Table (TACO) [43].

Over 1000 food items were reported, grouped according to nutritional value and characteristics of Brazilian dietary culture [5, 44]. Foods consumed by less than 10% of the sample were excluded from the analysis [45].

Foods were classified into 22 groups: fruit (fresh fruit, fruit salad and dried fruit); vegetables (all vegetables and legumes); beans (carioca and black beans, peas, lentils, chickpeas); roots and tubers (potato, manioc, yam, taro); rice, bread and cakes (white and whole rice, white and wholemeal bread and homemade sponges without icing); breakfast cereals (granola, oats, corn flakes); milk, milk derivatives and eggs (whole and skimmed milk, cheese, cream cheese, yoghurt, and boiled eggs, omelet); vegetable oils and olive oil; juices; processed meats; white meats; red meats; pastas and fast food (pizza, lasagna, spaghetti, hamburger, fritter); fried foods, animal fat and emulsions (fried egg, fried potatoes, chicken savory, cheese bread, rissoles, kibbeh, pork scratchings, butter, lard, mayonnaise and margarine); sugar and desserts (refined sugar, brown sugar, honey, jams, compotes, jelly, dulce de leche, peanut confectionary, soft chocolate bon bons, coconut confectionary and iced cakes with filling); processed sweet products (boiled sweets, chewing gum, ice-cream, biscuit creams and chocolates); coffee and teas; soft drinks, alcoholic beverages (lager, draft beer and wine); snacks and savories (salted peanuts, savories “chips”, packet sweet popcorn and salted popcorn); soups and broths; pâtés and sauces (mayonnaise based pâtés and white sauce).

Sleepiness measurements were made using the Karolinska Sleepiness Scale (KSS). KSS was completed by the drivers every three hours after waking up during 10 days. The KSS is self-rated and preceded by the question “How are you feeling right now?” with scores ranging from 1 to 9, classified as “extremely alert”=1, “very alert” =2, “alert” =3, “rather alert” =4, “neither alert nor sleepy” =5, “some signs of sleepiness” =6, “sleepy, but no difficulty remaining awake” =7, “sleepy, some effort to keep alert” =8, “extremely sleepy, fighting sleep, a lot of effort to remain awake” =9 [46].

Statistical Analysis

Normality was tested using the Shapiro Wilk test. Pearson’s Chi-squared test was applied to test the association between the categorical variables such as sex, age, marital status, nutritional status, drinking and smoking habits.

Dietary patterns were derived by conducting a factor analysis using principal component analysis, employing the 22 food groups as variables. The adequacy of the sample was determined using the Kaiser-Meyer-Olkin (KMO) test as a reference, with values >0.50 defined as acceptable. In order to determine the number of factors (patterns) to be retained for analysis, criteria of analysis of the *Scree Test* and *Eigenvalues* >1.5 was adopted. Three factors were retained for subsequent analyses. These factors (patterns) were named according to the food groups, factor loading scores and based on the names used in the literature on dietary patterns. Food groups with factor loadings $> |0.3|$ were considered significant.

The Linear Mixed Model was applied to check for the existence of significant differences between the mean sleepiness scores of drivers according to dietary patterns,

shift, day and time of collection (time bands) and also the effects of interaction among these variables.

All statistical analyses were performed using the SPSS 19.0 and Stata 13 software packages. A 5% level of statistical significance was adopted for all tests.

Results

In terms of gender distribution, 76.9 % (n=52) of the drivers studied were men. In addition, the short-haul (day shift) group represented the majority of the drivers, at 51.9%. A large proportion of the drivers were in the 20-39 years age group (48.0%) and most were married or lived with a partner (78.8%).

The percentage of smokers was 15.3%, while 21.1% of the drivers interviewed reported having given up smoking. With regard to use of alcoholic beverages, 51.9% of the participants reported drinking on special occasions, and higher beverage intake was evident among the long-haul (irregular shift) group (68 %). Notably, over 60% of the drivers were in the obese and overweight category. No statistically significant differences were found among the variables analyzed on the Pearson´s Chi-squared test (Table 1).

Table 1 – Sociodemographic and lifestyle characteristics of participants of study (n=52).

Variables	Long-haul (irregular shift)		Short-haul (day shift)		p (χ^2)
	N	%	N	%	
Sex					
Female	6	24.00	6	22.22	0.87
Male	19	76.00	21	77.78	
Age					
20 – 39 years	10	40.00	15	55.60	0.37*
40 - 49 years	11	44.00	7	25.90	
≥ 50 years	4	16.00	5	18.50	
Marital Status					
Single	5	20.00	6	22.22	0.84
Married/living with partner	20	80.00	21	77.78	
Educational level					
Less than 9 years	9	36.00	6	22.22	0.39
9 – 11 years	9	36.00	9	33.33	
12 years and more	7	28.00	12	44.45	
Smoking					
No	14	56.00	19	70.40	0.44*
Former Smoker	7	28.00	4	14.80	
Yes	4	16.00	4	14.80	
Alcohol use					
No	6	24.00	9	33.40	0.05*
Former Drinker	2	8.00	8	29.60	
Yes	17	68.00	10	37.00	
Nutritional status					
Normal	9	36.00	8	30.80	0.69
Overweight/ Obesity	16	64.00	18	69.20	

*Fischer's Exact test p<0.05

Three dietary patterns were derived: Traditional, Prudent and Western, explaining 34.9% of the total variance of intake. The first pattern (Traditional) consisted of foods featured in the Brazilian diet including beans, rice, bread, coffee/tea, juices, white meats, processed meats and low vegetable intake (significant negative loading). The second pattern (Prudent) was characterized by consumption of root vegetables and tubers, milk and dairy, eggs, vegetable oils and olive oil, breakfast cereals and by low intake of processed meat, fried foods and animal fat, processed sweet products,

alcoholic beverages and snacks/savories. The third pattern (Western) contained typical foods found in the modern Western diet, such as fast foods, soft drinks, pâtés and sauces, processed meat, breakfast cereals, low consumption of vegetables and white meat (Table 2).

Table 2 – Factor loadings for the three dietary patterns derived on factor analysis of drivers in second phase of study (n=52).

Food Group	Food Pattern*		
	Traditional	Prudent	Western
Fruit			
Vegetables	-0.3131		-0.4124
Beans	0.7944		
Root vegetables and Tubers		0.7038	
Rice, Bread and Cakes	0.7787		
Breakfast Cereals		0.3397	0.4727
Milk, Dairy and Eggs		0.5847	
Vegetable Oils and Olive oil		0.4623	
Juices	0.5166		
Processed Meats	0.5003	-0.3848	0.3689
White Meat	0.4760		-0.3375
Red Meat			
Pasta and Fast Food			0.7954
Fried foods, animal fat and emulsions		-0.3811	
Sugar and Desserts			
Processed sweet products		-0.3282	
Coffee and Teas	0.6074		
Soft drinks			0.4349
Alcoholic beverages		-0.6099	
Snacks and savories		-0.4836	
Soups and broths			
Pâtés and Sauces			0.6714
% Explained Variance	0.1332	0.1081	0.0987

*Only values >|0.3| and >|-0.3| shown.

The *Linear Mixed Model* analysis revealed a statistically significant difference in the levels of sleepiness between work shift types ($F=42.218$, $p<0.01$), with higher mean sleepiness scores among day workers (KSS short-haul=3.77, 95% CI 3.65-3.87) relative to irregular shift workers (KSS long-haul=3.28, 95% CI 3.15-3.40).

Examination of the overall sample, without stratification by work shift, revealed a time-of-day effect on mean sleepiness scores ($p<0.01$). The highest mean sleepiness scores were found for the early hours (00:00-02:59/03:00-05:59h with KSS=4.62, 95% CI 4.30-4.93 and KSS=4.0, 95% CI 3.75-4.34, respectively), nighttime (21:00-23:59h

KSS=4.05, 95%CI 3.84-4.25) and periods around lunchtime 12:00-14:59h KSS=3.31, 95% CI 3.11-3.51), characterizing a typical physiological pattern of variation in sleepiness over the 24-hour period (Figure 1A).

Drivers from the short-haul group (day workers) who adopted the Western diet had higher mean sleepiness scores compared to both individuals in the long-haul group (working night shifts) and drivers that had other dietary patterns who also worked during the day (short-haul)(Figure 1B). For drivers working irregular shifts (long-haul), mean sleepiness scores were similar across all three dietary patterns (KSS=3.08; KSS=3.45 and KSS=3.32). A significant interaction effect was found between dietary pattern and work shift type ($p=0.02$) (Figure 1B).

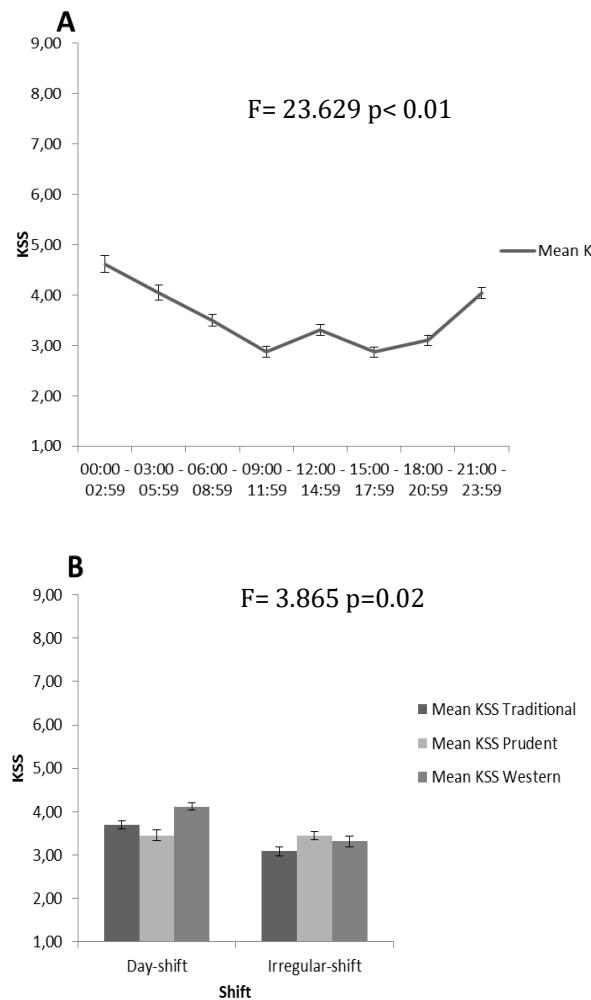


Figure 1 – Mean sleepiness score over 24-hour period (1A) and according to food pattern and work shift type (1B) among truck drivers (n=52).

Significant interaction effects were found between dietary pattern, work shift type and time of day for workers with the Prudent pattern ($p < 0.01$). The sleepiness scores showed expected variation during the 24-hour period (U-shaped curve, with greater sleepiness at night) for both the Traditional and Western dietary patterns. However, analysis of the sleepiness curve for the Prudent pattern revealed a delay in the peak compared to the other patterns, with the highest mean scores occurring between 03:00 and 05:59h as opposed to around midnight (Figure 2A). Drivers working irregular

shifts had no major variations in mean sleepiness scores during working hours when comparing the three dietary patterns (Figure 2B).

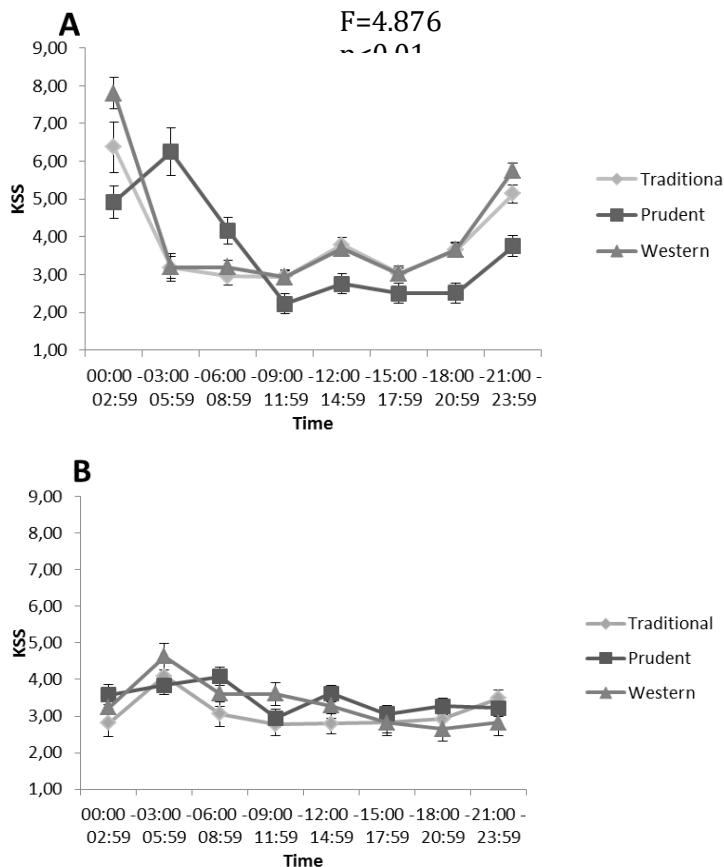


Figure 2 – Mean sleepiness in day-shift (2A) and irregular-shift (2B) drivers according to dietary patterns: Traditional, Prudent and Western (n=52).

Discussion

Three different dietary patterns were found among the drivers assessed in the present study. The first pattern (Traditional) was characterized by beans, rice, bread, coffee, tea, juices, white meat, processed meats and inverse correlation with vegetable intake. The second pattern (Prudent) was characterized by root vegetables and tubers, milk and dairy, eggs, vegetable oils and olive oil, while the third pattern (Western) included fast foods, soft drinks, pâtés and sauces, and processed meats. Moreover, the

present results showed an interaction among dietary pattern, work shift type and time of day. In other words, besides the expected effect in which sleepiness varies with shift type and time of day, an association was also detected between diet and sleepiness, with the Prudent pattern differing slightly to the others.

Also noteworthy is the flattening of the sleepiness curve, irrespective of diet, seen among the drivers from the long-haul group. This is likely due to the fact that, associated with these changes in dietary intake, the sleep deprivation common in night workers can exacerbate metabolic disturbances, such as glucose intolerance, insulin resistance and dyslipidemia [14]. On top of this, there is also circadian disruption manifested by changes in the sleep-wake cycle [47]. In this case, although the increased homeostatic pressure of sleep during wake state is expected to promote greater sleepiness during work shifts, the opposite occurs. By contrast, an increase in circadian pressure negatively influences sleep onset, despite homeostatic pressure due to sleep debt. Consequently, drivers remain alert during work and also have problems getting to sleep during time off, with a greater pressure for wake state than for sleep.

Human beings are naturally diurnal individuals, and they should be fasting at night, with endogenous mobilization of glucose into the blood stream. This explains why night workers generally have lower appetite, indigestion and gastrointestinal diseases, since many metabolic functions follow a pattern of circadian rhythm, including digestion, absorption and storage of nutrients [48,49]. Irregular shift work (including work at night) is also associated with a number of different health problems caused by changes in the endogenous timing system, particularly cardiovascular diseases [50]. In addition to these aspects, irregular shift workers have no set routine, hampering the maintenance of regular habits of physical activity and eating meals at the

proper time [51-54]. These factors lead to a high prevalence of overweight and obesity, a phenomenon also observed among the drivers assessed in the present study. Furthermore, the literature reports negative lifestyle habits associated with this group of workers, such as alcohol use and smoking. In conjunction, these variables are major causes underlying the development of chronic diseases such as obesity, diabetes, cancer and circulatory diseases [55,56].

Regarding dietary intake and night work, the literature indicates the adoption of unhealthy diets in terms of nutritional value, based on the consumption of fast foods, caffeine-rich drinks, soft drinks, chocolates and lower intake of fish and fruit by this group of workers [57,58]. This behavior is evidenced in the results of the present study by a Western dietary pattern characterized by the consumption of fast foods, processed meats and soft drinks. Another aspect typically found in the diet of individuals working irregular shifts, especially night shifts, is a diet with a nutritional composition that is carbohydrate-rich promoted by high intake of sweet products, bread and foods derived from grains. In a previous study, Nishiura et al. [59] reported that the preference for foods rich in fats, the habit of skipping the first meal of the day and eating outside the home increased with shorter sleep duration among workers. According to Gallant et al. [60], individuals that practiced night eating tended to choose tastier foods with a high glycemic level and rich in fats. Intake of these types of foods has a negative impact on post-prandial glucose metabolism with possible disruption of the peripheral circadian system, such as internal desynchronization.

The patterns found in this study have been previously described by the national and international literature [61-64]. The Western pattern has been associated with the parameters abdominal obesity, arterial hypertension and changes in metabolism of lipids

and glucose, as well as with coronary diseases and metabolic syndrome [65-70]. The Prudent pattern, considered the closest to a healthy pattern in the present sample and comprising foods considered beneficial for health, has been associated with lower prevalence of hypertension and lower levels of markers for cardiovascular diseases [71]. The Traditional pattern comprising rice and beans is considered healthy by the Ministry of Health [5] and has been associated with lower triglyceride values and waist-hip ratio [72].

The relationship between food intake, sleepiness and performance has not yet been clearly elucidated in the literature. In general, studies affirm a reduction in state of alertness after food intake [73-75]. Landström et al. [76], however, highlighted that the effects of macronutrients on sleep and performance are relatively tiny and weak compared to light/dark cycle, for instance.

Studies investigating this line of research have reported that carbohydrates, as well as meal times, have a strong effect on metabolism and internal rhythms [77, 78]. A study by Nehme [18] in security guards found an association between sleepiness levels and carbohydrate intake among obese individuals. The study suggested that obesity mediated the effect of carbohydrates on sleepiness and sleep duration in the workers studied. Similarly, a time-of-day effect on sleepiness was also found in the present study.

Given this scenario, the methodology employed in food pattern analysis allows the investigation of plausible relationships between dietary variables and a number of health conditions. The advantages of this method lie in the fact that global assessment of usual diet, as opposed to specific assessment of nutrients, is the greater ability to predict risk of diseases owing to several aspects such as lower chances of error due to erroneous

associations, reduced confounding effects by lifestyle-related variables and by encompassing complex interactions and correlations among nutrients that can alter their bioavailability action with the organism [79-82]. Nevertheless, a few limiting factors in the method of dietary pattern analysis should be mentioned. These factors include: the subjective nature of factor analysis affecting the consolidation of food items and composition of food groups; the number of factors to be retained along with their classification [83]; and the impossibility of drawing isolated causal inferences since these are based on the existence of correlations among variables [84,85].

The results found in the present study revealed the adoption of very different dietary practices among the drivers, yet these remain consistent with dietary patterns found in the general Brazilian population. In addition, the initial findings suggest an association of diet with sleepiness, particularly for the Prudent pattern. This relationship warrants further investigations by future studies to describe this relationship more fully. Recommendations and dietary guidelines for irregular-shift workers should also be defined to improve their quality of life in the workplace and attenuate the risk of non-communicable chronic diseases.

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Conflicts of interest

The authors declare no conflicts of interest.

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6.3 Artigo 03 – Lifestyle, environmental and social effects that affect body mass index (*Futura submissão ao periódico Current Biology*).

O terceiro manuscrito apresenta os resultados mais relevantes comparando trabalhadores rurais e urbanos da comunidade amazônica no que se refere ao sono, ritmos biológicos e alterações metabólicas.

Lifestyle, environmental and social effects that affect body mass index.

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Abstract

Background: The urbanization process has been associated with an increase in risk factors to non-communicable diseases. *Aim:* To evaluate the sleep, biological rhythms and metabolism among workers of an Amazonian community of Acre, according to different degrees of urbanization. *Methods:* A cross-sectional study of rural and urban residents (22 and 20, respectively) from the municipality of Xapuri, Acre. Sociodemographic, life habits, anthropometric, metabolic parameter variables (triglycerides, total cholesterol and fractions, fasting glucose and insulin resistance), chronotype and food intake were evaluated. Sleep, light exposure and activity levels variables were obtained by actigraphy and daily activity protocols during 10 days. The studied groups were compared with Student's t and Mann-Whitney tests for anthropometric variables, food intake and metabolic parameters. ANOVA for repeated measures tests were performed to compare the sleep variables, light and acitivity levels between groups. *Results:* Urban residents showed higher averages to all anthropometric variables, fasting glucose levels, fasting insulin and insulin resistance ($p<0.05$) when compared with rural residents. The lipid profile showed no statistically relevant differences among the groups. Rural residents showed higher averages of sleep length ($p<0.01$) and earlier sleep onset ($p=0.01$). *Conclusion:* The findings show an association between urbanization and the presence of risk factors like overweight, serum lipid level alteration, and insulin resistance.

Keywords: urbanization; non-communicable diseases; metabolic parameters; sleep; rural communities.

Introduction

Non-communicable diseases are considered a significant concern in the context of global public health and are a problem in both developed and developing countries (ALI et al., 2015; ALWAN, 2011). According to the World Health Organization (WHO), in 2015, more than 17 million people died victims of these diseases. Of these deaths, 82% occurred in developing countries and 37% were caused by cardiovascular diseases.

The urbanization process has been associated with substantial changes in the population's lifestyle, such as reduction of physical activity, adoption of nutrient-poor diets, sedentary work processes, exposure to artificial light and reduction of sleep duration (LUYSTER et al., 2012; HAWKES, 2006; CABALLERO, 2005). These have been identified as responsible for the increase in risk factors (dyslipidemias, obesity, hypertension, insulin resistance) for the diseases mentioned above (THOMAS & MICHAEL, 2012; POPKIN, 2015). The proportion of the urban population increased from 13% in the early 20th century to almost 50% in 2005 (KEARNEY, 2010). According to the World Cities Report, published by the United Nations in 2016, 54% of the world's population lives in urban areas. The report also notes that this growth trend has remained steady for the last 20 years, especially for developing nations, comprising Asian, Latin American and African countries (UNITED NATIONS HUMAN SETTLEMENTS PROGRAM, 2016). Recent studies show the relationship between the progress of the urbanization process in small cities and their impact on sleep quality when compared to rural populations and hunter-gatherer communities. Beale et al. (2017) when comparing sleep between a rural and urban community in Mozambique, found delays in sleep start times between urban

and rural dwellers. Moreno et al. (2015) in studying sleep patterns among rubber tappers in the Amazon observed a reduction in sleep duration among participants with access to electricity compared to the group without access. De la Iglesia et al. (2015) studying two indigenous communities of hunter-gatherers in Argentina, also reports shorter sleep duration among groups with access to electricity.

Several published studies show the relationship between short sleep duration and later sleep timing at the highest body mass index (BARON et al., 2011; ROENNEBERG et al., 2012, GONNISSEN et al., 2013, LUCASSEN et al., 2013, ARORA & TAHERI, 2015). As well as data from animal and human models emphasize that exposure to light may have the ability to modulate metabolism, especially in appetite regulating hormones, as well as body weight and body composition (DUNAI et al., 2007; FONKEN et al., 2010; FIGUEIRO et al., 2012; DANILENKO et al., 2013; COOMANS et al., 2013).

In this way, understanding the sleep patterns among groups that undergo an initial process of urbanization in comparison with rural communities is fundamental to a better understanding of the impacts of urbanization on human health, especially in the context of non-communicable diseases. The northern region of Brazil, especially the Amazon region, presents the ideal characteristics for this type of study, since part of its population resides in rural areas without access to electricity, and at the same time, it has small cities in initial stages of industrialization and access to the facilities of modern life, as well as the way of life of industrialized human societies.

From the above scenario, the aim study is to evaluate the sleep, biological rhythms and metabolism among workers of an Amazonian community of Acre, according to different degrees of urbanization.

Methods

2.1 Study sample and design

It is a cross-sectional study developed through the collection and analysis of sociodemographic data, life habits, anthropometrics and biochemical indicators of metabolic profile. The research was conducted between September and October 2015 and July and August 2016.

The total sample of the study ($n = 42$) consisted of two distinct groups: 1) rural workers ($n = 22$), resident in the extractive reserve of Chico Mendes located in the municipality of Xapuri; 2) urban dwellers ($n = 20$) from the same town, employed in the education and services sector. Currently, the city of Acre, in the northern region of Brazil, has 16,091 inhabitants in an area of 5,347,446 km², of which 5,761 are from the rural area and 10,330 (64%) from the urban area (IBGE, 2010).

As inclusion criteria for town volunteers were prioritized: male individuals, who lived and worked in the city. In addition, they should only have daytime work schedules. For exclusion criteria of the same group were defined: being female, shiftwork and presenting sleep disorders. For residents of the extractive reserve, as inclusion criteria were considered: residing and working in the extractive reserve (in activities such as extraction of latex, chestnut, subsistence agriculture and raising small animals), have electric light in the residence.

2.2 Variables

Socio-demographic and lifestyle questionnaire

Data on socio-demographic aspects were collected, such as age, sex, schooling, marital status, and number of people in the residence, presence of children under 18 years of age and life habits (physical activity, smoking and alcohol intake).

Nutritional Status

The body mass index (BMI = body mass / height², kg / m²), recommended by the World Health Organization (WHO, 2000), was used to evaluate the nutritional status of the study population. BMI was categorized according to the following cutoff points for the classification of subjects: low weight (BMI <18 kg / m²); eutrophy ≥ 18.5 kg / m² and <25 kg / m²; overweight ≥ 25 kg / m² and <30 kg / m²; obesity ≥ 30 kg / m².

As complementary information to the diagnosis of obesity in the population, the cut-off points for waist circumference (WC) proposed by the Brazilian Society of Cardiology (2013) were used, which defines as risk for metabolic morbidities, therefore abdominal obesity for WC ≥ 90 cm in men. Body fat index, visceral fat index and metabolic age were provided by the Tanita® (BC 543) digital scale.

Metabolic Parameters

Biochemical tests were performed by blood sample collection by a trained nurse. The parameters analyzed in the present study are: fasting glucose, fasting insulin, triglycerides, total cholesterol and fractions. The collected blood samples were transported according to all transport protocols of biological material to the state capital of Acre, Rio Branco for analysis by authorized laboratory. For the analysis of the lipid profile, the references of the Brazilian Dyslipidemias

Directive were used, which establish as high triglyceride values $\geq 150\text{mg} / \text{dL}$, total cholesterol $\geq 200\text{mg} / \text{dL}$, LDL-cholesterol $\geq 100\text{mg} / \text{dL}$, as well as HDL cholesterol $< 40\text{mg} / \text{dL}$ as low values (BRAZILIAN SOCIETY OF CARDIOLOGY, 2013). For fasting glycemia, reference values above $100\text{mg} / \text{dL}$ were used as values altered according to the Brazilian Diabetes Society (2016).

Insulin resistance was calculated using the HOMA-IR (*Homeostasis Model Assessment*) formula proposed by Matthews et al. (1985). High values above 2.71 were considered, according to the study by Geloneze et al. (2006) for the Brazilian population.

Actigraphy

To investigate sleep patterns, light exposure and activity levels, participants used non-dominant pulse accelerometers for 10 consecutive days. The accelerometer consists of a device that contains an accelerometer and light and temperature sensors and records the ambient light, ambient and skin temperature, and activity levels at 60-second intervals (*MotionWatch 8 CamNtech and ActTrust Condor Instruments*). The data obtained by the use of accelerometers were complemented by information from a protocol of daily activity, completed by the participants of the research, with the aid of the researcher when necessary. This protocol consisted of a 24-hour schedule divided into 15-minute intervals, which presented the following activities: work, transportation, meal or snack, play and other leisure activities. The raw data of the equipment has been checked and corrected for any inconsistencies according to the information contained in the activity protocols and subsequent edition of the instruments in the Philips Actware 6.0.5 software (*Philips Respirationics®*).

After edition of all the actograms, the variables related to sleep for work days and days off were estimated. The variables analyzed were: sleep onset, wake up time, sleep length, and midsleep, calculated by the sum of the start time of sleep with total sleep duration divided by two.

Munich ChronoType Questionnaire (MCTQ)

This MCTQ addresses questions about sleep duration, exposure to light considering work time and free time, as well as a self-assessment of the chronotype (ROENNEBERG et al., 2003). According to this questionnaire, chronotype is defined by midsleep on days off, taking into account the number of days of work and days off, which can be calculated by the following formula: $MSFc = MSF - 0.5 * (SDf - (SDw * 5 + SDf * 2) / 7)$. MSF is the midsleep on free days without correction; SDf is sleep duration on free days; SDw is sleep duration on working days.

The *social jetlag* was calculated by the absolute difference between midsleep on workdays (MSW) and midsleep on free days (MSF) (WITTMANN et al., 2006).

Food Intake

To evaluate food consumption we performed the 24-hour food recall (R24h), an instrument that allows food consumption to be quantified in the 24 hours of the day before the interview, during 3 days: 2 days of work and 1 day of rest.

The data collected by R24h were previously checked for information quality. Standardized quantification of foods and beverages in grams, milligrams and milliliters was performed. After this step, the data were computed and converted to

energy and macronutrients (carbohydrates, proteins and fats) using the Nutrition Data System for Research version 2016 software (NUTRITION COORDINATING CENTER, UNIVERSITY OF MINNESOTA, 2016). Typically Brazilian foods and preparations that were not included in the program had their nutritional values inserted according to information from the national table (TACO).

2.3 Statistical Analysis

The distribution of the variables was evaluated by the Shapiro Wilk test. Fisher's exact test was used to verify the associations between the following categorical variables: marital status, schooling, presence of children under 18 years of age, alcohol intake, smoking, physical activity, BMI, CC, fasting glucose, triglycerides, total cholesterol, LDL-cholesterol and HDL-cholesterol.

Student's t test (and its non-parametric equivalent) was performed for independent samples in order to compare data between the two groups (urban and rural) for the following variables: age, BMI, WC, body fat, visceral fat, muscle mass, metabolic age, fasting glucose, fasting insulin, triglycerides, total cholesterol, LDL-cholesterol, HDL-cholesterol and energy (Kcal).

ANOVA for repeated measures were performed to test the main effects and the interaction between day of week (week days and days off) and rural/town groups on sleep onset, wake up time, sleep length and midsleep. ANOVA for repeated measures were performed to test the main effects between rural/town groups and time of day (hour) on activity levels and light exposure on work days and days off.

Spearman's correlation tests were performed between variable: social jetlag, midsleep (MSFc), body mass index (BMI) and energy intake (Kcal) of rural and urban participants.

The Stata14 software program (Stata Corporation, College Station, TX, USA) was used for all analyses. A p-value <0.05 level of statistical significance was adopted for all tests.

2.4 Ethical Aspects

The study was approved by the Research Ethics Committee of the Faculty of Public Health of the University of São Paulo (CAAE: 44860515.0.0000.5421), and the study was carried out in accordance with the ethical standards laid down by the National Health Council (Resolution 466 of December 12, 2012) (BRASIL, 2012). Volunteers, after being clarified about the research objectives, signed an informed consent.

Results

The overall median age of the study sample was 42.5 years, IQR (38.00-50.00). In the division by groups the median age varied between 43.50 years, IQR (37.00-49.00) for urban individuals and 42.00, IQR (39.00 - 57.00) among the rural ones. No significant statistical differences were found between the groups (Mann-Whitney test, $z = 0.971$ $p = 0.332$).

Rural residents have a higher prevalence of smoking and half of the sample is addicted to smoking. There were significant statistical differences between rural and urban participants in terms of education ($p = 0.000$) and physical activity ($p = 0.040$) (Table 1).

Table 1. Demographic data lifestyle of rural and town subjects (n=42). Fischer's Exact test, *p<0.05

Variables	Town (n=20)		Rural (n=22)		p-value*
	N	%	N	%	
Marital Status					
Single	3	15.00	3	13.64	n.s
Married/living with partner	17	85	19	86.36	
Educational level					
Primary education uncompleted	1	5.00	20	90.91	p=0.000
Primary education concluded	19	95.00	2	9.09	
Children under 18 years					
Yes	16	80.00	17	77.27	n.s
No	4	20.00	5	22.73	
Smoking					
No	19	95.00	14	63.64	p=0.022
Yes	1	5.00	8	36.36	
Alcohol use					
No	13	65.00	11	50.00	n.s
Yes	7	35.00	11	50.00	
Physical Activity (leisure time)					
Yes	9	45.00	3	13.64	p=0.040
No	11	55.00	19	86.36	

When evaluated as to fasting glucose levels, fasting insulin and Homa-IR index, urban individuals stand out among the highest values, with significant differences compared to rural ($p <0.05$) (Figure 1 B, C and D). No significant statistical differences were observed between the levels of triglycerides, total cholesterol and fractions between urban and rural (Figure 1 A).

However, the values in Figure 1 highlight a trend of higher values among town residents, except for HDL-cholesterol, which demonstrate a higher value among rural residents, as a protective factor for cardiovascular diseases.

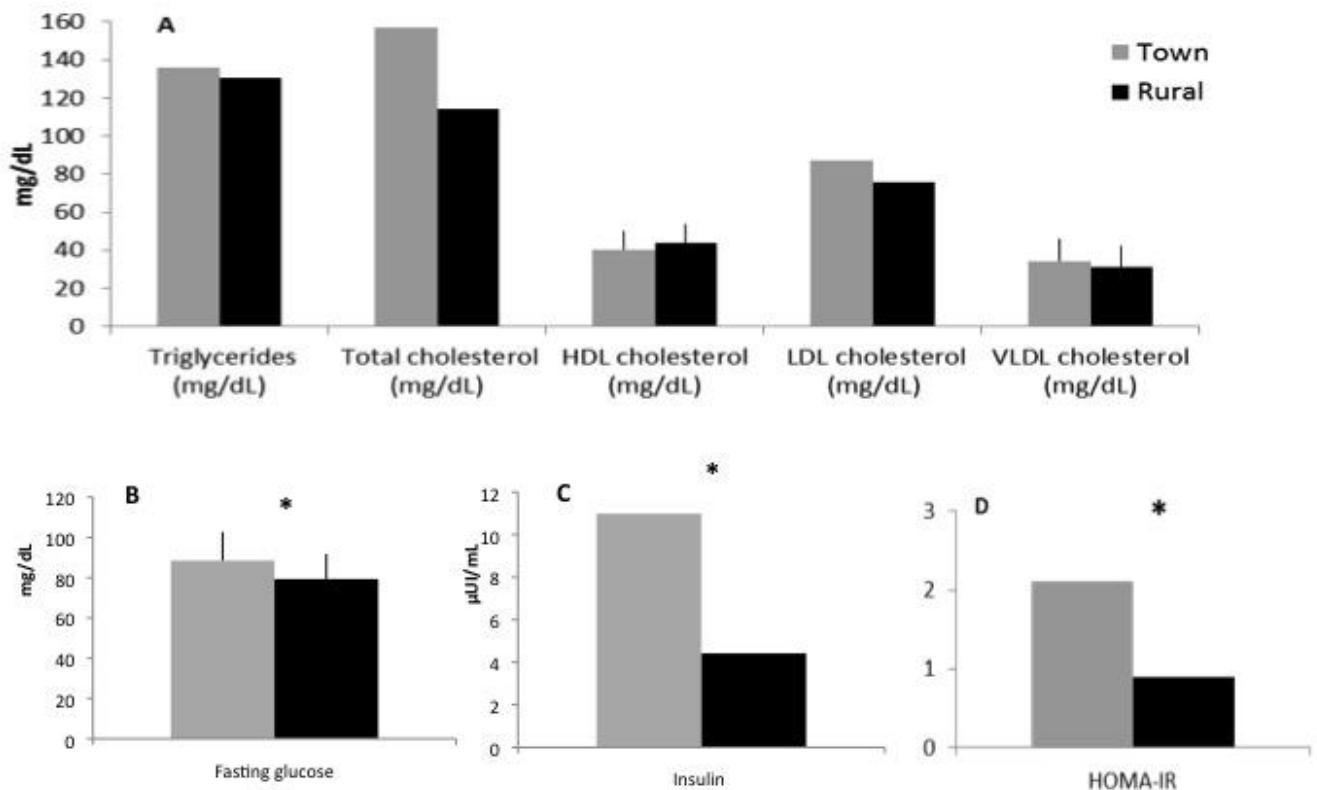


Figure 1. Lipid profile, glucose and insulin profile among town (n=20) and rural (n=22) participants. Student's t test or Mann-Whitney test. * $p<0.05$.

Town participants presented significantly higher values in relation to rural ones for all anthropometric variables ($p <0.05$), showing higher values of body fat, and consequently more indicators for overweight, obesity and metabolic risks (Figure 2 A, B, C, D and E).

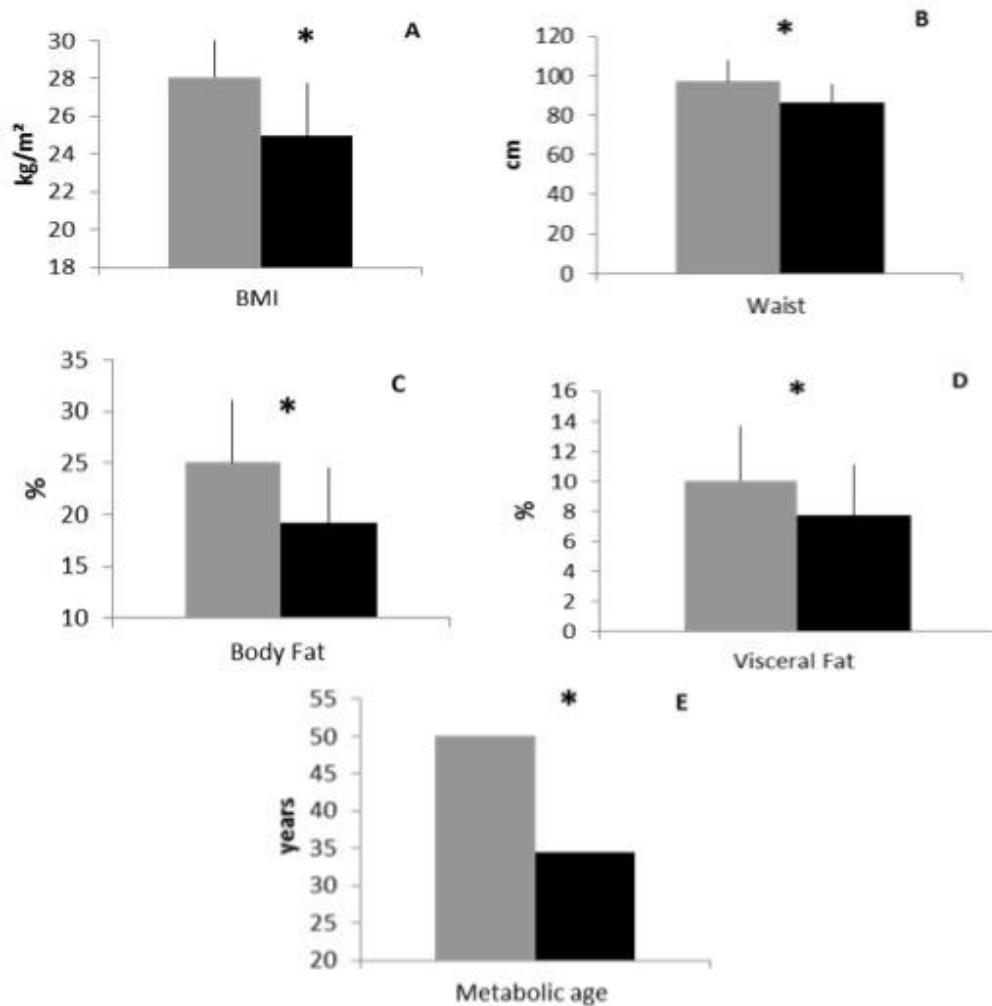
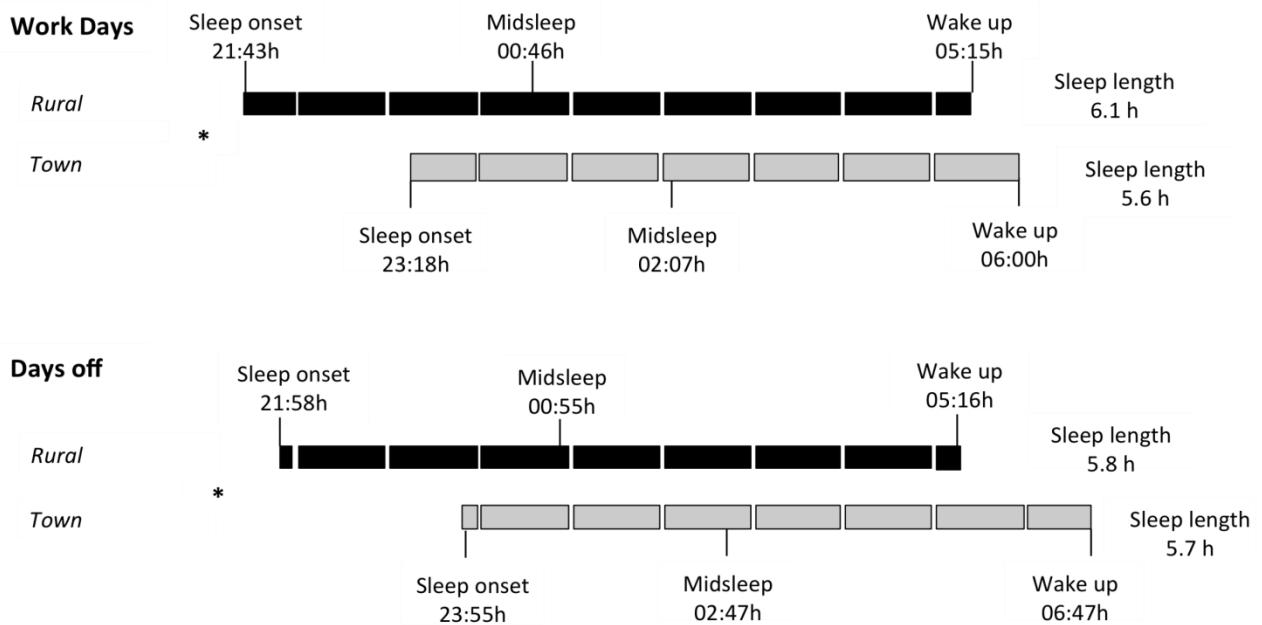


Figure 2. Anthropometric variables among town (n=20) and rural subjects (n=22). Student's t test: A, B ,C and D. Mann-Whitney test: E .* $p<0.05$.

Town residents showed lower averages of sleep length ($F=15.30, p=0.0004$) during work days; later sleep onset ($F=28.30, p<0.0001$; $F=23.18, p<0.0001$), later wake up time ($F=5.11, p=0.0299$; $F=25.15, p<0.0001$) and midsleep ($F=25.89, p<0.0001$; $F=41.99, p<0.0001$) during work and days off (Figure 3).



*p<0.05

Figure 3. Sleep patterns according work and days off among town (n=20) and rural (n=22) participants.

Individuals in rural areas were exposed to natural light once their work activities occur in the field, with activities related to land management. Among urban participants, there is less exposure to natural light, since work activities take place in enclosed spaces, such as schools and public offices (Fig. 4A). In both groups, there are higher levels of activity during the day, however, for the rural zone, higher values of activity levels compared to urban areas were observed, with significant differences between groups during working days (Fig. 4B).

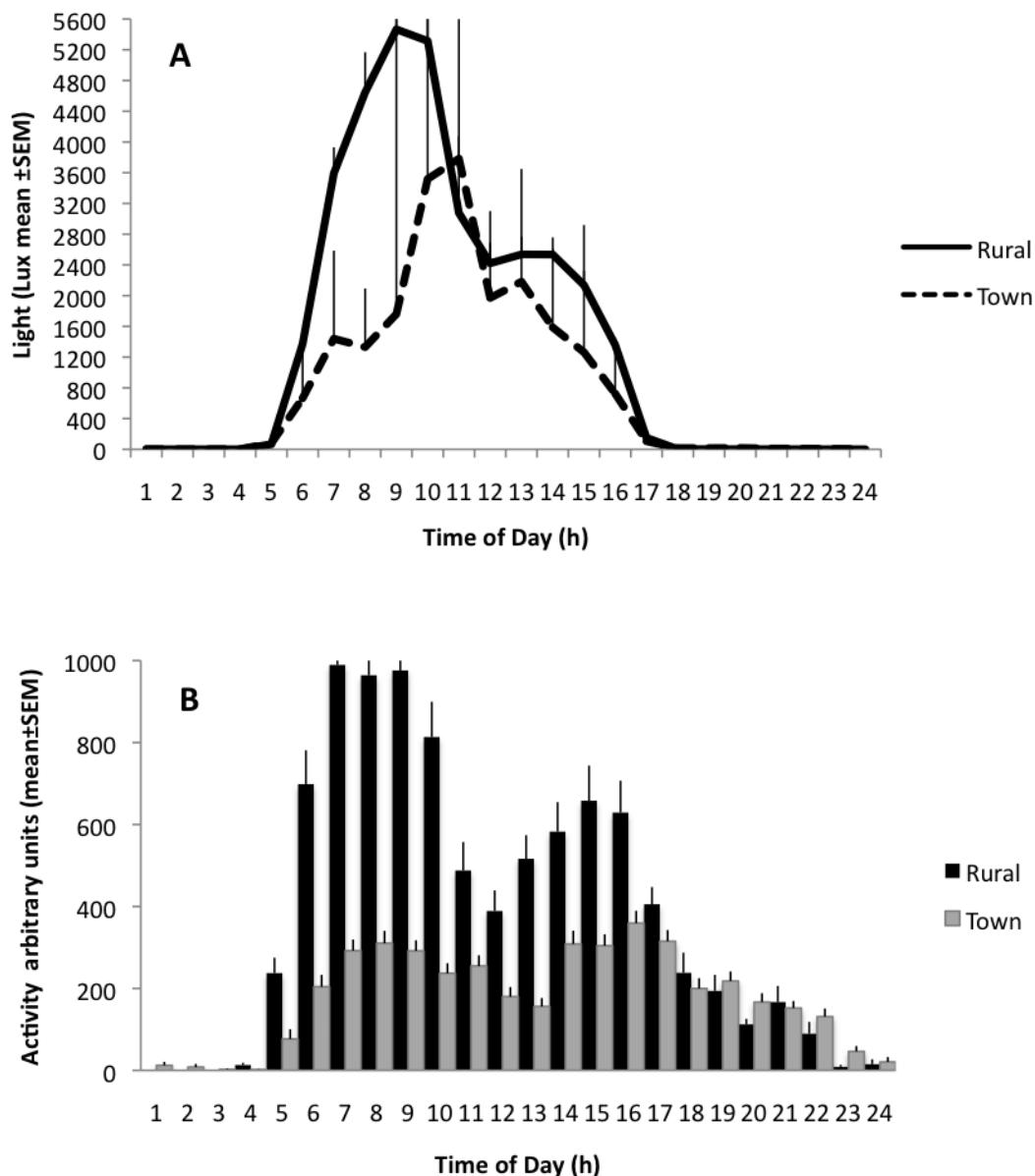


Figure 4. Light (A) and activity levels (B) per hour during work days of rurals and town participants ($n=42$). *Repeated measures ANOVA* show significant differences in activity levels ($F=17.81$, $p=0.0003$; $F=3.20$, $p=0.0036$) and light exposure ($F=10.18$, $p=0.0041$; $F=10.49$, $p<0.0001$) between the two groups and time of day.

For days off, no significant differences were found between groups (rural and town residents) for light exposure (Fig. 5A). However, for the activity levels, residents of the rural area presented higher values in comparison to the urban ones, with statistical significance (Fig. 5B).

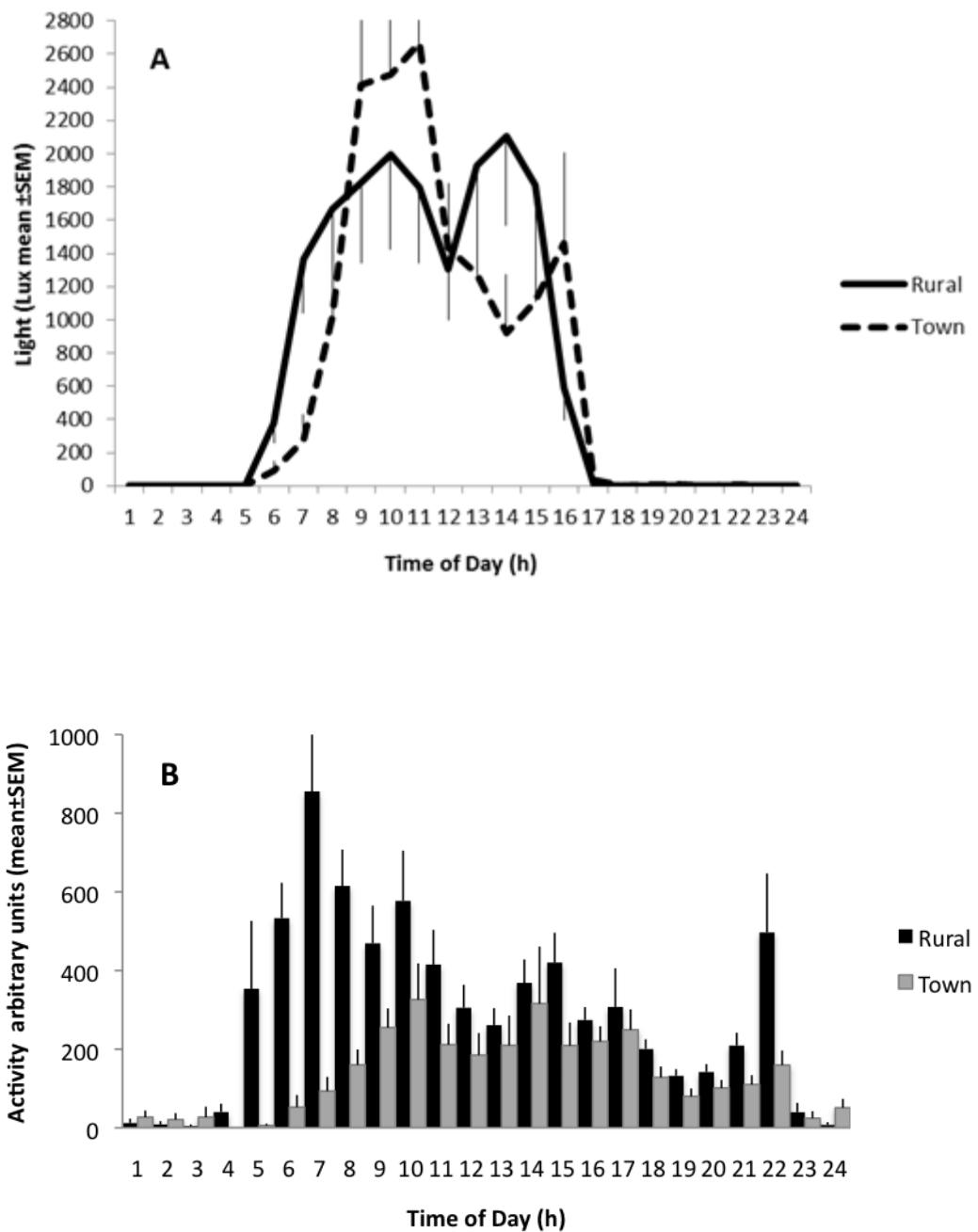


Figure 5. Light (A) and activity levels(B) per hour during days off of rurals and town participants ($n=42$). *Repeated measures ANOVA* show significant differences in activity levels ($F=15.79$, $p=0.0006$) and no differences in light exposure ($F=0.40$, $p=0.5322$) among two groups. Significant differences were found for time of day in activity levels ($F=2.19$, $p=0.0330$) and time of day for light exposure ($F=10.77$, $p<0.0001$).

From the calculation of social jet lag, possible correlations between midsleep (MSFc), body mass index (BMI) and energy intake (Kcal) of the participants were tested. However, no significant correlations were found ($p < 0.05$) (Fig 6, 7 and 8).

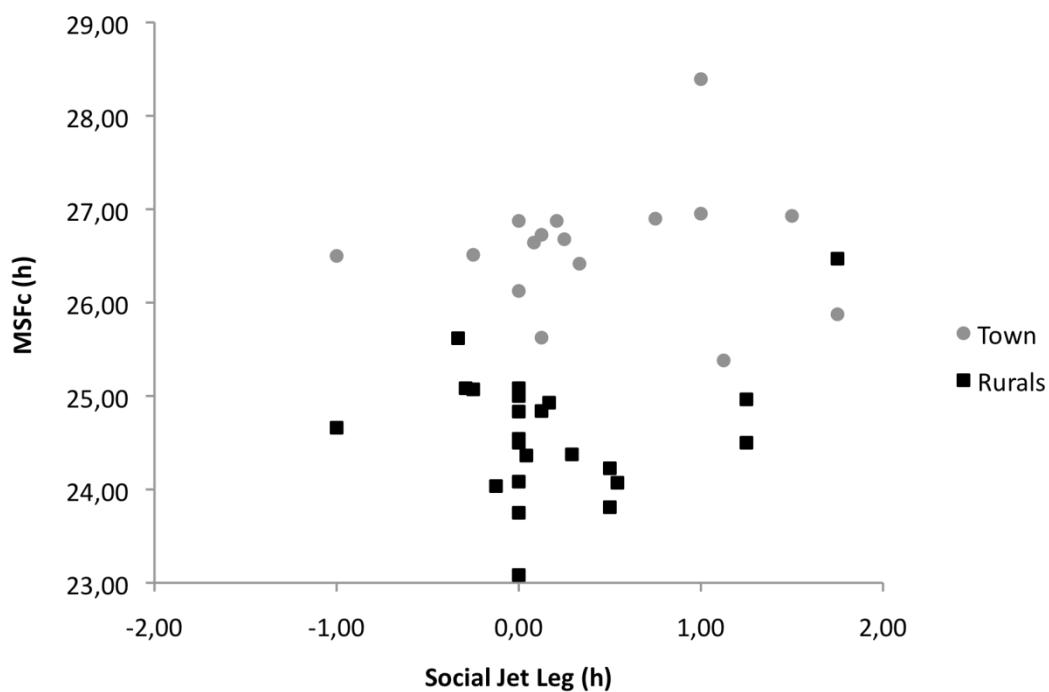


Figure 6. Social jet lag (decimal hours) and midsleep (MSFc - decimal hours) calculated from Munich questionnaire for town (n=20) and rural residents (n=22). Spearman's rho = 0.2238, p=0.1709.

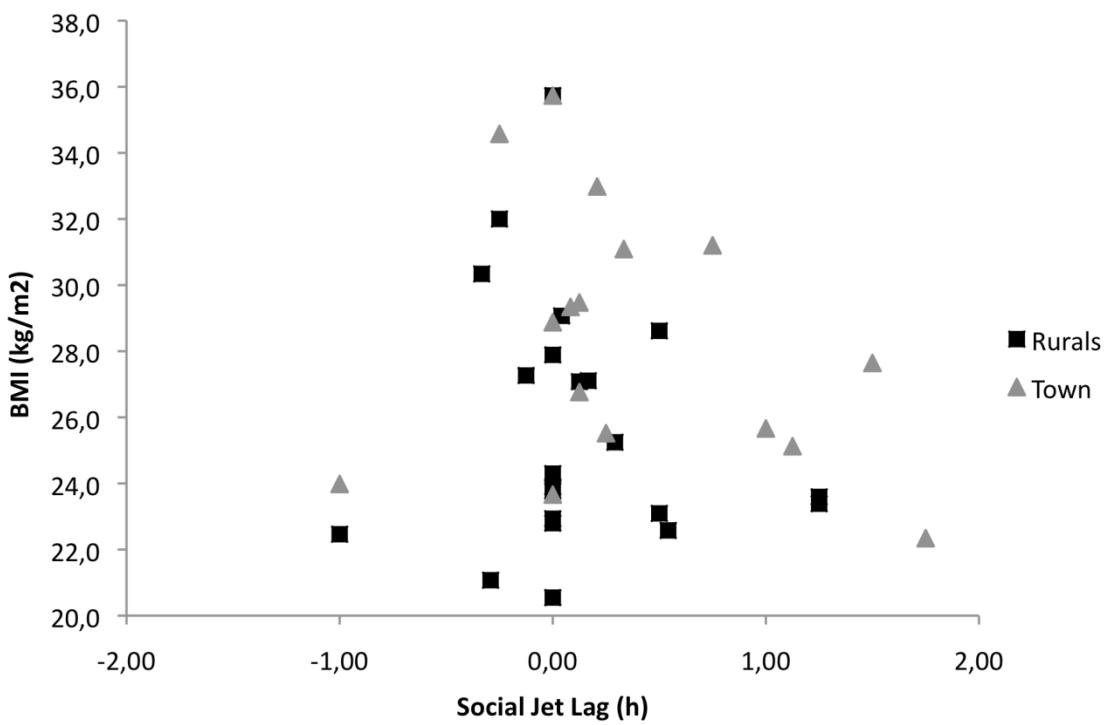


Figure 7. Social jet lag (decimal hours) and body mass index (BMI) for town (n=20) and rural residents (n=22). Spearman's $\rho = -0.1745$, $p=0.2881$.

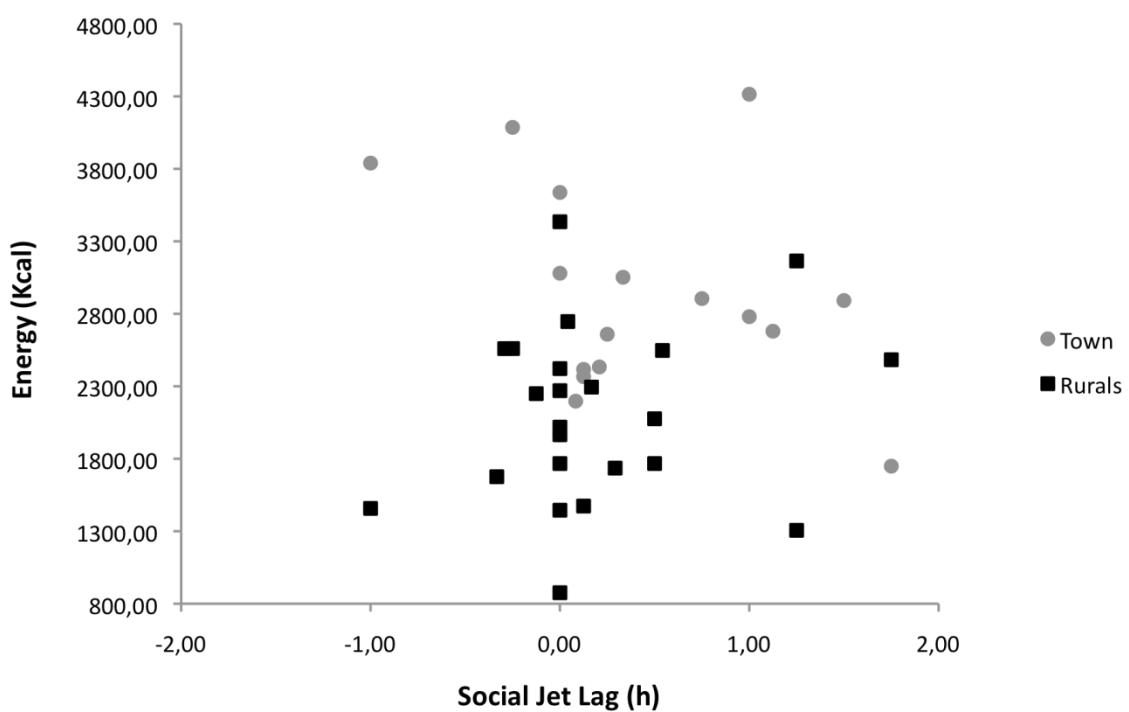


Figure 8. Social jet lag (decimal hours) and daily energy intake (Kcal) for town (n=20) and rural residents (n=22). Spearman's $\rho = 0.0899$, $p=0.5865$.

Discussion

Increasing modernization and urbanization in Brazil reach many distant regions and communities, bringing with them changes in life habits that can impact health population, increasing metabolic risks, as well as the development of cardiovascular diseases and the reduction of quality of life. According to Malik and collaborators (2013), the negative consequences of the urbanized lifestyle are the result of profound changes related to technological advances, intense mechanization, changes in housing environment, greater availability and food options, reduction of sleep duration and greater availability of social activities in the night time period. All these aspects together impact the quality of the diet, significantly reduce daily energy expenditure and contribute to increase obesity.

In our research, we describe the differences between an urban and rural population in aspects related to nutritional status, especially overweight and obesity, as well as metabolic factors associated with the risk of non communicable diseases and sleep quality. Our findings reinforce the presence of overweight and obesity among town residents, as well as important biochemical markers for altered metabolic diseases (fasting glucose, fasting insulin and insulin resistance by the Homa-IR index).

Studies have shown a strong relationship between the urbanization process and the presence of non-communicable diseases, especially associated risk factors, such as overweight, high blood pressure, changes in serum lipids and insulin resistance (FATEMA et al., 2016; NOVAK et al., 2012; ALLENDER et al., 2010; MONDA et al., 2007). Non-communicable diseases, such as cardiovascular diseases and diabetes, have a huge impact on socioeconomic development, especially for

developing countries, as it affects the economically active population, resulting in lost productivity (ALWAN & MACLEAN, 2009; NUGENT, 2008; LLOYD-WILLIAMS et al., 2008).

On the other hand, our findings reveal rural habitants in adequate weight and without the presence of metabolic alterations. However, they show lifestyle habits recognized as deleterious, such as the high prevalence of smoking and alcohol consumption. The literature reports that rural work, which in itself requires greater physical strength and lower educational level, may contribute significantly to a lower prevalence of cardio-metabolic risk factors among communities, since levels of physical effort in work activities are higher compared to work activities in cities (OBIRIKORANG et al., 2015; ASSAH et al., 2015; ASSAH et al., 2011; GREGORY et al., 2007; FORD et al., 1991).

In Brazil, this tendency is particularly observed in the North and Northeast regions, so that physical activity is carried out as a function of work and transportation to the same and not aimed at improving the quality of life (KNUTH et al., 2011), fact this is evidenced in our findings.

Also in this context, we highlight our results regarding sleep patterns, characterized by a delay in sleep offset and waking up hours, as well as a shorter sleep duration among the urban community when compared to the rural ones. However, the quality of sleep of rural residents is worse, since they present a more fragmented sleep and a high number of nocturnal awakenings (*data not shown*).

Once again, the literature shows the relationship between the intense physical effort in rural work and the quality of sleep. Martins et al. (2016) in a study with a similar population in the Amazon found the presence of musculoskeletal pain due to the work effort associated with the presence of sleep disorders. Moreno et al. (2016)

also show that rural work is an important predictor for insomnia and musculoskeletal pain.

Benjamini et al. (2016) when describing the quality of sleep in a Brazilian rural population found a high prevalence (34.9%) of poor sleep quality. According to the authors, high prevalences for poor sleep quality are a common finding in rural communities marked by strenuous work activities. Another study in rural communities and in small African cities found worse sleep quality among rural ones due to the worse conditions of the sleeping places and also the intense work activity. In addition, residents of the small city with access to electricity also present delays in sleep onset (BEALE et al., 2017). The authors of the study also point out that some aspects of the urban environment can have beneficial effects on sleep, such as access to more comfortable sleeping places, safer homes, adequate room temperature, etc.

In our study, urban residents have labor activities with less physical effort and access to more comfortable environmental conditions for the promotion of sleep, corroborating the recent literature findings mentioned above.

However, even in the face of possible benefits generated by urbanization, our findings demonstrate a shorter duration of sleep, later sleep onset, later wake up time, less light exposure during work days, body mass in the scientific literature and reinforced by our findings among urban participants.

Patel and Hu (2008) in an important review study showed that shorter sleep duration increases the risk for obesity. It is well described in the literature that sleep deprivation reduces leptin levels and increases ghrelin levels, thus altering metabolism, altering satiety and contributing to increased obesity (SPIEGEL et al., 2004; PATEL et al., 2006; GOLLEY et al., 2013).

In addition to sleep, exposure to light has been a recurring research topic associated with obesity. According to Reid and co-workers (2014), exposure to moderate light levels at biologically appropriate times may influence body weight regardless of sleep duration and time of onset. Obayashi et al. (2016), in a cohort study, demonstrated that exposure to light during the night and reduction of light exposure throughout the day were associated with an increase in obesity indicators in the elderly population evaluated regardless of sleep duration, sleep onset and sleep disease. It was estimated a 10% increase in BMI and 10.2% in waist / hip ratio in 10 years. For the authors, increasing nocturnal light and reducing exposure to natural light are common features of modern society and an important risk factor for obesity to be considered for the health of the population.

One of the possible mechanisms that explain the direct relationship between light exposure and body weight independent of caloric intake may be the influence of light on the secretion of hormones, such as melatonin. Exposure to daylight may alter nocturnal levels of melatonin and the sensitivity of the circadian oscillator to light. These factors may influence the metabolism and control of body weight (SMITH et al., 2004; CHANG et al., 2011; OBAYASHI et al., 2012).

Changes in melatonin concentrations may also affect insulin sensitivity, and studies in humans have shown that suppression of this hormone in the body (by excessive night light for example) is a risk factor for type 2 diabetes (PESCHKE et al., 2013; ZANUTO et al., 2013, McMULLAN et al., 2013). This fact also corroborates the findings of our research, since hyperglycemia and higher insulin resistance profile was observed among the residents of the small city, with greater access to modern facilities and greater exposure to light at night during working days.

Another important aspect to be discussed in the genesis of weight gain is dietary intake. Several studies, both in humans and in animal models, state that eating foods at times when they should be reserved for sleep can lead to overweight and metabolic diseases (COLLES et al., 2007; ARBLE et al., 2009; SALGADO-DELGADO et al., 2010; BARON et al., 2013).

According to McHill et al. (2017), when evaluating 110 adult subjects, the food intake schedule related to the onset of melatonin secretion was associated with body mass index and body fat percentage. These associations are independent of other factors widely discussed in relation to diet, such as the amount of energy and nutrients ingested.

In our findings the food consumption schedules were not explored for the present manuscript, however, it is highlighted a greater energy consumption by town residents in relation to the rural ones. This can be explained not only by the greater access to processed foods and higher caloric density found in supermarkets and cafeterias in the city, but also by the greater window of availability for the consumption of meals at later times by the town residents in relation to the rural ones, thus contributing as an important factor to the excess weight found in the sample.

In view of the described scenario, we highlight in our results the main factors associated to the higher body mass index among town residents, as shown by the scheme in figure 9.



Figure 9. Explanatory model scheme proposed by the study.

It should also be pointed out that some aspects of urbanization, such as greater access to the health and education system, could contribute positively to the improvement of the issues mentioned above. However, in developing countries such as Brazil, the growth of urban areas occurs rapidly, without planning and without the basic structures so that the problems of urbanization impact especially on the poorest populations of these regions (MALIK et al., 2013; POPKIN, 2009; FRASER, 2005).

Xu et al. (2014) point out this aspect in a study of rural and urban populations in Shaanxi Province, China, which is undergoing an accelerated urbanization process. The study found increased risk for metabolic syndrome among rural residents as a result of recent sociodemographic and lifestyle changes. The authors discuss the fact that rural communities in the process of urbanization share the same problems as

cities, such as soil, water and air contamination, but do not have access to the same conveniences as hospitals, health care, adequate housing, education and places for recreation and leisure activities.

In conclusion, our findings show an association between town residents and the presence of risk factors for metabolic disorders like overweight, insulin resistance, increased glucose, short sleep duration, less natural light exposure. However, in a developing country like Brazil, rural populations presents worse sleep quality and the adoption of unhealthy lifestyle's practices, like smoking and alcohol consuption.

This overview provides a dimension of the new challenges to be faced in terms of public health with the advancement of the contemporary lifestyle within the country and its potential health risks in concomitance with the old health problems of rural areas, characterized by poor access to basic health care, low educational level, low income and inadequate working conditions.

Conflicts of interest statement

We declare no conflicts of interest.

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7 CONSIDERAÇÕES FINAIS

Os achados deste conjunto de estudos nos permitem descrever um amplo cenário relacionado do quanto o estilo de vida e trabalho, assim como exposição à luz associados a distintos níveis de urbanização, podem influenciar padrões de sono, o estado nutricional e aspectos metabólicos de residentes de uma comunidade amazônica. Uma síntese desses achados é apresentada a seguir.

Com relação aos padrões de sono, os achados demonstram que os moradores da zona urbana apresentam uma duração do sono mais curta, com horários de início de sono e despertares mais tardios comparados aos moradores da zona rural, particularmente nos dias de trabalho. Todavia, no que concerne à presença de distúrbios de sono, convém ressaltar a maior prevalência entre os residentes rurais, provavelmente em função de um maior esforço físico no trabalho, associado a dor, fadiga musculoesquelética e envelhecimento.

A exposição à luz natural revelou-se reduzida nos dias de trabalho entre voluntários urbanos, comparados aos rurais. Entretanto, para os dias de folga, essas diferenças não permanecem entre os grupos. Tal achado, em conjunto com a redução da duração do sono entre moradores urbanos, reforçam a importância dessas variáveis como fatores de risco para a obesidade na sociedade moderna, possivelmente pela alteração da secreção de hormônios, como por exemplo a melatonina, e consequentemente, alterações no metabolismo e na regulação do peso corporal, independente da ingestão energética.

Nesse contexto, a alta prevalência de sobrepeso e obesidade, associada a importantes marcadores bioquímicos para pré-diabetes e diabetes alterados, como hiperglicemia, hiperinsulinemia e resistência insulínica entre participantes urbanos,

também apostam para essa possível associação de alterações metabólicas, obesidade, menor exposição a luz e redução do sono.

Os resultados encontrados a partir da análise de padrões alimentares revelaram uma associação do padrão alimentar com a sonolência. Essa evidência parece demonstrar que a eficácia dessa análise, a qual vai além da avaliação da ingestão energética e de macronutrientes. Este novo método de análise incluiu um conceito mais abrangente do comportamento alimentar na apreciação de desfechos relacionados à alimentação e ritmos biológicos, em especial sono e sonolência.

Em suma, esses estudos sugerem que o estudo de padrões alimentares fornece uma importante contribuição quando há interesse de se caracterizar os hábitos alimentares de uma população ou comunidade. Assim como o estudo isolado de macronutrientes parece ser insuficiente para o conhecimento do padrão alimentar de uma comunidade, o mesmo parece acontecer com padrões de sono e sonolência. Fatores como estilo de vida e trabalho, além do local da residência, acesso à energia elétrica, dentre outros fatores, devem ser mapeados para que seja possível conhecer e identificar padrões de sono e seu reflexo em aspectos da saúde da população.

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ANEXOS

ANEXO 1 - ARTIGO 1 NO FORMATO PUBLICADO

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Full length article

Effects of physical activity at work and life-style on sleep in workers from an Amazonian Extractivist Reserve*



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ABSTRACT

Physical activity has been recommended as a strategy for improving sleep. Nevertheless, physical effort at work might not be the ideal type of activity to promote sleep quality. The aim of this study was to evaluate the effects of type of job (low vs. high physical effort) and life-style on sleep of workers from an Amazonian Extractivist Reserve, Brazil. A cross-sectional study of 148 low physical activity (factory workers) and 340 high physical activity (rubber tappers) was conducted between September and November 2011. The workers filled out questionnaires collecting data on demographics (sex, age, occupation, marital status and children), health (reported morbidities, sleep disturbances, musculoskeletal pain and body mass index) and life-style (smoking, alcohol use and practice of leisure-time physical activity). Logistic regression models were applied with the presence of sleep disturbances as the primary outcome variable. The prevalence of sleep disturbances among factory workers and rubber tappers was 15.5% and 27.9%, respectively. The following independent variables of the analysis were selected based on a univariate model ($p < 0.20$): sex, age, marital status, work type, smoking, morbidities and musculoskeletal pain. The predictors for sleep disturbances were type of job (high physical effort); sex (female); age (> 40 years), and having musculoskeletal pain (≥ 5 symptoms). Rubber tapper work, owing to greater physical effort, pain and musculoskeletal fatigue, was associated with sleep disturbances. Being female and older than 40 years were also predictors of poor sleep. In short, these findings suggest that demanding physical exertion at work may not improve sleep quality.

1. Introduction

In recent years, sleep disturbances have been extensively reported in the literature, affecting all age groups. Numerous studies have reported a high prevalence of sleep problems in the general population with rates varying between 10–48% [1–4]. In Brazil, studies carried out in São Paulo city identified a prevalence of objective insomnia of 32% [5]. Moreover, a marked increase in sleep-related complaints was found, such as difficulties initiating and maintaining sleep [6].

Sleep deprivation negatively impacts quality of life, affecting the health of the population, and is associated with increased overweight and obesity, higher risk of cardiac and metabolic diseases, as well as greater risk of accidents in the workplace and higher health costs [7–9]. Studies have highlighted the practice of physical exercise as a factor

that can enhance sleep quality and duration and reduce the prevalence of sleep disorders [10–12]. However, it has been suggested that not all physical activities improve sleep quality. Highly intense physical activity may have a negative effect on sleep when it is work-related. Geroldi et al. [13] reported that individuals with an occupational history of low physical effort exhibited better sleep quality compared to workers with physically demanding jobs. These findings suggest that physical activity is a way of improving sleep quality, provided these activities are moderate and taken during leisure rather than demanding and work-related.

Brazil has undergone an intense restructuring of the production chain involving the replacement of human labor by mechanized and technology-based work, where this has had a major impact on the lives of the population. These changes in the work sphere have led to shifts

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in the epidemiologic profile of the workers, with the emergence of new risks to health, such as an increase in neuromuscular diseases, psychosocial problems, among other health issues [14]. Nevertheless, few studies have explored the possible effects of changes in the physical characteristics of work, activity and life-style on sleep quality of workers, particularly in rural regions of the country. In this context, two occupational categories were investigated in this study: 1) rubber tappers, who work in an activity with high physical demand; 2) workers from a factory, who work in activities with low or moderate physical activity.

Rubber tappers are forest workers and dwellers living closely with nature and from which they derive their basic needs. Thus, rubber tappers live off Brazilian nuts, rubber and sustainable lumber and other subsistence-based agriculture (small scale farming) and extractivism (hunting and fishing) [15]. The daily working life of rubber tappers entails vigorous physical activity involving long treks carrying the material collected (latex, Brazilian nuts) and substantial expenditure of energy. Fishing, hunting, playing football and meeting friends were some of the leisure activities observed among rubber tappers. By contrast, factory workers perform more static repetitive activities involving long periods standing and have access to electronic devices (television sets, computers etc.) as a form of leisure, factors that reduce their overall energy expenditure in their daily lives.

The aim of the present study was to assess the effects of physical activity at work and life-style on sleep of workers with high and low/moderate physical demands living on the same Amazonian Extractivist Reserve.

2. Methods

A cross-sectional study of a typical rural population represented by a group of rubber tappers with known high physical workload was undertaken. Another group from a similar cultural background and state of Brazil were represented by factory workers with low or moderate physical workload living in a small town (also in the Amazonian Extractivist Reserve). Thus, the population comprising rubber tappers from the Amazon forest and factory workers of a rubber factory (where the latex was refined into rubber for commercial processing) located in Xapuri, Acre state. The study was carried out between September and November 2011 (Fig. 1) [16].

2.1. Sample characteristic

At the time of the study, 712 rubber tappers were registered at the factory as suppliers of latex. However, during the period of data

collection, only 398 rubber tappers had active registrations, i.e. were effectively supplying the raw material. Of this total, 340 workers were interviewed at the places in the forest where the cooperative collects the latex. The remaining workers could not be contacted, mainly owing to difficulties accessing the rubber plantations during the rainy season. The number of rubber tappers interviewed represented 85.4% of the target population of 14 rubber plantations, thereby ensuring representativeness of the sample.

In addition, 160 workers at the cited factory were included, 148 (92.5%) of whom were interviewed. The workers were drawn from the following sectors: packing, electrical testing, maintenance, production, administration and cleaning. Besides the rubber tappers, only the administrative personal used to work in permanent day shift. All the other categories had to work in a rotating shift work.

All interviews took place at the factory during work hours at a venue which provided comfort and privacy. Therefore, the sample is representative and accurately reflects the characteristics of the population studied (Table 1) [17].

2.2. Variables

Data on sociodemographic characteristics, anthropometry (body mass and height), life-style, sleep, self reported morbidities, musculoskeletal pain and occupation type were reported by the workers.

2.3. Sociodemographic data, life habits and morbidity

The following sociodemographic aspects were included: age, sex, marital status and presence of children at home. The variables related to life-style were: smoking, alcohol use and practice of physical exercise outside work hours.

The information on practice of physical exercise was collected through the following questions: "Do you practice physical exercise during your free time?" (No/Yes); "If yes, which exercises?" and "How many times a week?" (once a week, 2–3 times a week and over 3 times a week).

In order to identify the frequency of morbidities, the items from the Work Ability Index (WAI) questionnaire [18,19] were included, collecting information on the occurrence of clinician-diagnosed diseases in the past 12 months.

2.4. Karolinska Sleep Questionnaire

The Karolinska Sleep Questionnaire (KSQ) was used to assess sleep disturbances reported by the workers over the past six months. The

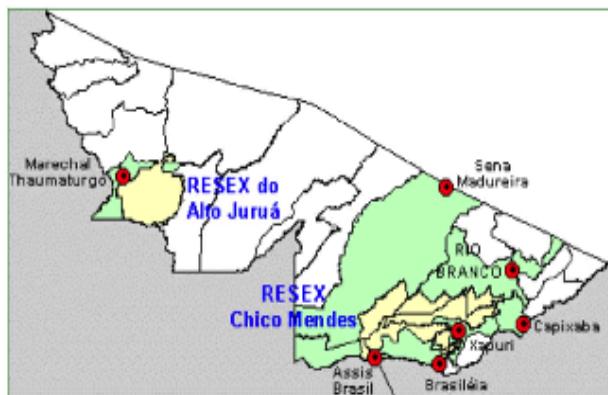


Fig. 1. Map of Acre state and location of the Chico Mendes Extractivist Reserve (RESEX). Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Não Renováveis (IBAMA), 2006.

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Table 1
Shift type and working times of study participants (n=488).

Type of work	Type of activity ^a	Sector	Shift type	Work hours	n
Factory	Moderate	Electrical testing and packing	Rotating	14:00–23:00 h 06:00–15:00 h 22:00–07:00 h	70
Factory	Moderate	Production	Rotating	06:00–18:00 h 18:00–06:00 h	10
Factory	Moderate	Maintenance	Rotating	08:00–20:00 h 20:00–08:00 h	11
Factory	Low	Administrative	Day	08:00–18:00 h	46
Factory	Moderate	Cleaning	Rotating	06:00–14:00 h 14:00–22:00 h	11
Rubber tapper	High	Extractivism	Day	05:00–17:00 h	340

^a Classification by metabolic rate according to Brazilian Bylaws no 15 (BRASIL, 1978).

KSQ contains 15 questions on sleep problems covering three dimensions: sleep disturbances; fatigue/non-restorative sleep and waking difficulties. This KSQ is a Likert type scale containing five response alternatives ranging from 1 to 5 with verbal anchors (never, rarely, sometimes, frequently and always) [20]. Each dimension was categorized after classification as "yes" for frequently/always or "no" for never/rarely/never. In this study we analyzed sleep disturbances, which were comprised difficulties initiating asleep; waking several times and difficulty getting back to sleep; too early final waking; disturbed sleep.

The internal reliability of the instrument in this study was 0.81 according to Cronbach's Alpha.

2.5. Nordic Questionnaire for the analysis of musculoskeletal symptoms

The Nordic Questionnaire was used to assess musculoskeletal pain [21]. This questionnaire comprises questions on work-related musculoskeletal pain/discomfort reported over the previous 12-month period. The general questionnaire assesses the following body regions: neck, shoulder, upper part of the back, lower part of the back, knuckles and hands, hips and thighs, knees, ankles and feet. The internal reliability of the questionnaire was tested using Cronbach's Alpha, yielding 0.93 in the present study. The figure of a human being highlighting parts of body was shown to the participant in order to help him/her to identify the body regions.

2.6. Body Mass Index (BMI)

For the assessment of nutritional status, data on reported body mass and height were self-reported to calculate body mass index (BMI) based on the formula: BMI=body mass/height². The workers were classified using the reference values published by the World Health Organization [22], according to the criteria: <18.5 kg/m² for "underweight"; 18.5–24.9 kg/m² for "normal"; 25.0–29.9 kg/m² for "overweight"; and ≥30 kg/m² for "obesity". The dichotomous variable "overweight or obesity" was employed for analyses. Participants were classified into "normal" (BMI < 25 kg/m²) or "overweight or obesity" (BMI ≥ 25 kg/m²).

2.7. Statistical analysis

A logistic regression model was estimated based on the stepwise forward method, with the outcome variable "presence of sleep disturbances", a dimension from the previously cited KSQ. The independent variables were selected using the Pearson's Chi-squared test, selecting variables with a p-value < 0.20. Variables attaining a p-value < 0.05 were retained in the final model. The Stata13 software program (Stata Corporation, College Station, TX, USA) was used for all analyses.

2.8. Ethical aspects

The ethical aspects were based on the norms of the National Health Council in Resolution no. 196 of 10th October 1996 [23], in compliance with the ethical standards of the Declaration of Helsinki. The project was approved by the Research Ethics Committee of the School of Public Health of the University of São Paulo (Protocol no. 2273) and all participants signed an informed consent form in duplicate, with one copy retained by the participant and the other filed by the researcher.

3. Results

The data revealed the rubber tappers (high physical activity) group to be predominantly male (91.5%), with mean age of 42 years (SE=0.76) and age range of 18–72 years. Notably, 27.3% of the rubber tappers were illiterate and 64.7% had not completed primary education.

Among the factory workers (low/moderate physical activity), there was an equal proportion of males (52%) and females (48%), and 68% of interviewees had completed secondary education. These workers had a mean age of 27.1 years (SE=0.5) and age range of 18–55 years.

The two groups (high vs. low/moderate physical activity) were different in all analyzed variables except for alcohol use. There was a significant age difference between the groups, rubber tappers being older than the factory workers (Table 2).

The prevalence of sleep disturbances among high vs. low/moderate physical activity workers was 27.9% and 15.5%, respectively ($p=0.003$). No statistically significant difference was found between the groups for reported morbidities. Workers with high physical activity with more than five musculoskeletal complaints were twice the number of those with low/moderate physical activity at work ($p < 0.001$) (Fig. 2).

The following factors were associated with the presence of sleep disturbances according to Pearson's Chi-squared test ($p < 0.20$): sex ($p=0.074$), marital status ($p=0.014$), age > 40 years ($p < 0.001$), type of job – with high physical activity ($p < 0.003$), smoking ($p < 0.006$), 5 or more musculoskeletal complaints ($p < 0.001$), presence of 3 or more reported morbidities ($p=0.002$). These variables were selected as independent variables for the logistic regression model.

Multiple regression analysis identified the following predictors for sleep disturbances (presented in the order of entrance in the model): sex (female); age (> 40 years), having musculoskeletal pain (≥5 symptoms); type of job (high physical activity). The variables marital status, smoking and presence of ≥3 reported morbidities were no longer significant in the final model (Fig. 3).

4. Discussion

The results of this study revealed a high prevalence of sleep disturbances among rubber tappers with high physical activity (27.9%) compared to factory workers with low/moderate physical

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Table 2
Socio-demographic, life-style and health characteristics according to degree of physical activity (n=488).

Variable	Categories	High physical activity (rubber tappers)		Low/moderate physical activity (factory workers)		p (χ^2)
		N	%	N	%	
Sex	Male	311	91.5	77	52	p < 0.001
	Female	29	8.5	71	48	
Age	18–30 years	82	24.1	116	78.4	p < 0.001
	31–40 years	85	25.0	26	17.6	
	> 40 years	170	50.0	6	4.1	
Marital Status	Single	92	27.1	91	61.5	p < 0.001
	Married/live with partner	248	72.9	57	38.5	
Practice physical exercise	Yes	127	37.4	90	60.8	p < 0.001
	No	213	62.6	58	39.2	
Smoking	Yes	169	49.7	19	12.8	p < 0.001
	No	171	50.3	129	87.2	
Alcohol use	Yes	173	50.9	88	59.5	n.s.
	No	167	49.1	60	40.5	
Nutritional Status	Normal	240	72.3	83	57.2	p = 0.001
	Overweight/Obesity	92	27.7	62	42.8	

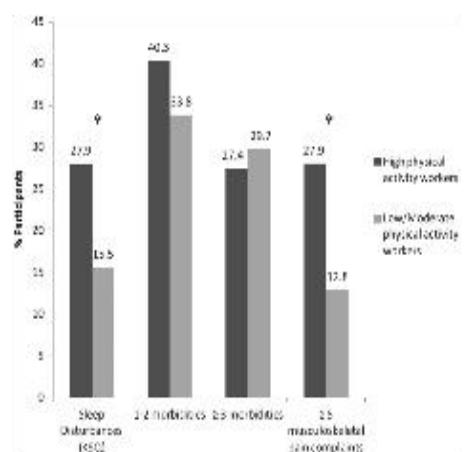


Fig. 2. Frequency of sleep disturbances (KSQ), reported morbidities and musculoskeletal pain among high and low/moderate physical activity (n=488). Pearson's Chi-square test, *p < 0.05.

activity (15.5%). This finding corroborates the results of the study by Moreno et al. [24] in which rubber tappers' job was associated with insomnia. One hypothesis to explain our findings is that the intense physical effort of the work may lead to musculoskeletal pain and in turn to sleep disturbances. In addition, we should consider the age differences between groups, which also may contribute to sleep disturbances. However, the cross-sectional nature of this study precluded the establishment of a cause and effect relationship for the results outlined.

Findings reported in the literature regarding the effects of physical exercise during leisure time on sleep quality have shown an opposite effect [25,26]. Vuori et al. [27], for instance, have shown that mild-to-

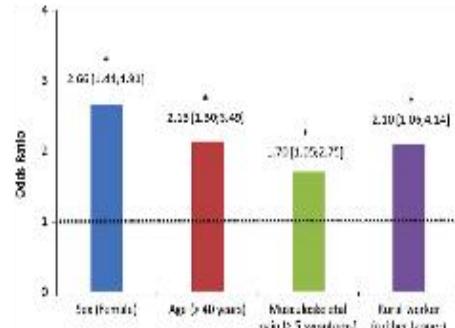


Fig. 3. Final logistic regression model according to presence of sleep disturbances (KSQ) in the study sample (n=488). Dashed line at 1 means reference cut-off. *p < 0.05 OR [CI95%].

moderate activities exert a positive effect on sleep quality. On the other hand, the same authors found a negative impact of vigorous physical exercise on sleep. Perhaps this is similar to what occurs during intense physical effort at work. A study by Marquezze et al. [28] of workers in the ceramic industry showed a tendency for worse sleep quality indexes in the presence of greater energy expenditure of the workers, particularly in the case of physically demanding labor activities. Soltani et al. [29] suggested that work requiring intense physical effort may constitute an independent factor influencing sleep quality although this relationship has not yet been fully elucidated.

Physical inactivity, however, is considered one of the main risk factors for the development of a number of chronic noncommunicable diseases, such as cardiovascular disease, diabetes, osteoporosis and some types of cancer [30]. Pursuing a physically active life, especially during leisure time, substantially reduces the risk for these diseases and promotes many health benefits such as lower corporal adiposity; improved cardiovascular and musculoskeletal health; reduced levels of anxiety and depression, among others [31].

According to data from the 2008 National Households Survey (PNAD), one out of every five Brazilians practiced no physical activity. Moreover, particularly in the North and Northeast regions of the country, physical activity is performed in the process of travelling to work among younger men with lower educational level, and thus is practiced out of necessity rather than as an option for improving quality of life [32].

Another aspect evident in our findings was the association between musculoskeletal pain symptoms and sleep disturbances among the workers. Rural work that is physically demanding is known to promote musculoskeletal injuries, where pain can lead to more serious and debilitating health issues, such as repetitive strain injury (RSI) and work-related musculoskeletal disorders (WMSD), caused by poor posture, long periods standing, heat discomfort and long work shifts [33].

Moreno et al. [24] also highlighted that the presence of organic and mental diseases can lead to more musculoskeletal complaints. According to Lima et al. [34], in a study of rural workers engaged in coffee harvesting, the field work involves dangerous and stressing working conditions which, together with musculoskeletal pain, can lead to the development of anxiety and depression as well as to a decline in the quality of sleep.

The work activity of rubber tappers is integrated with nature. In general this group has no direct contact with modern society's life-style such as access to the internet and/or television, since most of them do not even have electricity at home [35]. These workers start working at around 05:00 h and end in the late afternoon. The factory workers, on the other hand, although living in the same region, have incorporated some of the characteristics of modern society into their everyday lives,

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since they work shifts (including night work). There has been a change in the relationship with work, as well as in remuneration, which is dictated by the social clock as opposed to the rhythms imposed by nature, as is the case for activities of hunting, fishing and Brazilian nut and latex extraction [36]. Thus, an important aspect to consider is that the workers involved in this study have different living and work conditions.

In this scenario, the relationship between exhausting physical effort and musculoskeletal pain may be one of the possible explanations for the findings concerning predictors of risk for sleep disturbances among the workers studied. This is particularly true for rubber tappers, providing an intriguing contrast with factory workers: despite working in a setting of sedentary, factory and shift-based work (including nights), factory workers showed lower risk of developing sleep disturbances. However, we must emphasise that the rubber tappers were mostly older than the factory workers. Being older than 40 was found to be a risk factor for sleep disturbances as well as work with high physical activity. A relationship between sleep disorders and advanced age has been reported, with a reduction in total time and sleep efficiency as we age [37,38]. On the other hand, Grandner et al. [39] after analyzing the United States Behavioral Risk Surveillance System Factor data found that older individuals were less likely to report problems related to sleep when compared to young and middle-aged adults. The authors thus suggested that the increased reporting of sleep disorders with age is not a linear phenomenon, and can be mediated by factors other than aging such as general health and presence of morbidities. These present findings suggest that the variables related to age, life-style and work should be analyzed together, i.e. the working times and physical work conditions in general constitute part of the individual's life-style. Physical effort at work may have a deleterious effect on sleep, particularly when associated with life-style characteristics which reduce sleep quality, such as the environment for sleeping. There is still a gap in the literature regarding the sleep of workers living in remote areas, although recent studies have shown sleep habits in hunter-gatherers [40].

Being female was also identified as a predictor of sleep disturbances. This result corroborates previous findings in the literature on this subject [41,42]. In a study of sleep disturbances among adults, Zanuttu et al. [43] also found greater occurrence among women. This phenomenon may be explained based on two different perspectives: from a biological standpoint females have more fragmented sleep than males [44]; also socially, women are subject to multiple responsibilities involving work, family etc., creating stress which can negatively impact sleep [45]. In conclusion, rubber tappers reported a high prevalence of sleep disturbances, partly a result of demanding physical work, age, pain and musculoskeletal fatigue.

Conflicts of interest statement

We declare no conflicts of interest.

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ANEXO 2 - ARTIGO 2 NO FORMATO SUBMETIDO

Manuscript Details

Manuscript number NUT_2018_99

Title Prudent diet is associated with low sleepiness among short-haul truck drivers

Article type Original article

Abstract

Background: The lifestyle of post-industrial society has undergone major shifts, characterized by changes in demographic and epidemiologic profiles, eating habits and in job structures with irregular working hours, particularly night shifts. The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general particularly due to the increased sleepiness reported during night work. **Objective:** To determine the association between dietary patterns of Brazilians truck drivers and sleepiness levels, according to the work shift. **Methods:** A cross-sectional study of 52 drivers (25 long-haul and 27 short-haul) at a freight company was carried out. This study entailed application of a structured questionnaire collecting sociodemographic, lifestyle, and nutritional status. Assessment of dietary intake using a 24h dietary recall and evaluation of sleepiness was made by the Karolinska Sleepiness Scale. The principle components of the diet were analysed by factor analysis to derive dietary patterns. The Linear Mixed Model was then applied to determine a model for sleepiness levels of the drivers as a function of dietary pattern, day, time, and work shift. **Results:** Three intake patterns were derived: Traditional, Prudent and Western. Effects of time of day and shift type on sleepiness were found. An association between diet and sleepiness was also evident, where the Prudent pattern was associated with low sleepiness among short-haul truck drivers. **Conclusions:** The results of the present study revealed an association between dietary patterns and short-haul drivers, in which the healthy pattern showed low sleepiness during the day. Long-haul drivers appear to have a masking effect on their sleepiness, probably due to their irregular working time.

Keywords dietary patterns; sleepiness; truck drivers; shiftwork; eating behavior; food consumption

Taxonomy Working Condition, Life Style, Occupation

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Highlights

- Three different dietary patterns were found among the drivers assessed in the study
- The different dietary practices among the drivers were consistent with diet found in the general Brazilian population
- Effects of time of day and shift type on sleepiness were found.
- Prudent pattern diet was associated with low sleepiness among short-haul truck drivers
- Long-haul drivers appear to have a masking effect on their sleepiness

Prudent diet is associated with low sleepiness among short-haul truck drivers.

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Abstract

Background: The lifestyle of post-industrial society has undergone major shifts, characterized by changes in demographic and epidemiologic profiles, eating habits and in job structures with irregular working hours, particularly night shifts. The investigation of dietary patterns is of great importance for the discussion and devising of effective dietary strategies for shift and night workers in general particularly due to the increased sleepiness reported during night work.

Objective: To determine the association between dietary patterns of Brazilians truck drivers and sleepiness levels, according to the work shift.

Methods: A cross-sectional study of 52 drivers (25 long-haul and 27 short-haul) at a freight company was carried out. This study entailed application of a structured questionnaire collecting sociodemographic, lifestyle, and nutritional status. Assessment of dietary intake using a 24h dietary recall and evaluation of sleepiness was made by the Karolinska Sleepiness Scale. The principle components of the diet were analysed by factor analysis to derive dietary patterns. The Linear Mixed Model was then applied to determine a model for sleepiness levels of the drivers as a function of dietary pattern, day, time, and work shift.

Results: Three intake patterns were derived: Traditional, Prudent and Western. Effects of time of day and shift type on sleepiness were found. An association between diet and sleepiness was also evident, where the Prudent pattern was associated with low sleepiness among short-haul truck drivers.

Conclusions: The results of the present study revealed an association between dietary patterns and short-haul drivers, in which the healthy pattern showed low sleepiness during the day. Long-haul drivers appear to have a masking effect on their sleepiness, probably due to their irregular working time.

Keywords: dietary patterns, sleepiness, truck drivers, shiftwork, eating behavior, food consumption

1 Introduction

2 Over the last 50 years, the lifestyle of post-industrial society has undergone major
3 shifts, characterized by changes in demographic and epidemiologic profiles as well as in
4 industrialization and urbanization. Some of the changes in job structures include
5 irregular working hours, particularly involving nightshifts [1].

6 Shift work, especially night shifts, is associated with fatigue, stress, lower
7 performance in activities, greater risks of accidents, and early functional disability [2,3].
8 These characteristics are linked to poor working conditions and deregulation of
9 biological rhythms due to hours in which workers perform their activities [1,4].

10 In addition, changes in the lifestyle of the population over recent decades have
11 also affected eating habits. Preference for processed food products over foods rich in
12 fibre and vitamins, together with sedentarism promoted by changes in the structure of
13 work and by advances in technology, represent the main etiological factors of
14 overweight and obesity among adults [5-8].

15 Night workers are no exception to this change in dietary intake, indeed, the more
16 ready availability of processed foods has facilitated night-time snacking, a common
17 practice in this population. The dietary behavior of this group of workers is heavily
18 influenced by the working times. The consumption of snacks with a high energetic
19 value yet low nutritional value in terms of micronutrients and fiber during work time
20 has led to increased rates of overweight and obesity among these individuals [9- 13].

21 Several studies report an association between sleep restriction and changes in
22 dietary intake leading to weight gain [14-16]. Markwald et al. [17] found an increased
23 food intake during periods of reduced sleep duration and, consequently, weight gain
24 among study volunteers. According to the authors, this response seems to be a
25 physiological adaptation of the organism to supply the needed energy due to the longer
26 waking period. In addition, when the amount of sleep is restored there is a reduction in
27 energy consumption, especially carbohydrates and fats in the sample analyzed.

28 A study by Nehme [18] involving night security guards found an interaction
29 between obese individuals and increased sleep duration after a 30% increase in
30 carbohydrate content in the caloric value of nighttime meals, suggesting possible
31 mediation by obesity of the effect of carbohydrate intake on sleep of night workers. The
32 effects of carbohydrate intake during night shifts have been studied since the 1980s.

33 These studies suggest that carbohydrate consumption is a factor that changes body mass
34 and influences psychophysiological variables such as mood [19-22]. Dye et al. [23]
35 affirmed that carbohydrate-rich meals reduced mental performance and promoted
36 increased levels of sleepiness compared to meals rich in fats. According to Linder [24],
37 the effect of carbohydrate intake in promoting sleepiness occurs as a result of serotonin
38 production, potentialized by meals rich in this nutrient. One study showed that greater
39 consumption of carbohydrates compared to other macronutrients such as lipids was
40 associated with greater sleepiness [10].

41 Evidences from literature claim that the ingestion of meals with high content of
42 fats and sugars may predispose to excessive daytime sleepiness. According to Panossian
43 and Veasey [25], the food-induced sleepiness could be possible owing to the hormonal
44 and neuroendocrine response caused by this kind of nutrient, characterized by increase
45 glucose, leptin, cholecystokinin, peptide YY, inflammatory cytokines, reduction of
46 norepinephrine and decrease of neuronal wake sign.

47 The main sleep problems reported by shift workers are related to complaints of
48 excessive sleepiness [3]. According to Arkested and Wright [26], the misalignment
49 between the endogenous circadian rhythms and the work schedules established by night
50 shift work lead to sleepiness and sleep disorders and increase the risk of accidents.

51 Several studies investigate the effects of shift work on sleepiness levels. A study
52 of truck drivers in Belgium found the prevalence of high sleepiness in 18% of
53 respondents [27]. Another study conducted with drivers in Finland showed that about
54 40% of long-haul drivers and 21% of short-haul drivers reported problems in staying
55 alert during the work period [28].

56 However, exclusive analysis of nutrient intake does not allow the identification
57 of certain more specific dietary-related associations and outcomes [29]. For this reason,
58 we decided to investigate dietary patterns instead of prioritize the effect of a single
59 nutrient.

60 Drivers, as being shift workers, are also characterized by a poor diet in nutrients
61 and for changes in eating behavior. The studies carried out in this population highlight
62 the reduction of fruit and vegetable consumption, lower fiber intake, high consumption
63 of processed foods, fried foods and excessive sodium in meals [13, 30-32].

64 The investigation of dietary patterns is of great importance for the discussion and
65 devising of effective dietary strategies for shift and night workers in general. The
66 present study involved truck drivers, a group of workers exposed to long periods of
67 night work and static activity, which can lead to irritability, insomnia, reduced alertness,
68 sedentarism, intake of alcoholic beverages, overweight, obesity and unhealthy eating
69 habits [33-35]. Thus, the hypothesis of this study is that the healthy eating pattern is
70 associated with low sleepiness during the day. The premise behind this hypothesis is
71 that healthy food intake habits lead to good sleep quality which in turn would reduce
72 diurnal sleepiness. Therefore, the aim of this study was to determine the association
73 between dietary patterns of Brazilians truck drivers with sleepiness levels, according to
74 work shift.

75 **Methods**

76 *Study sample and design*

77 The present cross-sectional study was conducted in a freight company as part of
78 an institutional program promoting health and quality of life. The company in question
79 has been operating for 35 years and possesses branches in all the capital cities of Brazil.

80 The company had 248 drivers (110 short-haul and 138 long-haul) on its staff at
81 the time of data collection (May and September 2012). An initial total of 120 drivers
82 were randomly selected (40 short-haul males, 40 long-haul males, 20 short-haul females
83 and 20 long-haul females) of which only 71 individuals agreed to take part in of the
84 study (29 long-haul and 42 short-haul).

85 Short-haul drivers worked a fixed day-time schedule of 09:00 to 17:00h,
86 Monday to Friday, with Saturday and Sunday off. Depending on seasonal demands,
87 overtime during the week and on Saturdays was common. Long-haul drivers worked
88 irregular hours on predominantly long distance trips often made during the night (from
89 23:00h) and early hours. Periods off were not systematically scheduled in advance.

90 The following exclusion criteria were applied: use of medications causing
91 changes in sleep, presence of psychiatric, hormonal or sleep disturbances, and having a
92 second job. After losses from the sample, the final number of participants that has
93 measured sleepiness and answered the 24-hour dietary recall was 52 (n=27 short-haul
94 and n=25 long-haul). The sampling power calculated *a posteriori* was 0.95 (95%), with

95 an effect of 21.4% according to calculations performed using the Stata statistical
96 software.

97 *Ethical Aspects*

98 The study was approved by the Research Ethics Committee of the School of
99 Public Health of the University of São Paulo (COEP FSP/USP), under approval number
100 2313/2012. All drivers randomly selected were asked to take part in the study and
101 agreed voluntarily after being explained the objectives of the study and signing the Free
102 and Informed Consent Form, previously approved by the COEP of the FSP/USP as
103 stipulated in resolution 196/96, of the Ministry of Health National Board of Health [36].

104 *Data collection and processing*

105 This study was performed with the application of a structured questionnaire
106 collecting data on sociodemographic (gender, age, educational level, marital status) and
107 lifestyle habits (drinking, smoking). Data were also collected for self-reported body
108 mass and height to assess study participants' nutritional status. Studies suggest the use
109 of self-report measurements as a rapid, economical and reliable alternative for
110 monitoring nutritional status of the population in situations when direct measurements
111 are not feasible [37-40].

112 The 24-hR was conducted on three non-consecutive days, comprising two
113 working days and one day off, to minimize the influence of intrapersonal variability on
114 dietary intake of the sample studied. A photograph album illustrating serves of the most
115 common foods in the Brazilian diet was employed as an aid during interviews [41].

116 The data collected by the 24hR were previously checked for quality of the
117 information. Standardized quantification of foods and beverages in grams, milligrams
118 and milliliters was performed. Data were keyed into the software Nutrition Data System
119 for Research version 2007 [42], whose main database is the Food Composition table of
120 the United States Department of Agriculture. Nutritional values of traditional Brazilian
121 preparations and foods not included in the software program were input based on
122 information from the Brazilian Food Composition Table (TACO) [43].

123 Over 1000 food items were reported, grouped according to nutritional value and
124 characteristics of Brazilian dietary culture [5, 44]. Foods consumed by less than 10% of
125 the sample were excluded from the analysis [45].

126 Foods were classified into 22 groups: fruit (fresh fruit, fruit salad and dried
127 fruit); vegetables (all vegetables and legumes); beans (carioca and black beans, peas,
128 lentils, chickpeas); roots and tubers (potato, manioc, yam, taro); rice, bread and cakes
129 (white and whole rice, white and wholemeal bread and homemade sponges without
130 icing); breakfast cereals (granola, oats, corn flakes); milk, milk derivatives and eggs
131 (whole and skimmed milk, cheese, cream cheese, yoghurt, and boiled eggs, omelet);
132 vegetable oils and olive oil; juices; processed meats; white meats; red meats; pastas and
133 fast food (pizza, lasagna, spaghetti, hamburger, fritter); fried foods, animal fat and
134 emulsions (fried egg, fried potatoes, chicken savory, cheese bread, rissoles, kibbeh, pork
135 scratchings, butter, lard, mayonnaise and margarine); sugar and desserts (refined sugar,
136 brown sugar, honey, jams, compotes, jelly, dulce de leche, peanut confectionary, soft
137 chocolate bon bons, coconut confectionary and iced cakes with filling); processed sweet
138 products (boiled sweets, chewing gum, ice-cream, biscuit creams and chocolates);
139 coffee and teas; soft drinks, alcoholic beverages (lager, draft beer and wine); snacks and
140 savories (salted peanuts, savories “chips”, packet sweet popcorn and salted popcorn);
141 soups and broths; pâtés and sauces (mayonnaise based pâtés and white sauce).

142 Sleepiness measurements were made using the Karolinska Sleepiness Scale
143 (KSS). KSS was completed by the drivers every three hours after waking up during 10
144 days. The KSS is self-rated and preceded by the question “How are you feeling right
145 now?” with scores ranging from 1 to 9, classified as “extremely alert”=1, “very alert”
146 =2, “alert” =3, “rather alert” =4, “neither alert nor sleepy” =5, “some signs of
147 sleepiness” =6, “sleepy, but no difficulty remaining awake” =7, “sleepy, some effort to
148 keep alert” =8, “extremely sleepy, fighting sleep, a lot of effort to remain awake” =9
149 [46].

150 *Statistical Analysis*

151 Normality was tested using the Shapiro Wilk test. Pearson’s Chi-squared test
152 was applied to test the association between the categorical variables such as sex, age,
153 marital status, nutritional status, drinking and smoking habits.

154 Dietary patterns were derived by conducting a factor analysis using principal
155 component analysis, employing the 22 food groups as variables. The adequacy of the
156 sample was determined using the Kaiser-Meyer-Olkin (KMO) test as a reference, with
157 values >0.50 defined as acceptable. In order to determine the number of factors
158 (patterns) to be retained for analysis, criteria of analysis of the *Scree Test* and
159 *Eigenvalues* >1.5 was adopted. Three factors were retained for subsequent analyses.
160 These factors (patterns) were named according to the food groups, factor loading scores
161 and based on the names used in the literature on dietary patterns. Food groups with
162 factor loadings > |0.3| were considered significant.

163 The Linear Mixed Model was applied to check for the existence of significant
164 differences between the mean sleepiness scores of drivers according to dietary patterns,
165 shift, day and time of collection (time bands) and also the effects of interaction among
166 these variables.

167 All statistical analyses were performed using the SPSS 19.0 and Stata 13
168 software packages. A 5% level of statistical significance was adopted for all tests.

169

170 **Results**

171 In terms of gender distribution, 76.9 % (n=52) of the drivers studied were men.
172 In addition, the short-haul (day shift) group represented the majority of the drivers, at
173 51.9%. A large proportion of the drivers were in the 20-39 years age group (48.0%) and
174 most were married or lived with a partner (78.8%).

175 The percentage of smokers was 15.3%, while 21.1% of the drivers interviewed
176 reported having given up smoking. With regard to use of alcoholic beverages, 51.9% of
177 the participants reported drinking on special occasions, and higher beverage intake was
178 evident among the long-haul (irregular shift) group (68 %). Notably, over 60% of the
179 drivers were in the obese and overweight category. No statistically significant
180 differences were found among the variables analyzed on the Pearson's Chi-squared test
181 (Table 1).

182

183

184 **Table 1** – Sociodemographic and lifestyle characteristics of participants of study (n=52).

Variables	Long-haul (irregular shift)		Short-haul (day shift)		p (χ^2)
	N	%	N	%	
Sex					
Female	6	24.00	6	22.22	
Male	19	76.00	21	77.78	0.87
Age					
20 – 39 years	10	40.00	15	55.60	
40 – 49 years	11	44.00	7	25.90	0.37*
≥50 years	4	16.00	5	18.50	
Marital Status					
Single	5	20.00	6	22.22	
Married/living with partner	20	80.00	21	77.78	0.84
Educational level					
Less than 9 years	9	36.00	6	22.22	
9 – 11 years	9	36.00	9	33.33	0.39
12 years and more	7	28.00	12	44.45	
Smoking					
No	14	56.00	19	70.40	
Former Smoker	7	28.00	4	14.80	0.44*
Yes	4	16.00	4	14.80	
Alcohol use					
No	6	24.00	9	33.40	
Former Drinker	2	8.00	8	29.60	0.05*
Yes	17	68.00	10	37.00	
Nutritional status					
Normal	9	36.00	8	30.80	
Overweight/ Obesity	16	64.00	18	69.20	0.69

185 *Fischer's Exact test p<0.05

186 Three dietary patterns were derived: Traditional, Prudent and Western,
 187 explaining 34.9% of the total variance of intake. The first pattern (Traditional) consisted
 188 of foods featured in the Brazilian diet including beans, rice, bread, coffee/tea, juices,
 189 white meats, processed meats and low vegetable intake (significant negative loading).
 190 The second pattern (Prudent) was characterized by consumption of root vegetables and
 191 tubers, milk and dairy, eggs, vegetable oils and olive oil, breakfast cereals and by low
 192 intake of processed meat, fried foods and animal fat, processed sweet products,
 193 alcoholic beverages and snacks/savories. The third pattern (Western) contained typical
 194 foods found in the modern Western diet, such as fast foods, soft drinks, pâtés and

195 sauces, processed meat, breakfast cereals, low consumption of vegetables and white
 196 meat (Table 2).

197 **Table 2** – Factor loadings for the three dietary patterns derived on factor analysis of drivers in
 198 second phase of study (n=52).

Food Group		Food Pattern*	
	Traditional	Prudent	Western
Fruit			
Vegetables	-0.3131		-0.4124
Beans	0.7944		
Root vegetables and Tubers		0.7038	
Rice, Bread and Cakes	0.7787		
Breakfast Cereals		0.3397	0.4727
Milk, Dairy and Eggs		0.5847	
Vegetable Oils and Olive oil		0.4623	
Juices	0.5166		
Processed Meats	0.5003	-0.3848	0.3689
White Meat	0.4760		-0.3375
Red Meat			
Pasta and Fast Food			0.7954
Fried foods, animal fat and emulsions		-0.3811	
Sugar and Desserts			
Processed sweet products		-0.3282	
Coffee and Teas	0.6074		0.4349
Soft drinks			
Alcoholic beverages		-0.6099	
Snacks and savories		-0.4836	
Soups and broths			
Pâtés and Sauces			0.6714
% Explained Variance	0.1332	0.1081	0.0987

199 *Only values >|0.3| and >|-0.3| shown.

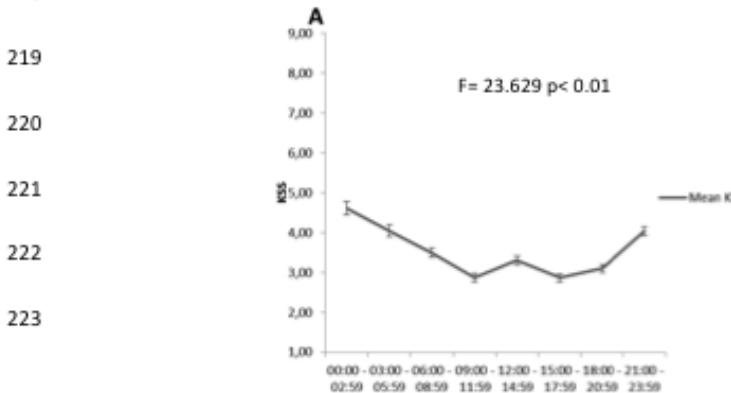
200 The *Linear Mixed Model* analysis revealed a statistically significant difference in
 201 the levels of sleepiness between work shift types ($F=42.218$, $p<0.01$), with higher mean
 202 sleepiness scores among day workers (KSS short-haul=3.77, 95% CI 3.65-3.87) relative
 203 to irregular shift workers (KSS long-haul=3.28, 95% CI 3.15-3.40).

204 Examination of the overall sample, without stratification by work shift, revealed
 205 a time-of-day effect on mean sleepiness scores ($p<0.01$). The highest mean sleepiness
 206 scores were found for the early hours (00:00-02:59/03:00-05:59h with KSS=4.62, 95%
 207 CI 4.30-4.93 and KSS=4.0, 95% CI 3.75-4.34, respectively), nighttime (21:00-23:59h
 208 KSS=4.05, 95%CI 3.84-4.25) and periods around lunchtime 12:00-14:59h KSS=3.31,
 209 95% CI 3.11-3.51), characterizing a typical physiological pattern of variation in
 210 sleepiness over the 24-hour period (Figure 1A).

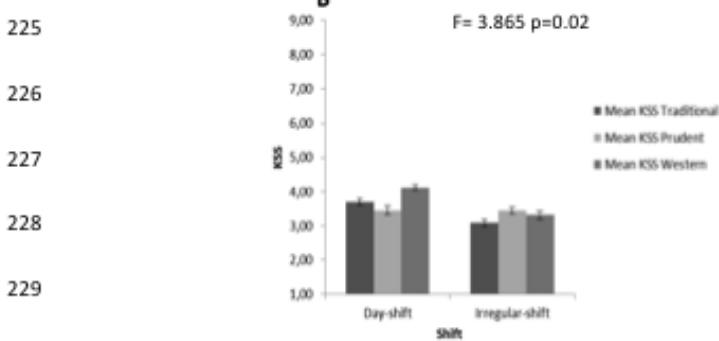
211 Drivers from the short-haul group (day workers) who adopted the Western diet
 212 had higher mean sleepiness scores compared to both individuals in the long-haul group
 213 (working night shifts) and drivers that had other dietary patterns who also worked

214 during the day (short-haul)(Figure 1B). For drivers working irregular shifts (long-haul),
 215 mean sleepiness scores were similar across all three dietary patterns (KSS=3.08;
 216 KSS=3.45 and KSS=3.32). A significant interaction effect was found between dietary
 217 pattern and work shift type ($p=0.02$) (Figure 1B).

218



224



231 **Figure 1** – Mean sleepiness score over 24-hour period (1A) and according to food pattern and
 232 work shift type (1B) among truck drivers (n=52).

233

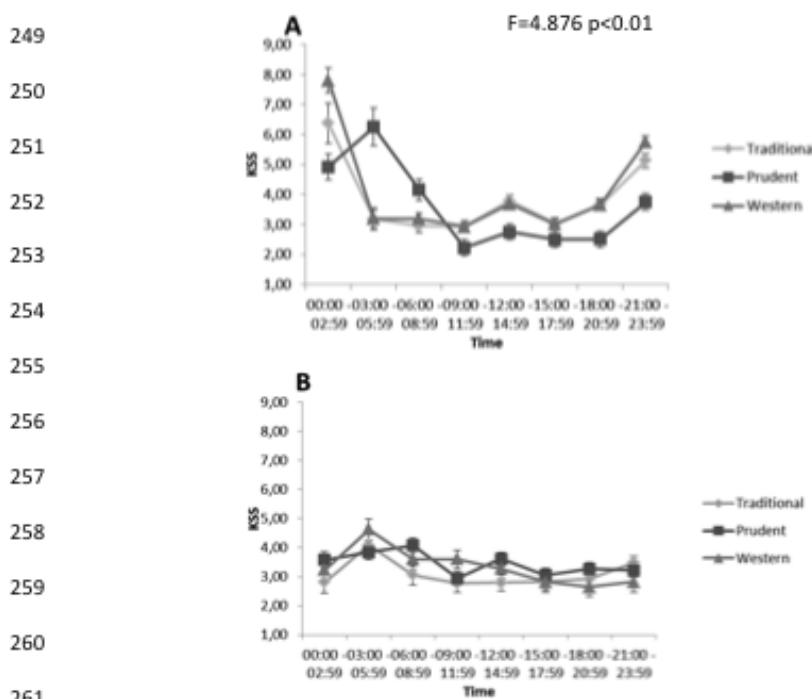
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235

236

237 Significant interaction effects were found between dietary pattern, work shift
 238 type and time of day for workers with the Prudent pattern ($p<0.01$). The sleepiness
 239 scores showed expected variation during the 24-hour period (U-shaped curve, with
 240 greater sleepiness at night) for both the Traditional and Western dietary patterns.
 241 However, analysis of the sleepiness curve for the Prudent pattern revealed a delay in the
 242 peak compared to the other patterns, with the highest mean scores occurring between
 243 03:00 and 05:59h as opposed to around midnight (Figure 2A). Drivers working irregular
 244 shifts had no major variations in mean sleepiness scores during working hours when
 245 comparing the three dietary patterns (Figure 2B).

247



262 **Figure 2** – Mean sleepiness in day-shift (2A) and irregular-shift (2B) drivers according to
 263 dietary patterns: Traditional, Prudent and Western (n=52).

264

265

266

267

268 **Discussion**

269 Three different dietary patterns were found among the drivers assessed in the
270 present study. The first pattern (Traditional) was characterized by beans, rice, bread,
271 coffee, tea, juices, white meat, processed meats and inverse correlation with vegetable
272 intake. The second pattern (Prudent) was characterized by root vegetables and tubers,
273 milk and dairy, eggs, vegetable oils and olive oil, while the third pattern (Western)
274 included fast foods, soft drinks, pâtés and sauces, and processed meats. Moreover, the
275 present results showed an interaction among dietary pattern, work shift type and time of
276 day. In other words, besides the expected effect in which sleepiness varies with shift
277 type and time of day, an association was also detected between diet and sleepiness, with
278 the Prudent pattern differing slightly to the others.

279 Also noteworthy is the flattening of the sleepiness curve, irrespective of diet,
280 seen among the drivers from the long-haul group. This is likely due to the fact that,
281 associated with these changes in dietary intake, the sleep deprivation common in night
282 workers can exacerbate metabolic disturbances, such as glucose intolerance, insulin
283 resistance and dyslipidemia [14]. On top of this, there is also circadian disruption
284 manifested by changes in the sleep-wake cycle [47]. In this case, although the increased
285 homeostatic pressure of sleep during wake state is expected to promote greater
286 sleepiness during work shifts, the opposite occurs. By contrast, an increase in circadian
287 pressure negatively influences sleep onset, despite homeostatic pressure due to sleep
288 debt. Consequently, drivers remain alert during work and also have problems getting to
289 sleep during time off, with a greater pressure for wake state than for sleep.

290 Human beings are naturally diurnal individuals, and they should be fasting at
291 night, with endogenous mobilization of glucose into the blood stream. This explains
292 why night workers generally have lower appetite, indigestion and gastrointestinal
293 diseases, since many metabolic functions follow a pattern of circadian rhythm,
294 including digestion, absorption and storage of nutrients [48,49]. Irregular shift work
295 (including work at night) is also associated with a number of different health problems
296 caused by changes in the endogenous timing system, particularly cardiovascular
297 diseases [50]. In addition to these aspects, irregular shift workers have no set routine,
298 hampering the maintenance of regular habits of physical activity and eating meals at the
299 proper time [51-54]. These factors lead to a high prevalence of overweight and obesity,

300 a phenomenon also observed among the drivers assessed in the present study.
301 Furthermore, the literature reports negative lifestyle habits associated with this group of
302 workers, such as alcohol use and smoking. In conjunction, these variables are major
303 causes underlying the development of chronic diseases such as obesity, diabetes, cancer
304 and circulatory diseases [55,56].

305 Regarding dietary intake and night work, the literature indicates the adoption of
306 unhealthy diets in terms of nutritional value, based on the consumption of fast foods,
307 caffeine-rich drinks, soft drinks, chocolates and lower intake of fish and fruit by this
308 group of workers [57,58]. This behavior is evidenced in the results of the present study
309 by a Western dietary pattern characterized by the consumption of fast foods, processed
310 meats and soft drinks. Another aspect typically found in the diet of individuals working
311 irregular shifts, especially night shifts, is a diet with a nutritional composition that is
312 carbohydrate-rich promoted by high intake of sweet products, bread and foods derived
313 from grains. In a previous study, Nishiura et al. [59] reported that the preference for
314 foods rich in fats, the habit of skipping the first meal of the day and eating outside the
315 home increased with shorter sleep duration among workers. According to Gallant et al.
316 [60], individuals that practiced night eating tended to choose tastier foods with a high
317 glycemic level and rich in fats. Intake of these types of foods has a negative impact on
318 post-prandial glucose metabolism with possible disruption of the peripheral circadian
319 system, such as internal desynchronization.

320 The patterns found in this study have been previously described by the national
321 and international literature [61-64]. The Western pattern has been associated with the
322 parameters abdominal obesity, arterial hypertension and changes in metabolism of lipids
323 and glucose, as well as with coronary diseases and metabolic syndrome [65-70]. The
324 Prudent pattern, considered the closest to a healthy pattern in the present sample and
325 comprising foods considered beneficial for health, has been associated with lower
326 prevalence of hypertension and lower levels of markers for cardiovascular diseases [71].
327 The Traditional pattern comprising rice and beans is considered healthy by the Ministry
328 of Health [5] and has been associated with lower triglyceride values and waist-hip ratio
329 [72].

330 The relationship between food intake, sleepiness and performance has not yet
331 been clearly elucidated in the literature. In general, studies affirm a reduction in state of

332 alertness after food intake [73-75]. Landström et al. [76], however, highlighted that the
333 effects of macronutrients on sleep and performance are relatively tiny and weak
334 compared to light/dark cycle, for instance.

335 Studies investigating this line of research have reported that carbohydrates, as
336 well as meal times, have a strong effect on metabolism and internal rhythms [77, 78]. A
337 study by Nehme [18] in security guards found an association between sleepiness levels
338 and carbohydrate intake among obese individuals. The study suggested that obesity
339 mediated the effect of carbohydrates on sleepiness and sleep duration in the workers
340 studied. Similarly, a time-of-day effect on sleepiness was also found in the present
341 study.

342 Given this scenario, the methodology employed in food pattern analysis allows
343 the investigation of plausible relationships between dietary variables and a number of
344 health conditions. The advantages of this method lie in the fact that global assessment of
345 usual diet, as opposed to specific assessment of nutrients, is the greater ability to predict
346 risk of diseases owing to several aspects such as lower chances of error due to erroneous
347 associations, reduced confounding effects by lifestyle-related variables and by
348 encompassing complex interactions and correlations among nutrients that can alter their
349 bioavailability action with the organism [79-82]. Nevertheless, a few limiting factors in
350 the method of dietary pattern analysis should be mentioned. These factors include: the
351 subjective nature of factor analysis affecting the consolidation of food items and
352 composition of food groups; the number of factors to be retained along with their
353 classification [83]; and the impossibility of drawing isolated causal inferences since
354 these are based on the existence of correlations among variables [84,85].

355 The results found in the present study revealed the adoption of very different
356 dietary practices among the drivers, yet these remain consistent with dietary patterns
357 found in the general Brazilian population. In addition, the initial findings suggest an
358 association of diet with sleepiness, particularly for the Prudent pattern. This relationship
359 warrants further investigations by future studies to describe this relationship more fully.
360 Recommendations and dietary guidelines for irregular-shift workers should also be
361 defined to improve their quality of life in the workplace and attenuate the risk of non-
362 communicable chronic diseases.

363

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367 conducted the study, analyzed the data and wrote the paper. LAM revised the
368 manuscript. CRCM designed the study, interpreted the data and revised the manuscript.
369 All authors read and approved the final manuscript.

370

371 **Conflicts of interest**

372 The authors declare no conflicts of interest.

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ANEXO 3 - ARTIGO 3 NO FORMATO PARA SUBMISSÃO

Lifestyle, environmental and social effects that affect body mass index.

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Abstract

Background: The urbanization process has been associated with an increase in risk factors to non-communicable diseases. **Aim:** To evaluate the sleep, biological rhythms and metabolism among workers of an Amazonian community of Acre, according to different degrees of urbanization. **Methods:** a cross-sectional study of rural and urban residents (22 and 20, respectively) from the municipality of Xapuri, Acre. Sociodemographic, life habits, anthropometric, metabolic parameter variables (triglycerides, total cholesterol and fractions, fasting glucose and insulin resistance), chronotype and food intake were evaluated. Sleep, light exposure and activity levels variables were obtained by actigraphy and daily activity protocols during 10 days. The studied groups were compared with Student's t and Mann-Whitney tests for anthropometric variables, food intake and metabolic parameters. ANOVA for repeated measures tests were performed to compare the sleep variables, light and acitivity levels between groups. **Results:** Urban residents showed higher averages to all anthropometric variables, fasting glucose levels, fasting insulin and insulin resistance ($p<0.05$) when compared with rural residents. The lipid profile showed no statistically relevant differences among the groups. Rural residents showed higher averages of sleep length ($p<0.01$) and earlier sleep onset ($p=0.01$). **Conclusion:** the findings show an association between urbanization and the presence of risk factors like overweight, serum lipid level alteration, and insulin resistance.

Keywords: urbanization; non-communicable diseases; metabolic parameters; sleep; rural communities.

1 **Introduction**

2 Non-communicable diseases are considered a significant concern in the
3 context of global public health and are a problem in both developed and developing
4 countries (ALI et al., 2015; ALWAN, 2011). According to the World Health
5 Organization (WHO), in 2015, more than 17 million people died victims of these
6 diseases. Of these deaths, 82% occurred in developing countries and 37% were caused
7 by cardiovascular diseases.

8 The urbanization process has been associated with substantial changes in the
9 population's lifestyle, such as reduction of physical activity, adoption of nutrient-poor
10 diets, sedentary work processes, exposure to artificial light and reduction of sleep
11 duration (LUYSTER et al., 2012; HAWKES, 2006; CABALLERO, 2005). These
12 have been identified as responsible for the increase in risk factors (dyslipidemias,
13 obesity, hypertension, insulin resistance) for the diseases mentioned above
14 (THOMAS & MICHAEL, 2012; POPKIN, 2015). The proportion of the urban
15 population increased from 13% in the early 20th century to almost 50% in 2005
16 (KEARNEY, 2010). According to the World Cities Report, published by the United
17 Nations in 2016, 54% of the world's population lives in urban areas. The report also
18 notes that this growth trend has remained steady for the last 20 years, especially for
19 developing nations, comprising Asian, Latin American and African countries
20 (UNITED NATIONS HUMAN SETTLEMENTS PROGRAM, 2016). Recent studies
21 show the relationship between the progress of the urbanization process in small cities
22 and their impact on sleep quality when compared to rural populations and hunter-
23 gatherer communities. Beale et al. (2017) when comparing sleep between a rural and
24 urban community in Mozambique, found delays in sleep start times between urban

25 and rural dwellers. Moreno et al. (2015) in studying sleep patterns among rubber
26 tappers in the Amazon observed a reduction in sleep duration among participants with
27 access to electricity compared to the group without access. De la Iglesia et al. (2015),
28 studying two indigenous communities of hunter-gatherers in Argentina, also reports
29 shorter sleep duration among groups with access to electricity.

30 Several published studies show the relationship between short sleep duration
31 and later sleep timing at the highest body mass index (BARON et al., 2011;
32 ROENNEBERG et al., 2012, GONNISSEN et al., 2013, LUCASSEN et al., 2013,
33 ARORA & TAHERI, 2015). As well as data from animal and human models
34 emphasize that exposure to light may have the ability to modulate metabolism,
35 especially in appetite regulating hormones, as well as body weight and body
36 composition (DUNAI et al., 2007; FONKEN et al., 2010; FIGUEIRO et al., 2012;
37 DANILENKO et al., 2013; COOMANS et al., 2013).

38

39 In this way, understanding the sleep patterns among groups that undergo an
40 initial process of urbanization in comparison with rural communities is fundamental
41 to a better understanding of the impacts of urbanization on human health, especially in
42 the context of non-communicable diseases. The northern region of Brazil, especially
43 the Amazon region, presents the ideal characteristics for this type of study, since part
44 of its population resides in rural areas without access to electricity, and at the same
45 time, it has small cities in initial stages of industrialization and access to the facilities
46 of modern life, as well as the way of life of industrialized human societies.

47 From the above scenario, the aim study is to evaluate the sleep, biological
48 rhythms and metabolism among workers of an Amazonian community of Acre,
49 according to different degrees of urbanization.

50 **Methods**

51 *2.1 Study sample and design*

52 It is a cross-sectional study developed through the collection and analysis of
53 sociodemographic data, life habits, anthropometrics and biochemical indicators of
54 metabolic profile. The research was conducted between September and October 2015
55 and July and August 2016.

56 The total sample of the study ($n = 42$) consisted of two distinct groups: 1) rural
57 workers ($n = 22$), resident in the extractive reserve of Chico Mendes located in the
58 municipality of Xapuri; 2) urban dwellers ($n = 20$) from the same city, employed in
59 the education and services sector. Currently, the city of Acre, in the northern region of
60 Brazil, has 16,091 inhabitants in an area of 5,347,446 km², of which 5,761 are from
61 the rural area and 10,330 (64%) from the urban area (IBGE, 2010).

62 As inclusion criteria for town volunteers were prioritized: male individuals,
63 who lived and worked in the city. In addition, they should only have daytime work
64 schedules. For exclusion criteria of the same group were defined: being female,
65 shiftwork and presenting sleep disorders. For residents of the extractive reserve, as
66 inclusion criteria were considered: residing and working in the extractive reserve (in
67 activities such as extraction of latex, chestnut, subsistence agriculture and raising
68 small animals), have electric light in the residence.

69 *2.2 Variables*

70 **Socio-demographic and lifestyle questionnaire**

71 Data on socio-demographic aspects were collected, such as age, sex,
72 schooling, marital status, and number of people in the residence, presence of children
73 under 18 years of age and life habits (physical activity, smoking and alcohol intake).

74 **Nutritional Status**

75 The body mass index (BMI = body mass / height², kg / m²), recommended by
76 the World Health Organization (WHO, 2000), was used to evaluate the nutritional
77 status of the study population. BMI was categorized according to the following cutoff
78 points for the classification of subjects: low weight (BMI <18 kg / m²); eutrophy ≥
79 18.5 kg / m² and <25 kg / m²; overweight ≥ 25 kg / m² and <30 kg / m²; obesity ≥ 30
80 kg / m².

81 As complementary information to the diagnosis of obesity in the population,
82 the cut-off points for waist circumference (WC) proposed by the Brazilian Society of
83 Cardiology (2013) were used, which defines as risk for metabolic morbidities,
84 therefore abdominal obesity for WC ≥ 90 cm in men . Body fat index, visceral fat
85 index and metabolic age were provided by the Tanita® (BC 543) digital scale.

86 **Metabolic Parameters**

87 Biochemical tests were performed by blood sample collection by a trained
88 nurse. The parameters analyzed in the present study are: fasting glucose, fasting
89 insulin, triglycerides, total cholesterol and fractions. The collected blood samples
90 were transported according to all transport protocols of biological material to the state
91 capital of Acre, Rio Branco for analysis by authorized laboratory.
92 For the analysis of the lipid profile, the references of the Brazilian Dyslipidemias

93 Directive were used, which establish as high triglyceride values $\geq 150\text{mg} / \text{dL}$, total
94 cholesterol $\geq 200\text{mg} / \text{dL}$, LDL-cholesterol $\geq 100\text{mg} / \text{dL}$, as well as HDL cholesterol
95 $<40\text{mg} / \text{dL}$ as low values (BRAZILIAN SOCIETY OF CARDIOLOGY, 2013). For
96 fasting glycemia, reference values above $100\text{mg} / \text{dL}$ were used as values altered
97 according to the Brazilian Diabetes Society (2016).

98 Insulin resistance was calculated using the HOMA-IR (*Homeostasis Model*
99 *Assessment*) formula proposed by Matthews et al. (1985). High values above 2.71
100 were considered, according to the study by Geloneze et al. (2006) for the Brazilian
101 population.

102 **Actigraphy**

103 To investigate sleep patterns, light exposure and activity levels, participants
104 used non-dominant pulse accelerometers for 10 consecutive days. The accelerometer
105 consists of a device that contains an accelerometer and light and temperature sensors
106 and records the ambient light, ambient and skin temperature, and activity levels at 60-
107 second intervals (*MotionWatch 8 CamNtech and ActTrust Condor Instruments*). The
108 data obtained by the use of accelerometers were complemented by information from a
109 protocol of daily activity, completed by the participants of the research, with the aid
110 of the researcher when necessary. This protocol consisted of a 24-hour schedule
111 divided into 15-minute intervals, which presented the following activities: work,
112 transportation, meal or snack, play and other leisure activities. The raw data of the
113 equipment has been checked and corrected for any inconsistencies according to the
114 information contained in the activity protocols and subsequent edition of the
115 instruments in the Philips Actware 6.0.5 software (*Philips Respirationics®*).

116 After edition of all the actograms, the variables related to sleep for work days
117 and days off were estimated. The variables analyzed were: sleep onset, wake up time,
118 sleep length, and midsleep, calculated by the sum of the start time of sleep with total
119 sleep duration divided by two.

120 **Munich ChronoType Questionnaire (MCTQ)**

121 This MCTQ addresses questions about sleep duration, exposure to light
122 considering work time and free time, as well as a self-assessment of the chronotype
123 (ROENNEBERG et al., 2003). According to this questionnaire, chronotype is defined
124 by midsleep on days off, taking into account the number of days of work and days off,
125 which can be calculated by the following formula: $MSFc = MSF - 0.5 * (SDf - (SDw * 5 + SDf * 2) / 7)$. MSF is the midsleep on free days without correction; SDf is sleep
126 duration on free days; SDw is sleep duration on working days.
127

128 The *social jetlag* was calculated by the absolute difference between
129 midsleep on workdays (MSW) and midsleep on free days (MSF) (WITTMANN et al.,
130 2006).

131

132 **Food Intake**

133 To evaluate food consumption we performed the 24-hour food recall
134 (R24h), an instrument that allows food consumption to be quantified in the 24 hours
135 of the day before the interview, during 3 days: 2 days of work and 1 day of rest.

136 The data collected by R24h were previously checked for information
137 quality. Standardized quantification of foods and beverages in grams, milligrams and
138 milliliters was performed. After this step, the data were computed and converted to

139 energy and macronutrients (carbohydrates, proteins and fats) using the Nutrition Data
140 System for Research version 2016 software (NUTRITION COORDINATING
141 CENTER, UNIVERSITY OF MINNESOTA, 2016). Typically Brazilian foods and
142 preparations that were not included in the program had their nutritional values
143 inserted according to information from the national table (TACO).

144

145 *2.3 Statistical Analysis*

146 The distribution of the variables was evaluated by the Shapiro Wilk test.
147 Fisher's exact test was used to verify the associations between the following
148 categorical variables: marital status, schooling, presence of children under 18 years of
149 age, alcohol intake, smoking, physical activity, BMI, CC, fasting glucose,
150 triglycerides, total cholesterol, LDL-cholesterol and HDL-cholesterol.

151 Student's t test (and its non-parametric equivalent) was performed for
152 independent samples in order to compare data between the two groups (urban and
153 rural) for the following variables: age, BMI, WC, body fat , visceral fat, muscle mass,
154 metabolic age, fasting glucose, fasting insulin, triglycerides, total cholesterol, LDL-
155 cholesterol, HDL-cholesterol, energy (Kcal), carbohydrates (g), proteins (g) and fat
156 (g).

157 ANOVA for repeated measures were performed to test the main effects and
158 the interaction between day of week (week days and days off) and rural/town groups
159 on sleep onset, wake up time, sleep length and midsleep. ANOVA for repeated
160 measures were performed to test the main effects between rural/town groups and time
161 of day (hour) on activity levels and light exposure on work days and days off.

162 Spearman's correlation tests were performed between variable: social jetlag,
163 midsleep (MSFc), body mass index (BMI) and energy intake (Kcal) of rural and urban
164 participants.

165 The Stata14 software program (Stata Corporation, College Station, TX, USA)
166 was used for all analyses. A p-value <0.05 level of statistical significance was adopted
167 for all tests.

168 *2.4 Ethical Aspects*

169 The study was approved by the Research Ethics Committee of the Faculty of
170 Public Health of the University of São Paulo (CAAE: 44860515.0.0000.5421), and
171 the study was carried out in accordance with the ethical standards laid down by the
172 National Health Council (Resolution 466 of December 12, 2012) (BRASIL, 2012).
173 Volunteers, after being clarified about the research objectives, signed an informed
174 consent.

175 **Results**

176 The overall median age of the study sample was 42.5 years, IQR (38.00-
177 50.00). In the division by groups the median age varied between 43.50 years, IQR
178 (37.00-49.00) for urban individuals and 42.00, IQR (39.00 - 57.00) among the rural
179 ones. No significant statistical differences were found between the groups (Mann-
180 Whitney test, z = 0.971 p = 0.332).

181 Rural residents have a higher prevalence of smoking and half of the sample is
182 addicted to smoking. There were significant statistical differences between rural and
183 urban participants in terms of education (p = 0.000) and physical activity (p = 0.040)
184 (Table 1).

185

186 **Table 1.** Demographic data lifestyle of rural and town subjects (n=42). Fischer's
 187 Exact test, *p<0.05

Variables	Town (n=20)		Rural (n=22)		p-value*
	N	%	N	%	
Marital Status					
Single	3	15.00	3	13.64	n.s
Married/living with partner	17	85	19	86.36	
Educational level					
Primary education uncompleted	1	5.00	20	90.91	p=0.000
Primary education concluded	19	95.00	2	9.09	
Children under 18 years					
Yes	16	80.00	17	77.27	n.s
No	4	20.00	5	22.73	
Smoking					
No	19	95.00	14	63.64	p=0.022
Yes	1	5.00	8	36.36	
Alcohol use					
No	13	65.00	11	50.00	n.s
Yes	7	35.00	11	50.00	
Physical Activity (leisure time)					
Yes	9	45.00	3	13.64	p=0.040
No	11	55.00	19	86.36	

188

189 When evaluated as to fasting glucose levels, fasting insulin and Homa-IR
 190 index, urban individuals stand out among the highest values, with significant
 191 differences compared to rural ($p <0.05$) (Figure 1 B, C and D). No significant
 192 statistical differences were observed between the levels of triglycerides, total
 193 cholesterol and fractions between urban and rural (Figure 1 A).

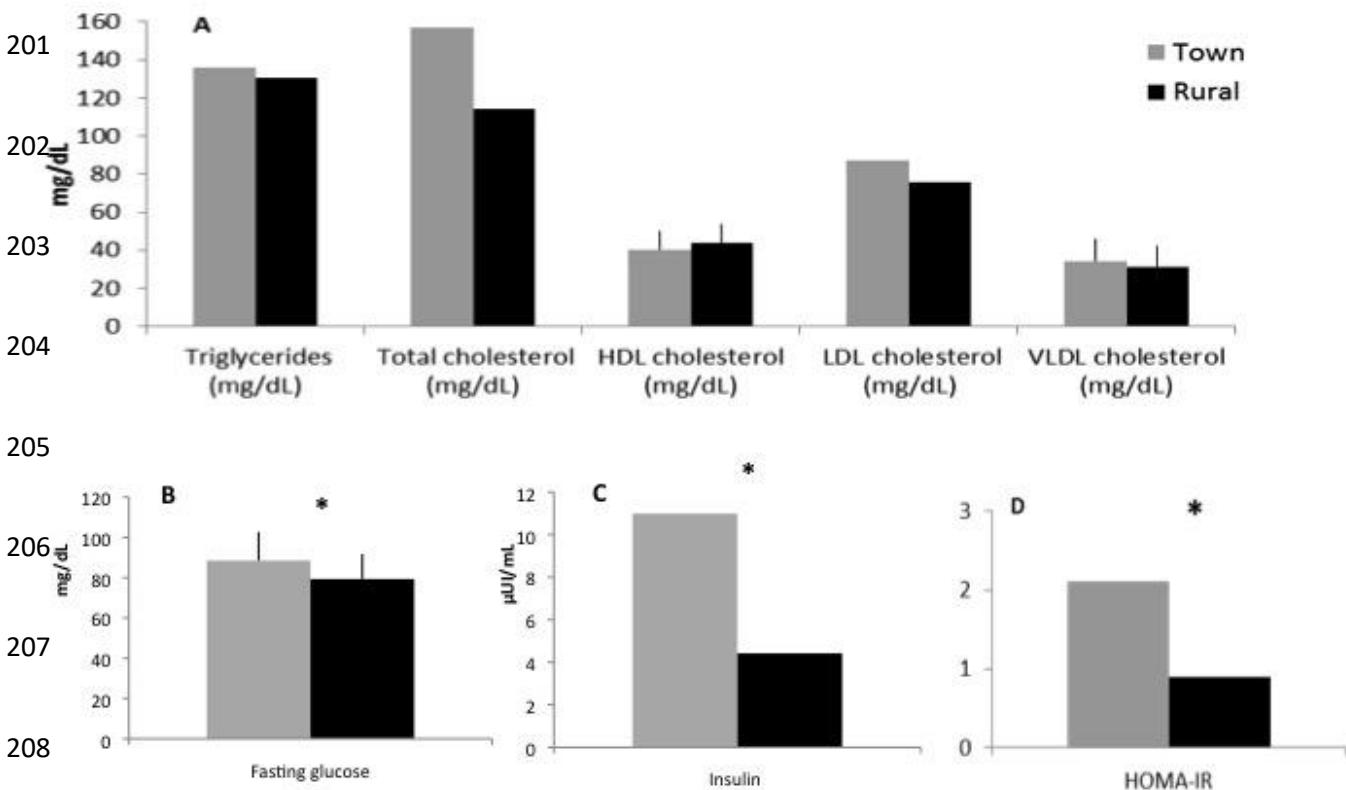
194 However, the values in Figure 1 highlight a trend of higher values among town
 195 residents, except for HDL-cholesterol, which demonstrate a higher value among rural
 196 residents, as a protective factor for cardiovascular diseases.

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209 **Figure 1.** Lipid profile, glucose and insulin profile among town (n=20) and rural
210 (n=22) participants. Student's t test or Mann-Whitney test. *p<0.05.

211

212 Town participants presented significantly higher values in relation to rural
213 ones for all anthropometric variables ($p <0.05$), showing higher values of body fat,
214 and consequently more indicators for overweight, obesity and metabolic risks (Figure
215 2 A, B, C, D and E).

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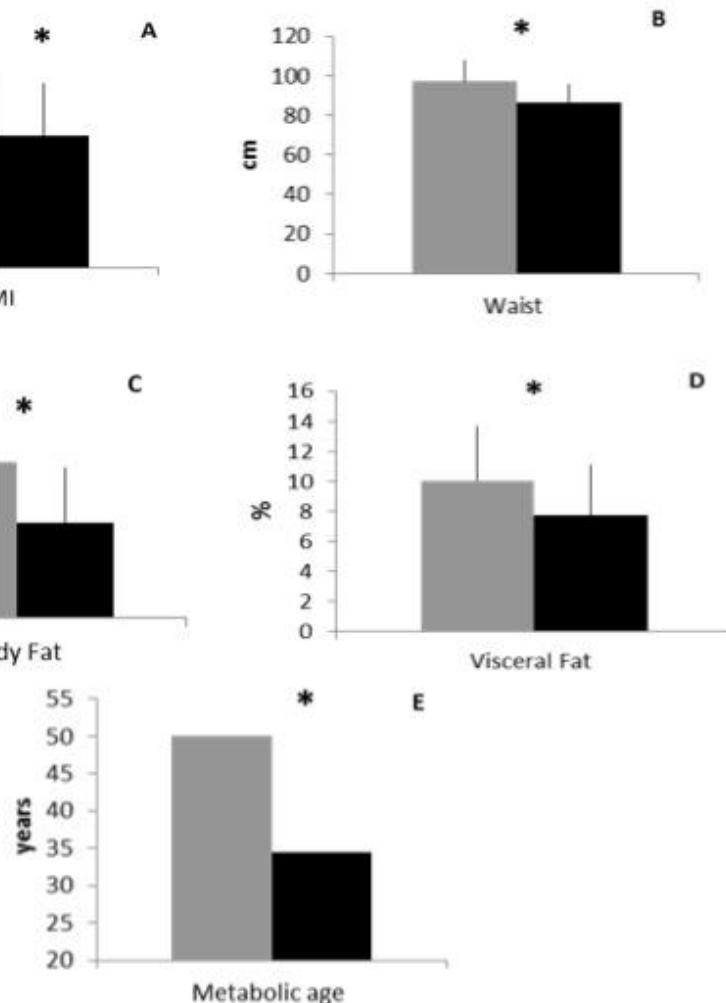
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Town residents showed lower averages of sleep length ($F=15.30, p=0.0004$)

Figure 2. Anthropometric variables among town (n=20) and rural subjects (n=22). Student's t test: A, B ,C and D. Mann-Whitney test: E .*p<0.05.

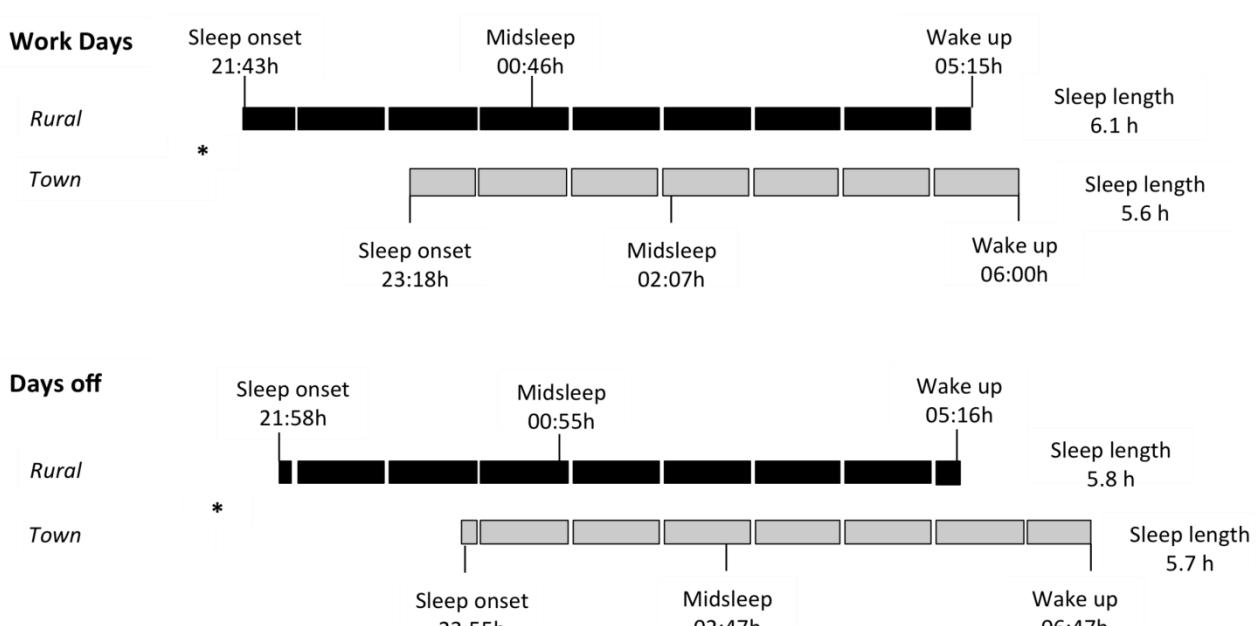


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* $p<0.05$

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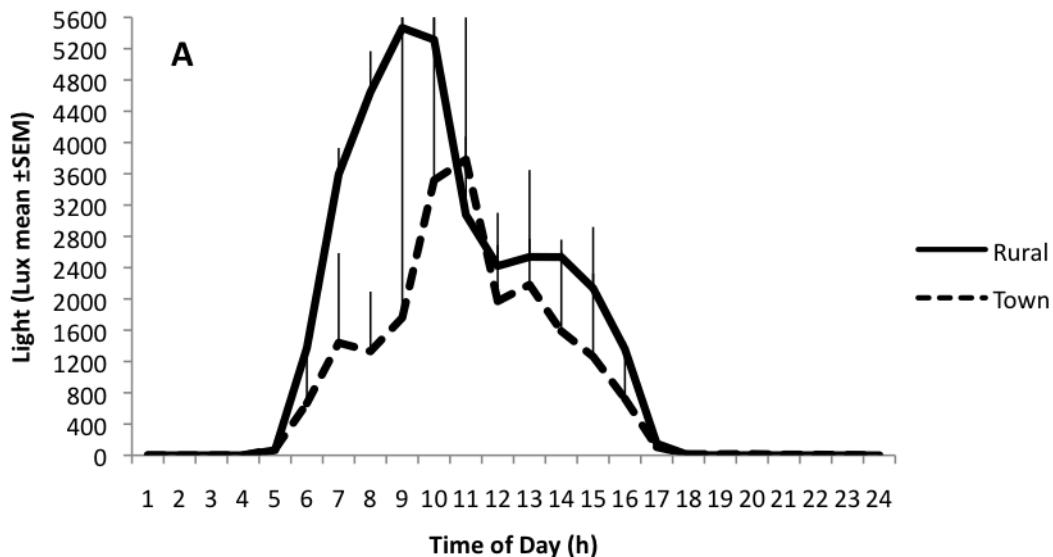
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262 **Figure 3.** Sleep patterns according work and days off among town (n=20) and rural
263 (n=22) participants.

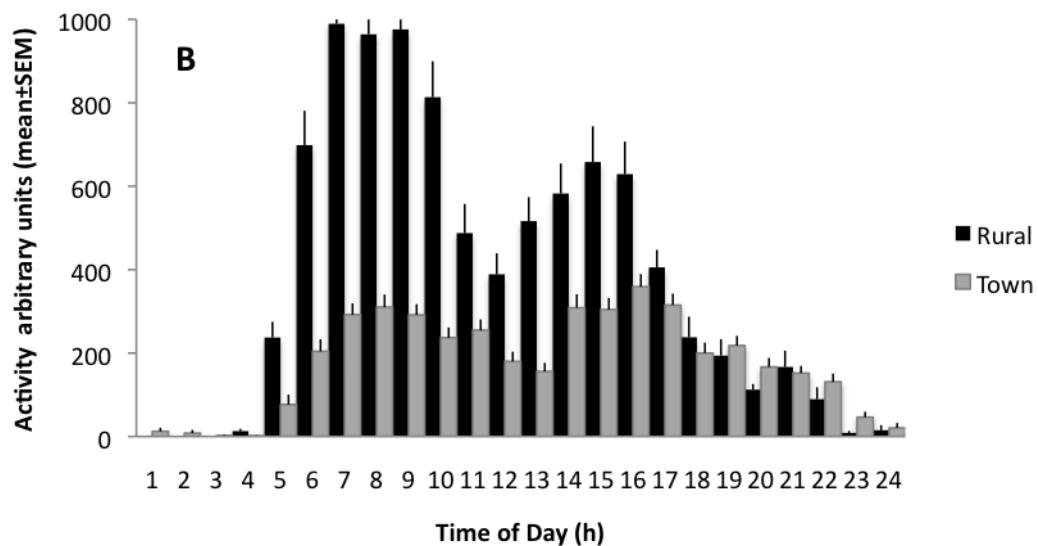
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265 Individuals in rural areas were exposed to natural light once their work
266 activities occur in the field, with activities related to land management. Among urban
267 participants, there is less exposure to natural light, since work activities take place in
268 enclosed spaces, such as schools and public offices (Fig. 4A). In both groups, there
269 are higher levels of activity during the day, however, for the rural zone, higher values
270 of activity levels compared to urban areas were observed, with significant differences
271 between groups during working days (Fig. 4B).

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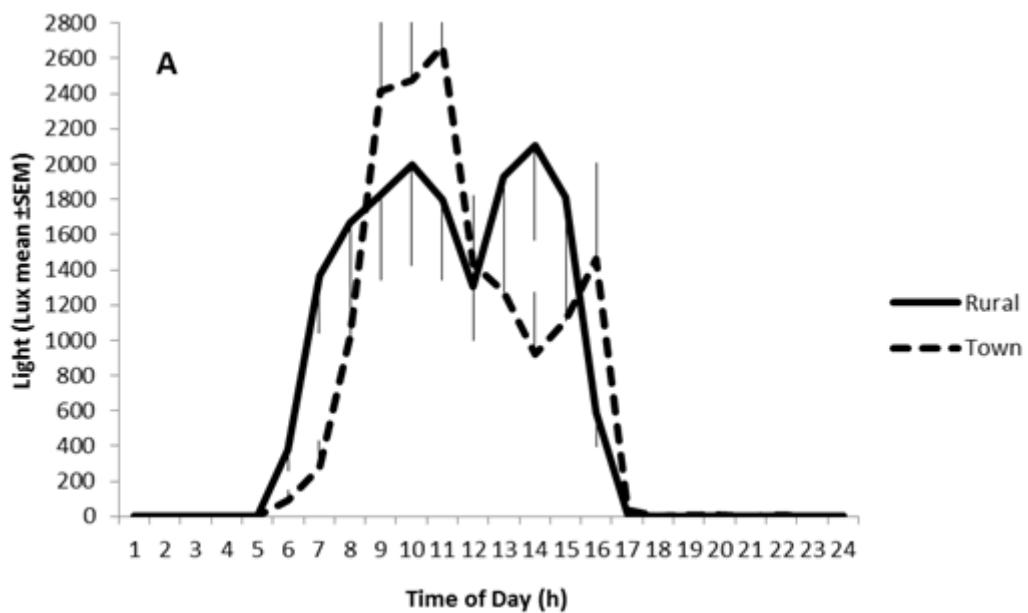
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275 **Figure 4.** Light (A) and activity levels (B) per hour during work days of rurals and town participants ($n=42$). *Repeated measures ANOVA* show significant differences in
 276 activity levels ($F=17.81, p=0.0003; F=3.20, p=0.0036$) and light exposure ($F=10.18$
 277 $p=0.0041; F=10.49, p<0.0001$) between the two groups and time of day.
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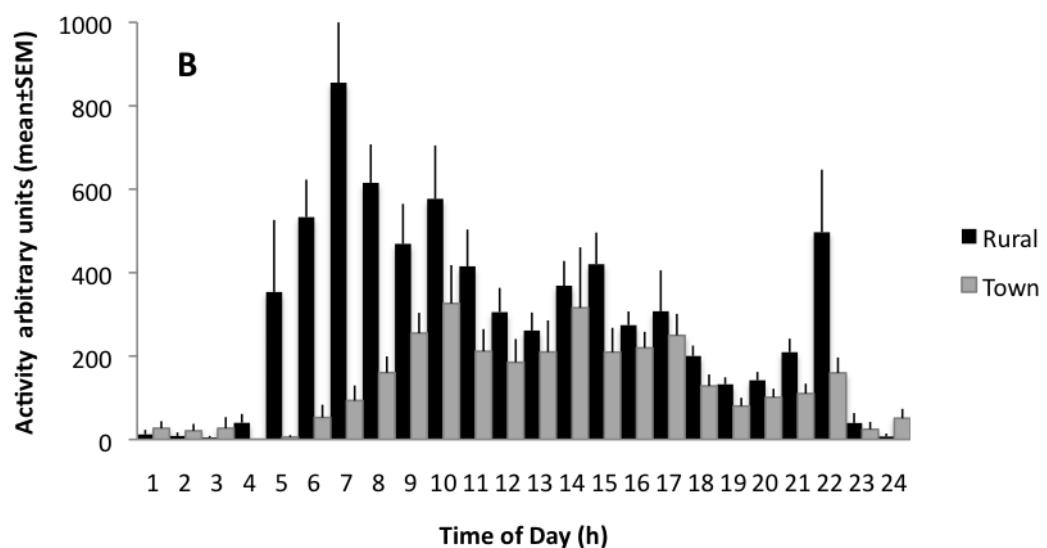
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280 For days off, no significant differences were found between groups (rural and
 281 town residents) for light exposure (Fig. 5A). Entretanto, para os níveis de atividades,
 282 residentes da zona rural apresentaram valores mais elevados em comparação aos
 283 urbanos, com significância estatística (Fig. 5B).

284



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286

287 **Figure 5.** Light (A) and activity levels(B) per hour during days off of rurals and town
 288 participants ($n=42$). *Repeated measures ANOVA* show significant differences in
 289 activity levels ($F=15.79, p=0.0006$) and no differences in light exposure ($F=0.40$
 290 $p=0.5322$) among two groups. Significant differences were found for time of day in
 291 activity levels ($F=2.19, p=0.0330$) and time of day for light exposure ($F=10.77,$
 292 $p<0.0001$).

293

294 The mean values of consumption of research plots were, respectively, the differences
295 between urban residents (2840.49 Kcal, SD 697.92 kcal) and rural (2105.87 Kcal, SD
296 624.87 Kcal) (Student t test , $t = -3.5562$, $p = 0.0010$).

297 Ingestion of fats (g) and proteins (g) were higher among urban participants
298 (94.19g, SD 29.39g and 120.66g, SD 33.91g, respectively) compared to rural ones
299 (56.44g, SD 21.82g and 87.30g, SD 31.21 g) with differences between means
300 (Student's t-test: $t = -4.7080$, $p < 0.0001$ et $= -3.2789$, $p = 0.0022$, respectively).

301 With the ingestion of carbohydrates (g), there was a reduction of the
302 differences in the population of origin (305.96g SD 120.46g) and the city residents
303 (370.13g SD 91.86g) (Student's t test, $t = -1 , 8934$, $p = 0.0657$).

304 From the calculation of social jet lag, possible correlations between
305 midsleep (MSFc), body mass index (BMI) and energy intake (Kcal) of the
306 participants were tested. However, no significant correlations were found ($p < 0.05$)
307 (Fig 6, 7 and 8).

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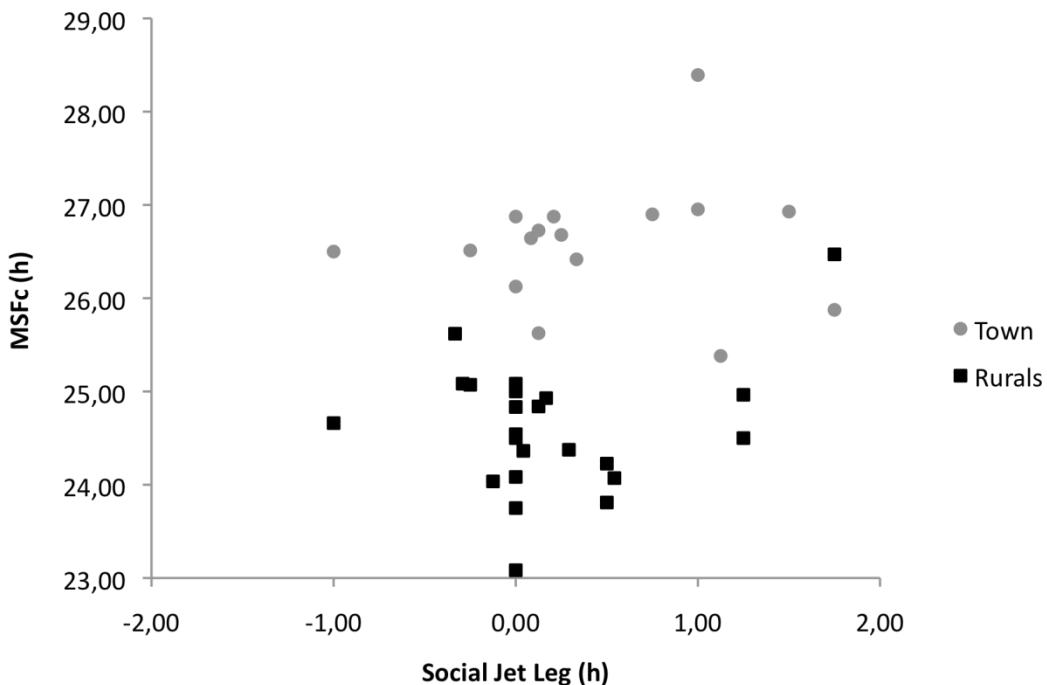
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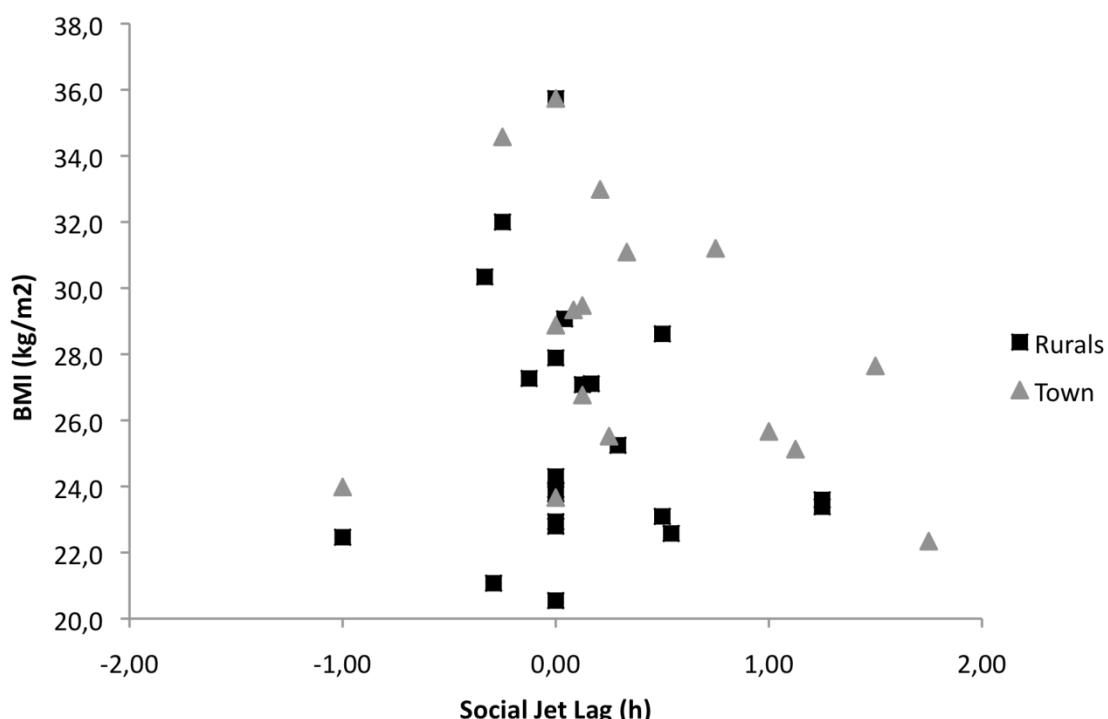
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317 **Figure 6.** Social jet lag (decimal hours) and midsleep (MSFc - decimal hours)
 318 calculated from Munich questionnaire for town (n=20) and rural residents (n=22).
 319 Spearman's rho = 0.2238, p=0.1709.

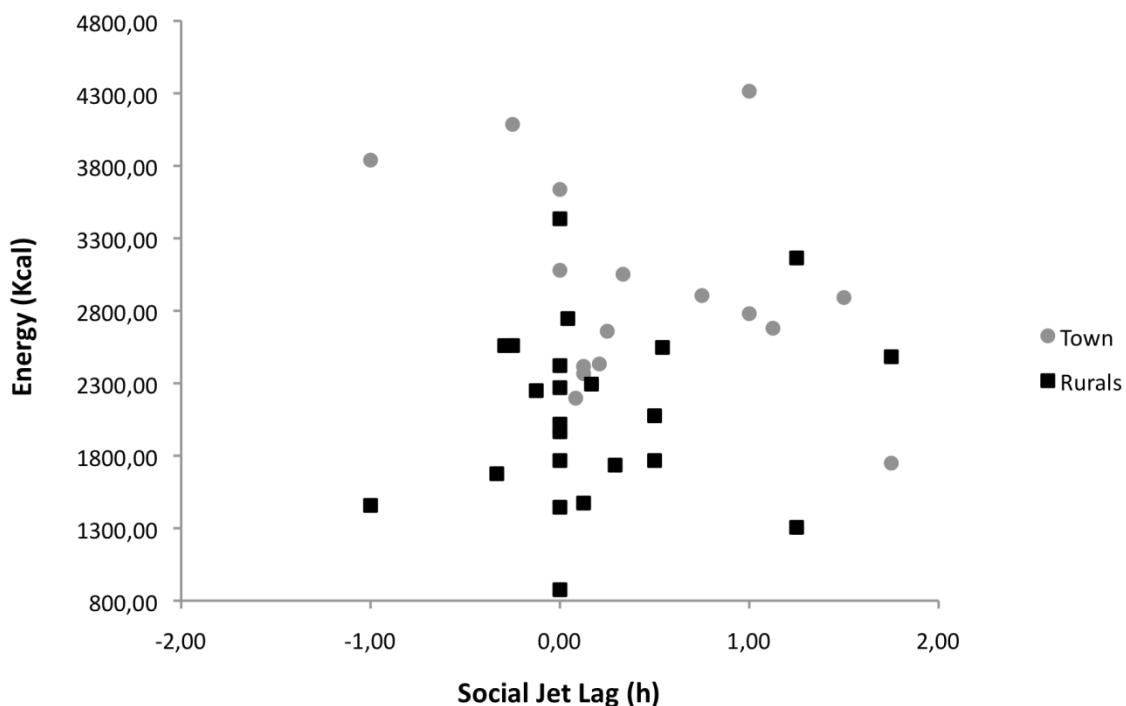
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322 **Figure 7.** Social jet lag (decimal hours) and body mass index (BMI) for town (n=20)
 323 and rural residents (n=22). Spearman's rho = - 0.1745, p=0.2881.

324



325

326 **Figure 8.** Social jet lag (decimal hours) and daily energy intake (Kcal) for town
 327 (n=20) and rural residents (n=22). Spearman's rho = 0.0899, p=0.5865.

328

329 Discussion

330 Increasing modernization and urbanization in Brazil reach many distant
 331 regions and communities, bringing with them changes in life habits that can impact
 332 health population, increasing metabolic risks, as well as the development of
 333 cardiovascular diseases and the reduction of quality of life. According to Vasanti and
 334 collaborators (2013), the negative consequences of the urbanized lifestyle are the
 335 result of profound changes related to technological advances, intense mechanization,
 336 changes in housing environment, greater availability and food options, reduction of
 337 sleep duration and greater availability of social activities in the night time period. All

338 these aspects together impact the quality of the diet, significantly reduce daily energy
339 expenditure and contribute to increase obesity.

340 In our research, we describe the differences between an urban and rural
341 population in aspects related to nutritional status, especially overweight and obesity,
342 as well as metabolic factors associated with the risk of non communicable diseases
343 and sleep quality. Our findings reinforce the presence of overweight and obesity
344 among town residents, as well as important biochemical markers for altered metabolic
345 diseases (fasting glucose, fasting insulin and insulin resistance by the Homa-IR
346 index).

347 Studies have shown a strong relationship between the urbanization process and
348 the presence of non-communicable diseases, especially associated risk factors, such as
349 overweight, high blood pressure, changes in serum lipids and insulin resistance
350 (FATEMA et al., 2016; NOVAK et al., 2012; ALLENDER et al., 2010; MONDA et
351 al., 2007). Non-communicable diseases, such as cardiovascular diseases and diabetes,
352 have a huge impact on socioeconomic development, especially for developing
353 countries, as it affects the economically active population, resulting in lost
354 productivity (ALWAN & MACLEAN, 2009; NUGENT, 2008; LLOYD-WILLIAMS
355 et al., 2008).

356 On the other hand, our findings reveal rural habitants in adequate weight and
357 without the presence of metabolic alterations. However, they show lifestyle habits
358 recognized as deleterious, such as the high prevalence of smoking and alcohol
359 consumption. The literature reports that rural work, which in itself requires greater
360 physical strength and lower educational level, may contribute significantly to a lower
361 prevalence of cardio-metabolic risk factors among communities, since levels of

362 physical effort in work activities are higher compared to work activities in cities
363 (OBIRIKORANG et al., 2015; ASSAH et al., 2015; ASSAH et al., 2011; GREGORY
364 et al., 2007; FORD et al., 1991).

365 In Brazil, this tendency is particularly observed in the North and Northeast
366 regions, so that physical activity is carried out as a function of work and
367 transportation to the same and not aimed at improving the quality of life (KNUTH et
368 al., 2011), fact this is evidenced in our findings.

369 Also in this context, we highlight our results regarding sleep patterns,
370 characterized by a delay in sleep offset and waking up hours, as well as a shorter sleep
371 duration among the urban community when compared to the rural ones. However, the
372 quality of sleep of rural residents is worse, since they present a more fragmented sleep
373 and a high number of nocturnal awakenings (*data not shown*).

374 Once again, the literature shows the relationship between the intense physical
375 effort in rural work and the quality of sleep. Martins et al. (2016) in a study with a
376 similar population in the Amazon found the presence of musculoskeletal pain due to
377 the work effort associated with the presence of sleep disorders. Moreno et al. (2016)
378 also show that rural work is an important predictor for insomnia and musculoskeletal
379 pain.

380 Benjamini et al. (2016) when describing the quality of sleep in a Brazilian
381 rural population found a high prevalence (34.9%) of poor sleep quality. According to
382 the authors, high prevalences for poor sleep quality are a common finding in rural
383 communities marked by strenuous work activities. Another study in rural
384 communities and in small African cities found worse sleep quality among rural ones
385 due to the worse conditions of the sleeping places and also the intense work activity.
386 In addition, residents of the small city with access to electricity also present delays in

387 sleep onset (BEALE et al., 2017). The authors of the study also point out that some
388 aspects of the urban environment can have beneficial effects on sleep, such as access
389 to more comfortable sleeping places, safer homes, adequate room temperature, etc.

390 In our study, urban residents have labor activities with less physical effort and
391 access to more comfortable environmental conditions for the promotion of sleep,
392 corroborating the recent literature findings mentioned above.

393 However, even in the face of possible benefits generated by urbanization,
394 our findings demonstrate a shorter duration of sleep, later sleep onset, later wake up
395 time, less light exposure during work days, higher caloric intake, body mass in the
396 scientific literature and reinforced by our findings among urban participants.

397 Patel and Hu (2008) in an important review study showed that a shorter
398 sleep duration increases the risk for obesity. It is well described in the literature that
399 sleep deprivation reduces leptin levels and increases ghrelin levels, thus altering
400 metabolism, altering satiety and contributing to increased obesity (SPIEGEL et al.,
401 2004; PATEL et al. , 2006; GOLLEY et al., 2013).

402 In addition to sleep, exposure to light has been a recurring research topic
403 associated with obesity. According to Reid and co-workers (2014), exposure to
404 moderate light levels at biologically appropriate times may influence body weight
405 regardless of sleep duration and time of onset. Obayashi et al. (2016), in a cohort
406 study, demonstrated that exposure to light during the night and reduction of light
407 exposure throughout the day were associated with an increase in obesity indicators in
408 the elderly population evaluated regardless of duration and onset of the disease. sleep.
409 It was estimated a 10% increase in BMI and 10.2% in waist / hip ratio in 10 years. For
410 the authors, increasing nocturnal light and reducing exposure to natural light are

411 common features of modern society and an important risk factor for obesity to be
412 considered for the health of the population.

413 One of the possible mechanisms that explain the direct relationship between
414 light exposure and body weight independent of caloric intake may be the influence of
415 light on the secretion of hormones, such as melatonin. Exposure to daylight may alter
416 nocturnal levels of melatonin and the sensitivity of the circadian oscillator to light.
417 These factors may influence the metabolism and control of body weight (SMITH et
418 al., 2004; CHANG et al., 2011; OBAYASHI et al., 2012).

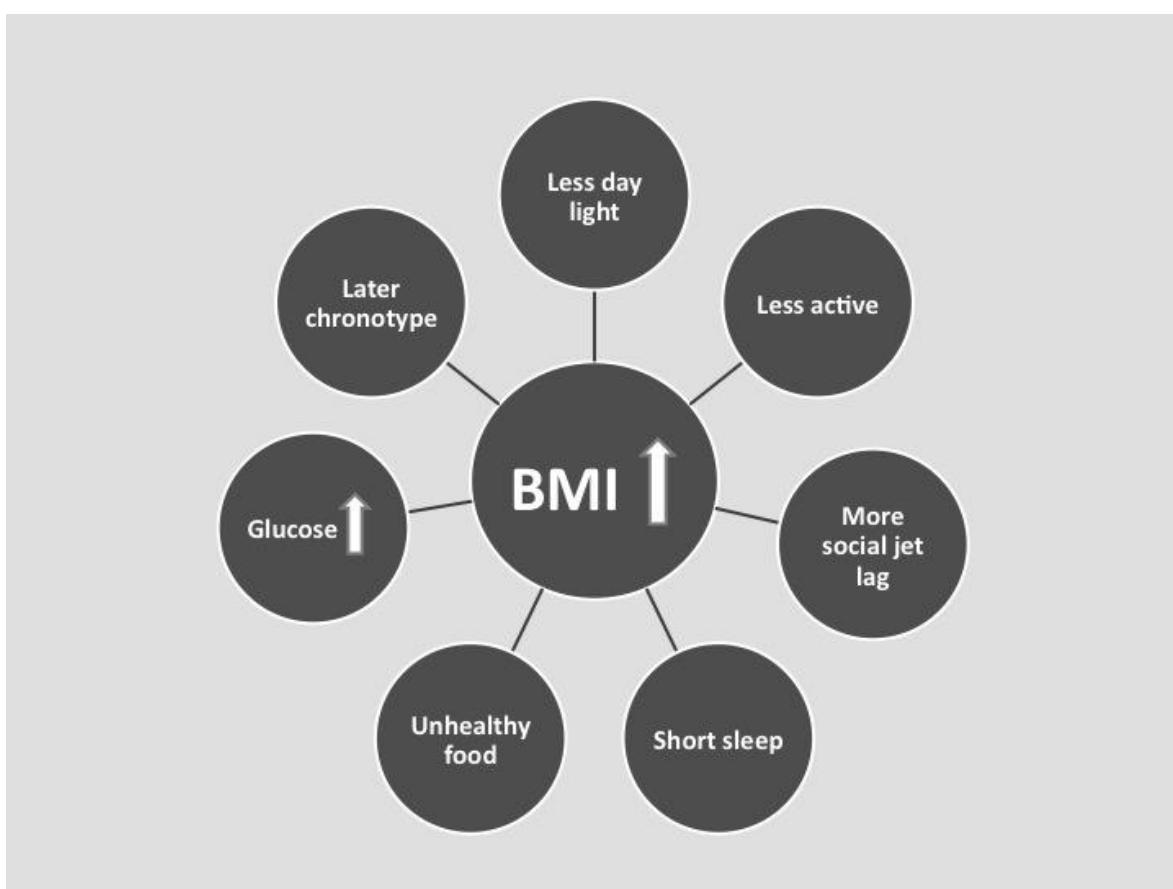
419 Changes in melatonin concentrations may also affect insulin sensitivity, and
420 studies in humans have shown that suppression of this hormone in the body (by
421 excessive night light for example) is a risk factor for type 2 diabetes (PESCHKE et
422 al., 2013; ZANUTO et al., 2013, McMULLAN et al., 2013). This fact also
423 corroborates the findings of our research, since hyperglycemia and higher insulin
424 resistance profile was observed among the residents of the small city, with greater
425 access to modern facilities and greater exposure to light at night during working days.

426 Another important aspect to be discussed in the genesis of weight gain is
427 dietary intake. Several studies, both in humans and in animal models, state that eating
428 foods at times when they should be reserved for sleep can lead to overweight and
429 metabolic diseases (COLLES et al., 2007; ARBLE et al., 2009; SALGADO-
430 DELGADO et al., 2010; BARON et al., 2013).

431 According to McHill et al. (2017), when evaluating 110 adult subjects, the
432 food intake schedule related to the onset of melatonin secretion was associated with
433 body mass index and body fat percentage. These associations are independent of other
434 factors widely discussed in relation to diet, such as the amount of energy and nutrients
435 ingested.

436 In our findings the food consumption schedules were not explored for the
 437 present manuscript, however, it is highlighted a greater energy consumption by city
 438 dwellers in relation to the rural ones. This can be explained not only by the greater
 439 access to processed foods and higher caloric density found in supermarkets and
 440 cafeterias in the city, but also by the greater window of availability for the
 441 consumption of meals at later times by the urban dwellings in relation to the rural
 442 ones , thus contributing as an important factor to the excess weight found in the
 443 sample.

444 In view of the described scenario, we highlight in our results the main
 445 factors associated to the higher body mass index among city residents, as shown by
 446 the scheme in figure 9.



469 **Figure 9.** Explanatory model scheme proposed by the study.
 470

471 It should also be pointed out that some aspects of urbanization, such as greater
472 access to the health and education system, could contribute positively to the
473 improvement of the issues mentioned above. However, in developing countries such
474 as Brazil, the growth of urban areas occurs rapidly, without planning and without the
475 basic structures so that the problems of urbanization impact especially on the poorest
476 populations of these regions (VASANTI et al., 2013; POPKIN, 2009; FRASER,
477 2005).

478 Xu et al. (2014) point out this aspect in a study of rural and urban populations
479 in Shaanxi Province, China, which is undergoing an accelerated urbanization process.
480 The study found increased risk for metabolic syndrome among rural residents as a
481 result of recent sociodemographic and lifestyle changes. The authors discuss the fact
482 that rural communities in the process of urbanization share the same problems as
483 cities, such as soil, water and air contamination, but do not have access to the same
484 conveniences as hospitals, health care, adequate housing, education and places for
485 recreation and leisure activities.

486 In conclusion, our findings show an association between town residents and
487 the presence of risk factors for metabolic disorders like overweight, insulin resistance,
488 increased glucose, short sleep duration, less natural light exposure. However, in a
489 developing country like Brazil, rural populations presents worse sleep quality and the
490 adoption of unhealthy lifestyle's practices, like smoking and alcohol consuption.

491 This overview provides a dimension of the new challenges to be faced in
492 terms of public health with the advancement of the contemporary lifestyle within the
493 country and its potential health risks in concomitance with the old health problems of

494 rural areas, characterized by poor access to basic health care, low educational level,
495 low income and inadequate working conditions.

496 **Conflicts of interest statement**

497
498 We declare no conflicts of interest.

499

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ANEXO 4 – QUESTIONÁRIO



UNIVERSIDADE DE SÃO PAULO
FACULDADE DE SAÚDE PÚBLICA
DEPARTAMENTO DE SAÚDE AMBIENTAL

DADOS DE IDENTIFICAÇÃO

Entrevistador (a):
1. Data da entrevista:
2. Local da entrevista:
<input type="checkbox"/> Cooperativa dos seringueiros <input type="checkbox"/> Residência <input type="checkbox"/> Local de Trabalho <input type="checkbox"/> Outros.
3. Sexo do entrevistado:
<input type="checkbox"/> F <input type="checkbox"/> M
4. Qual a sua data de nascimento?
<hr style="display: inline-block; width: 100px; vertical-align: middle;"/> / <hr style="display: inline-block; width: 100px; vertical-align: middle;"/> / <hr style="display: inline-block; width: 100px; vertical-align: middle;"/>
5. Em que cidade você nasceu?
<hr style="border: none; border-top: 1px solid black; margin-bottom: 10px;"/>
6. Qual seu local de residência?
<input type="checkbox"/> Cidade (parte urbana Xapuri) <input type="checkbox"/> Reserva Extrativista
7. Qual a sua ocupação?
<input type="checkbox"/> Seringueiro

Trabalhador da cidade. O quê faz? _____

8. Há luz elétrica na sua residência?

Sim

Não

ANTROPOMETRIA

9. Peso: _____ kg	IMC (Índice de Massa Corporal) _____ kg
10. Altura: _____ metros	
11. Circunferência quadril: _____ cm	
12. Circunferência cintura: _____ cm	

QUESTIONÁRIO SOCIODEMOGRÁFICO

14. Você estudou?

Sim

Não (PASSE PARA A PERGUNTA 17)

15. Você estudou até o:

Primário incompleto

Ensino Fundamental completo (terminou a 8^a série)

Ensino Médio incompleto (não terminou o 3º colegial)

Ensino Médio completo (terminou o 3º colegial)

Faculdade incompleta

Faculdade completa

Pós-Graduação completa

Pós-Graduação incompleta

16. Você estuda atualmente?

Sim (Em qual horário) _____

Não

17. Estado conjugal atual é:

Solteiro(a)

Casado(a) / Vive com companheiro(a)

Separado(a) / Divorciado(a)

Viúvo(a)

18. Alguma criança mora com você? (Pode ser seu filho ou não)

Sim

Não

19. Quantas crianças moram com você de acordo com a idade delas (PODE HAVER MAIS DE 1 OPÇÃO)

Menor que 1 ano _____ criança (s)

De 1 a 5 anos _____ criança (s)

De 6 a 10 anos _____ criança (s)

De 11 a 15 anos _____ criança (s)

20. Você fuma cigarro (comum, de palha, cachimbo ou masca tabaco)?

Sim

Não

21. Quantos cigarros você fuma por dia? _____

22. Você bebe?

Sim

Não

23. Com que freqüência você bebe nessas ocasiões?

Menos de 1 vez por mês

1 vez por mês

A cada 15 dias

1 a 2 vezes por semana

3 a 5 vezes por semana

6 a 7 vezes por semana

24. Você costuma tomar algum medicamento?

Sim. Qual? _____

Não

25. Há quanto tempo você toma esse medicamento (meses/anos) _____

26. Este medicamento tem prescrição médica?

Sim

Não

27. Você pratica exercício físico?

Não

Sim. Qual? _____

28. Quantas vezes por semana você pratica exercício físico?

1 vez por semana

De 2 a 3 vezes por semana

Mais do que 3 vezes por semana

29. Qual seu tipo de vínculo empregatício?

Celetista

Cooperativado

Autônomo

Contrato temporário (Quanto tempo dura esse contrato?) _____

Terceirizado

Estatutário

Outro (Qual?) _____

30. Como são seus horários de trabalho:

Diurno Fixo: _____ às _____ horas

Outro (Qual?) _____

31. Quantas horas você trabalha por semana?

32. Você tem folgas no trabalho?

Sim

Não

33. Quantos dias de folga você tem?

1 dia

1 dia e meio

2 dias

3 dias

4 dias ou mais

34. Como é sua escala de folga?

MORBIDADES REFERIDAS (ICT)

Na sua opinião, quais das lesões por acidentes ou doenças citadas abaixo, **você possui atualmente?** Marque também aquelas que foram **confirmadas pelo médico que você possui atualmente**. E marque com um X se **faz uso de medicação para a lesão (s) / doença (s) assinalada (s)**.

DEIXE EM BRANCO CASO NÃO TENHA NENHUM DOS PROBLEMAS DESCritos ABAIXO.

		Em minha opinião	Diagnóstico médico	Faz uso de medicamento
1.	Dor nas costas que se irradia para perna (ciático)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Artrite reumatoide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Outra doença músculo-esquelética. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Hipertensão arterial (pressão alta)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Doença coronariana, dor no peito durante exercício (angina pectoris)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Infarto do miocárdio, trombose coronariana	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Insuficiência cardíaca	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	Outra doença cardiovascular. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	Infecções repetidas do trato respiratório (incluindo sinusite aguda, amigdalite, bronquite aguda)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.	Bronquite crônica	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.	Sinusite crônica	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.				

	Asma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.	Enfisema	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.	Tuberculose pulmonar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15.	Outra doença respiratória. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16.	Distúrbio emocional severo (exemplo, depressão severa)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17.	Distúrbio emocional leve (exemplo, depressão leve, tensão, ansiedade, insônia)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18.	Problema ou diminuição da audição	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19.	Doença ou lesão da visão (não assinale se apenas usa óculos e/ou lentes de contato de grau)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20.	Doença neurológica (acidente vascular cerebral ou “derrame”, neuralgia, enxaqueca, epilepsia)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21.	Outra doença neurológica ou dos órgãos dos sentidos. Qual?_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22.	Pedras ou doenças da vesícula biliar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23.	Doença do pâncreas ou do fígado	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24.	Úlcera gástrica ou duodenal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25.	Gastrite ou irritação duodenal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

26.	Colite ou irritação do cólon	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27.	Outra doença digestiva. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28.	Infecção das vias urinárias	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29.	Doença dos rins	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30.	Doença dos genitais e aparelho reprodutor (exemplo, problema nas trompas ou ovários, ou na próstata)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31.	Outra doença geniturinária. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32.	Alergia, eczema	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33.	Outra erupção. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34.	Outra doença na pele. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35.	Tumor benigno	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36.	Tumor maligno (câncer). Onde? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37.	Obesidade	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38.	Diabetes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39.	Bócio ou outra doença da tireóide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40.	Outra doença endócrina ou metabólica. Qual?			

	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41.	Anemia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42.	Outra doença do sangue. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43.	Defeito de nascimento. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44.	Outro problema ou doença. Qual? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IPAQ

As perguntas estão relacionadas ao tempo que você gasta fazendo atividade física em uma semana **NORMAL / HABITUAL**.

Para responder as questões lembre que:

Atividades físicas VIGOROSAS são aquelas que precisam de um grande esforço físico e que fazem respirar MUITO mais forte que o normal.

Atividades físicas MODERADAS são aquelas que precisam de algum esforço físico e que fazem respirar UM POUCO mais forte que o normal.

SEÇÃO 1 – ATIVIDADE FÍSICA NO TRABALHO

Esta seção inclui as atividades que você faz no seu trabalho, remunerado ou voluntário. **NÃO INCLUIR** as tarefas domésticas, cuidar do jardim e da casa, tomar conta da sua família ou o transporte para o trabalho. Estas serão incluídas na Seção 3.

Pense apenas naquelas atividades que durem pelo menos 10 minutos contínuos.

102. Em quantos dias de uma semana normal você realiza **atividades vigorosas**, por pelo menos 10 minutos contínuos, como trabalho de construção pesada, levantar e transportar objetos pesados, trabalhar com enxadas ou pá, cavar valas ou buracos, ou subir escadas, **como parte do seu trabalho**:

_____ dias por semana () Nenhum → **Vá para questão 103**

103. Quanto tempo, no total, você geralmente gasta POR DIA fazendo essas atividades físicas rigorosas, **como parte do seu trabalho?**

_____ horas _____ minutos/dia

104. Em quantos dias de uma semana normal você faz **atividades moderadas**, por pelo menos 10 minutos contínuos, como caminhar rapidamente, levantar e transportar pequenos objetos, **como parte do seu trabalho?**

_____ dias por SEMANA () Nenhum → **Vá para questão 105**

105. Quanto tempo, no total, você geralmente gasta POR DIA fazendo essas atividades moderadas, **como parte do seu trabalho?**

_____ horas _____ minutos/dia

106. Em quantos dias de uma semana normal você **caminha**, durante pelo menos 10 minutos contínuos, **como parte do seu trabalho?** (**NÂO INCLUA o caminhar como forma de transporte para ir ou voltar ao trabalho**)

_____ dias por SEMANA () Nenhum → **VÁ PARA A SEÇÃO 2 – TRANSPORTE**

107. Quanto tempo, no total, você geralmente gasta POR DIA caminhando **como parte do seu trabalho?** (**NÂO INCLUA o caminhar como forma de transporte para ir ou voltar ao trabalho**)

_____ horas _____ minutos/dia

108. Quando você caminha, **como parte do seu trabalho**, a que passo você geralmente anda? (**NÂO INCLUA o caminhar como forma de transporte para ir ou voltar ao trabalho**)

() Passo rápido/vigoroso () Passo moderado () Passo Lento

SEÇÃO 2 – ATIVIDADE FÍSICA COMO MEIO DE TRANSPORTE

Estas questões se referem à forma típica como você se desloca de um lugar para outro, incluindo seu trabalho, cinema, lojas e outros.

109. Em quantos dias de uma semana normal você anda de carro, moto, ônibus, trem e/ou metrô?

_____ dias por SEMANA () Nenhum → **Vá para questão 110**

110. Quanto tempo, no total, você geralmente gasta POR DIA andando de carro, moto, ônibus, trem e/ou metrô?

_____ horas _____ minutos/dia

Agora pense somente em relação a caminhar ou pedalar para ir de um lugar a outro **como meio de transporte**.

111. Em quantos dias de uma semana normal você **anda de bicicleta** por pelo menos 10 minutos contínuos para ir de um lugar para outro? (**NÃO INCLUA o pedalar por lazer ou exercício**)

_____ dias por SEMANA () Nenhum → **Vá para a questão 113**

112. Nos dias que você pedala, quanto tempo no total, você gasta para ir de um lugar para outro? (**NÃO INCLUA o pedalar por lazer ou exercício**)

_____ horas _____ minutos/dia

113. Quando você anda de bicicleta, a que velocidade você costuma pedalar? (**NÃO INCLUA o pedalar por lazer ou exercício**)

() rápida () moderada () lenta

114. Em quantos dias de uma semana normal você **caminha**, por pelo menos 10 minutos contínuos, para ir de um lugar para outro? (**NÃO INCLUA as caminhadas por lazer ou exercício**)

_____ dias por SEMANA () Nenhum → **VÁ PARA SEÇÃO 3 – ATIVIDADE FÍSICA EM CASA**

115. Quando você caminha para ir de um lugar para outro, quanto tempo POR DIA você gasta? (**NÃO INCLUA as caminhadas por lazer ou exercício**)

_____ horas _____ minutos/dia

116. Quando você caminha para ir de um lugar a outro, a que passo você normalmente anda? (**NÃO INCLUA as caminhadas por lazer ou exercício**)

() Passo rápido/vigoroso () Passo moderado () Passo lento

SEÇÃO 3 – ATIVIDADE FÍSICA EM CASA: TRABALHO, TEREFAS DOMÉSTICAS E CUIDAR DA FAMÍLIA

Esta parte inclui as atividades físicas que você faz em uma semana NORMAL, dentro e ao redor da sua casa. Por exemplo: trabalho doméstico, cuidar do jardim, cuidar do quintal, trabalho de manutenção da casa ou cuidar de sua família. Novamente, pense somente naquelas atividades físicas com duração de pelo menos de 10 minutos contínuos.

117. Em quantos dias de uma semana normal você faz **atividades vigorosas** no jardim ou quintal, por pelo menos 10 minutos, como carpir, cortar lenha, cavar, levantar ou transportar objetos pesados e lavar ou esfregar o chão?

_____ dias por SEMANA () nenhum → **Vá para a questão 118**

118. Nos dias que faz este tipo de atividades físicas vigorosas no quintal ou jardim, quanto tempo no total, você gasta POR DIA?

_____ horas _____ minutos/dia

119. Em quantos dias de uma semana normal você faz **atividades moderadas** no jardim ou quintal, por pelo menos 10 minutos, como levantar e carregar pequenos objetos, limpar vidros, varrer, rastelar?

_____ dias por semana () nenhum → **Vá para questão 120**

120. Nos dias que você faz este tipo de atividades físicas moderadas no jardim ou no quintal, quanto tempo no total, você gasta **POR DIA**?

_____ horas _____ minutos/dia

121. Em quantos dias de uma semana normal você faz **atividades moderadas**, por pelo menos 10 minutos contínuos, como carregar pesos leves, limpar vidros, varrer ou limpar o chão dentro de sua casa?

_____ dias por SEMANA () Nenhum → **VÁ PARA A SEÇÃO 4 - RECREAÇÃO**

122. Nos dias que você faz este tipo de atividades físicas moderadas dentro da sua casa, quanto tempo no total, você gasta **POR DIA**?

_____ horas _____ minutos/dia

SEÇÃO 4 – ATIVIDADES FÍSICAS DE RECREAÇÃO, ESPORTE, EXERCÍCIO, E DE LAZER

Esta seção se refere às atividades físicas que você faz em uma semana NORMAL unicamente por recreação, esporte, exercício ou lazer. Novamente, pense apenas nas atividades físicas que faz por pelo menos 10 minutos contínuos. Por favor, NÃO inclua atividades que você já tenha citado.

123. Sem contar qualquer caminhada que você tenha citado anteriormente, em quantos dias de uma semana normal, você **caminha**, por pelo menos 10 minutos contínuos, no seu tempo livre?

_____ dias por SEMANA () Nenhum → **Vá para a questão 125**

124. Nos dias em que você caminha no seu tempo livre, quanto tempo no total, você gasta **POR DIA**?

_____ horas _____ minutos/dia

125. Quando você caminha no seu tempo livre, a que passo você normalmente anda?

() Passo rápido/vigoroso () Passo moderado ()
Passo lento

126. Em quantos dias de uma semana normal, você faz **atividades vigorosas** no seu tempo livre, por pelo menos 10 minutos contínuos, como correr, nadar rápido, pedalar rápido ou musculação pesada?

_____ dias por SEMANA () Nenhum → **Vá para a questão 127**

127. Nos dias em que você faz estas atividades vigorosas no seu tempo livre, quanto tempo no total, você gasta POR DIA?

_____ horas _____ minutos/dia

128. Em quantos dias de uma semana normal, você faz **atividades moderadas** no seu tempo livre, por pelo menos 10 minutos contínuos, como caminhar a passo rápido, pedalar ou nadar em ritmo moderado, musculação moderada, jogar vôlei recreativo ou futebol?

_____ dias por SEMANA () Nenhum → **VÁ PARA A SEÇÃO 5 – TEMPO GASTO SENTADO**

129. Nos dias em que você faz essas atividades moderadas no seu tempo livre, quanto tempo no total, você gasta POR DIA?

_____ horas _____ minutos/dia

SEÇÃO 5 – TEMPO GASTO SENTADO

Estas últimas questões são sobre o tempo que você permanece sentado, no trabalho, na escola, em casa e durante o seu tempo livre. Isto inclui o tempo sentado lendo, sentado enquanto descansa, visitando um amigo, sentado ou deitado assistindo TV. Não inclua o tempo gasto sentado durante o transporte.

130. Quanto tempo no total, você gasta sentado durante **um dia de semana normal?**

_____ horas _____ minutos/dia

131. Quanto tempo no total, você gasta sentado durante **um dia de final de semana normal?**

_____ horas _____ minutos/dia

Obrigada pela sua participação,

Equipe de pesquisa:

Coordenadora :Profa. Dr^a. Claudia Roberta de Castro Moreno

Pesquisadora:

Andressa Juliane Martins

Tel.: (11) 3061-7712 – Ramal 229/227

ANEXO 5 – PROTOCOLOS DE ATIVIDADES DIÁRIAS

PROTOCOLO DE ATIVIDADES

Nº Questionário: _____

DATA: _____ / _____ / _____

DIA DA SEMANA: _____

NºACT:_____

	Folga																		
---	-------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Caso tenha tomado algum medicamento (ou remédio para dormir ou ficar acordado), por favor, anote o horário em que tomou esse remédio e o nome do medicamento: _____

ANEXO 6 – RECORDATÓRIO ALIMENTAR DE 24H

Nº do questionário: _____

Data da entrevista: _____/_____/_____

ANEXO 7 – FOLHA DE APROVAÇÃO DO COMITÊ DE ÉTICA

FACULDADE DE SAÚDE
PÚBLICA DA UNIVERSIDADE
DE SÃO PAULO



PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Padrão alimentar, ritmos biológicos e repercuções na saúde de trabalhadores de uma reserva extrativista amazônica.

Pesquisador: Andressa Juliane Martins

Área Temática:

Versão: 1

CAAE: 44860515.0.0000.5421

Instituição Proponente: Faculdade de Saúde Pública da Universidade de São Paulo - FSP/USP

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.127.697

Data da Relatoria: 22/05/2015

Apresentação do Projeto:

O projeto apresenta-se descrito de forma satisfatória, indicando o contexto da pesquisa e incluindo revisão de literatura apropriada na temática.

Objetivo da Pesquisa:

Avallar associação entre ritmos biológicos e padrões alimentares de indivíduos adultos residentes na região amazônica, sendo um grupo de indivíduos residentes em meio urbano e um grupo de indivíduos residentes em reserva extrativista.

Avallação dos Riscos e Benefícios:

A avaliação de riscos e benefícios apresentada no projeto inclui descrição dos riscos decorrentes de coleta de amostras de sangue e saliva para análise, assim como entrega de resultados dos diagnósticos realizados e orientação para busca de serviços de saúde em caso de detecção de problemas de saúde.

Comentários e Considerações sobre a Pesquisa:

O projeto inclui coleta de dados sociodemográficos, antropométricos e padrões de alimentação dos grupos a serem avaliados em questionários específicos, além de coleta de amostras de sangue e saliva para realização de exames bioquímicos relacionados à associação entre ritmos biológicos e padrões alimentares de indivíduos adultos.

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FACULDADE DE SAÚDE
PÚBLICA DA UNIVERSIDADE
DE SÃO PAULO



Continuação do Parecer: 1.127.697

Considerações sobre os Termos de apresentação obrigatória:

O termo de consentimento livre e esclarecido apresenta as principais características do projeto de forma clara e sucinta, indicando um conjunto de informações similares às apresentadas no projeto de pesquisa submetido.

Recomendações:

Pela ausência de pendências, recomenda-se aprovação do projeto de pesquisa por este CEP.

Conclusões ou Pendências e Lista de Inadequações:

O projeto de pesquisa apresenta informações claras e necessárias à condução de pesquisa envolvendo seres humanos, assim como documentação completa para prosseguimento do estudo proposto.

Pela aprovação.

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

Considerações Finais a critério do CEP:

Acatado parecer do relator pela aprovação.

SAO PAULO, 28 de Junho de 2015

Assinado por:

Sandra Roberta Gouveia Ferreira Vivolo
(Coordenador)

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ANEXO 8 – TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título do Projeto de Pesquisa: Padrão alimentar, ritmos biológicos e repercussões na saúde de trabalhadores de uma reserva extrativista amazônica.

Pesquisadores responsáveis: Claudia Roberta de Castro Moreno e Andressa Juliane Martins

O senhor está sendo convidado a participar como voluntário de uma pesquisa científica, cujo objetivo é investigar se a relação do seu consumo alimentar com horários de dormir e acordar pode afetar sua saúde. A pesquisa será realizada em uma etapa. O senhor será entrevistado por cerca de 30 minutos e responderá a perguntas que possibilitará o conhecimento acerca de dados sociodemográficos, hábitos de vida e presença de doenças. Serão aferidas variáveis antropométricas, que consistirão em peso, altura e circunferência da cintura, por meio de uma fita métrica e balança portátil. Após a entrevista, o senhor utilizará um aparelho chamado actímetro, semelhante a um relógio, durante 7 dias e preencherá um diário de atividades conforme nossa orientação, para que possamos conhecer melhor seu sono. Durante esses 7 dias, nos encontraremos novamente para pequenas entrevistas em relação à sua ingestão de alimentos durante 3 dias alternados.

Além disso, coletaremos amostras de saliva para a análise de um hormônio chamado melatonina, que tem relação aos seus horários de dormir e acordar. Para isso, pediremos que o senhor cuspa em um recipiente a cada 30 minutos entre 18:00 e 22:00 horas, em um dia de trabalho e um dia de folga. Também serão coletadas amostras de sangue, para a avaliação da glicemia de jejum (açúcar no sangue), triglicérides, colesterol total e frações (gordura no sangue) e um hormônio chamado insulina, que regula os níveis de açúcar no sangue. A coleta será feita por enfermeiro habilitado e treinado, seguindo todas as normas e procedimentos de segurança e higiene preconizados, para não haver riscos ao senhor. Entretanto, observamos que há a possibilidade de ocorrer riscos e desconfortos relacionados à coleta venosa, ainda que raros e passageiros, como dor localizada no local da punção e hematoma. Desmaios ou infecções no local da punção são raros.

A pesquisa resguardará o anonimato dos participantes em publicações científicas futuras. Este projeto foi submetido ao Comitê de Ética em Pesquisa da Faculdade de Saúde Pública da Universidade de São Paulo, sítio à Av. Dr. Arnaldo, 715, Cerqueira César – CEP 01246-904, São Paulo, SP, telefone (11) 3061-7779 – e-mail: coep@fsp.usp.br.

Avaliação de Risco da Pesquisa

- () Sem Risco (X) Risco Mínimo () Risco Médio
 () Risco Baixo () Risco Maior

Após ler e receber explicações sobre a pesquisa, e ter meus direitos de:

1. Receber resposta a qualquer pergunta e esclarecimento sobre os procedimentos, riscos, benefícios e outros relacionados à pesquisa;
2. Retirar o consentimento a qualquer momento e deixar de participar do estudo;
3. Não ser identificado e ser mantido o caráter confidencial das informações relacionadas à privacidade. Caso tenha interesse, poderei conhecer o resultado de meus exames de sangue;
4. Receber uma via deste termo de consentimento livre e esclarecido;
5. Procurar esclarecimentos com a pesquisadora responsável no Departamento de Saúde Ambiental da Faculdade de Saúde Pública da Universidade de São Paulo, sítio à Av. Dr. Arnaldo, 715, Cerqueira César – CEP 01246-904, São Paulo, SP – Telefone: (11) 3061-7712, em caso de dúvidas ou notificação de acontecimentos não previstos.

Declaro que concordo em participar desse estudo e que me foi dada a oportunidade de ler e esclarecer as minhas dúvidas.

Xapuri _____ de _____ de 20____

Nome do Entrevistado: _____

Assinatura: _____

Nós, *Claudia Roberta de Castro Moreno e Andressa Juliane Martins*, declaramos que fornecemos todas as informações referentes ao projeto ao participante.

Assinatura: _____ Data: _____ / _____ / _____

Telefone: (11) 3061-7712 / (11) 98726-4456



Claudia Roberta de Castro Moreno

Endereço para acessar este CV: <http://lattes.cnpq.br/3142225155853707>

Última atualização do currículo em 28/05/2018

Possui graduação em Biologia pela Universidade Presbiteriana Mackenzie (1986), Mestrado em Saúde Pública pela Universidade de São Paulo (1993) e Doutorado em Saúde Pública pela Universidade de São Paulo (1998). Obteve bolsa de doutorado-sanduíche para realizar estágio no Institute for Circadian Physiology em Cambridge, EUA, de 1996 a 1997. Realizou pós-doutoramento na Faculdade de Saúde Pública/USP; no Instituto do Sono/Unifesp com bolsa de Jovem Pesquisador da Fapesp de 1999 a 2002 e no Stress Research Institute, Suécia, de 2014 a 2015. É Profa. Associada da Faculdade de Saúde Pública da Universidade de São Paulo; Professora Visitante do Stress Research Institute, Universidade de Estocolmo, Suécia, de 2015 a 2018; diretora da Working Time Society e da Associação Brasileira de Sono. Foi da Comissão de Avaliação Trienal da área de Saúde Coletiva da CAPES; Presidente da Comissão de Relações Internacionais da Faculdade de Saúde Pública da USP de 2010 a 2014; Vice-coordenadora do Programa de Pós-graduação em Saúde Pública da FSP/USP de 2008 a 2010 e Coordenadora do Programa de Pós-graduação em Saúde Pública de 2010 a 2012. Atua em uma interface entre a Psicologia do Trabalho, Cronobiologia e a Saúde Pública, com estudos sobre fatores psicosociais no trabalho e promoção da saúde, abordando questões ligadas à organização do trabalho e seus efeitos na saúde do trabalhador e suas famílias. Neste contexto publicou estudos relacionados a sono, ritmos biológicos, problemas cardiovasculares, metabolismo e nutrição. (Text informado pelo autor)

Identificação

Nome

Claudia Roberta de Castro Moreno

Nome em citações bibliográficas

MORENO, CRC;MORENO, CLAUDIA ROBERTA;MORENO, C.;MORENO, C.R.;Moreno, C. R.;Moreno, C. R. de C.;MORENO, C. R. de C.;Moreno, Claudia R. de C.;Moreno, Claudia Roberta;MORENO, CLAUDIA;C R Castro Moreno;CASTRO MORENO, Claudia Roberta;Moreno, Claudia R

Endereço

Endereço Profissional

Universidade de São Paulo, Faculdade de Saúde Pública.
Av. Dr. Arnaldo, 715
Cerqueira César
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URL da Homepage: www.fsp.usp.br

Formação acadêmica/titulação

1994 - 1998

Doutorado em Saúde Pública (Conceito CAPES 6).

Universidade de São Paulo, USP, Brasil.

Título: Fragmentação do sono e adaptação ao trabalho noturno, Ano de obtenção: 1998.

Orientador: Luiz Menna-Barreto.

Bolsista do(a): Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq, Brasil.

Palavras-chave: trabalho em turnos; sono; trabalho noturno; ritmo de temperatura; adaptação ao trabalho; gênero.

Grande área: Ciências da Saúde

Grande Área: Ciências da Saúde / Área: Saúde Coletiva / Subárea: Ergonomia /

Especialidade: Cronobiologia.

Setores de atividade: Saúde Humana; Mercado de Trabalho e Mão-De-Obra.

Mestrado em Saúde Pública (Conceito CAPES 6).

Universidade de São Paulo, USP, Brasil.

Título: Critérios cronobiológicos na adaptação ao trabalho em turnos alternantes: validação de um instrumento de medida, Ano de Obtenção: 1993.

Orientador: Frida Marina Fischer.

Bolsista do(a): Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP, Brasil.

Palavras-chave: trabalho em turnos; ritmo de temperatura; ciclo vigília-sono; saúde do trabalhador; ergonomia; instrumento de medida.

1989 - 1993



Andressa Juliane Martins

Endereço para acessar este CV: <http://lattes.cnpq.br/6750790333058181>
Última atualização do currículo em 07/12/2017

Doutoranda em Ciências pela Faculdade de Saúde Pública da USP. Realizou estágio-sanduíche junto ao Stress Research Institute, na Universidade de Estocolmo sob a supervisão do Prof.Dr. Arne Lowden. Mestre em Saúde Pública pela Faculdade de Saúde Pública da USP (2013). Nutricionista graduada pela Faculdade Católica Salesiana do Espírito Santo (2010). Experiência em pesquisa voltada para síndrome metabólica, nutrição e distúrbios do sono, hábitos alimentares, saúde do trabalhador e segurança alimentar e nutricional. Experiência no atendimento nutricional em pacientes pós-operatório em cirurgia bariátrica e em doença renal crônica. (**Texto informado pelo autor**)

Identificação

Nome

Nome em citações bibliográficas

Andressa Juliane Martins

MARTINS, A. J.; MARTINS, ANDRESSA JULIANE

Endereço

Formação acadêmica/titulação

2014

Doutorado em andamento em Doutorado em Ciências.

Faculdade de Saúde Pública - USP, FSP-USP, Brasil.

Título: Padrão alimentar, ritmos biológicos e repercussões na saúde de trabalhadores de uma reserva extrativista amazônica.

Orientador: Claudia Roberta de Castro Moreno.

Bolsista do(a): Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP, Brasil.

Mestrado em Mestrado em Saúde Pública.

Faculdade de Saúde Pública - USP, FSP-USP, Brasil.

Título: Sonolência e consumo de carboidratos entre motoristas de caminhão.,Ano de Obtenção: 2013.

Orientador: Claudia Roberta de Castro Moreno.

Bolsista do(a): Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES, Brasil.

Palavras-chave: estado nutricional; consumo alimentar; níveis de sonolência; saúde do trabalhador.

Grande área: Ciências da Saúde

Grande Área: Ciências da Saúde / Área: Saúde Coletiva / Subárea: Saúde Pública /

Especialidade: Saúde do Trabalhador.

Grande Área: Ciências da Saúde / Área: Nutrição.

Setores de atividade: Atividades de atenção à saúde humana.

Graduação em Nutrição.

Faculdade Católica Salesiana do Espírito Santo - Vitória, UNISALES, Brasil.

Título: Hábitos alimentares, resistência insulínica e síndrome metabólica: um estudo em bancários..

Orientador: Márcia Mara Corrêa.

Bolsista do(a): Ministério da Educação, PROUNI, Brasil.

2006 - 2010

Extensão universitária em Análise de Regressão Múltipla. (Carga horária: 40h).

Faculdade de Saúde Pública - USP, FSP-USP, Brasil.

Biologia do Sono. (Carga horária: 75h).

Universidade Federal de São Paulo, UNIFESP, Brasil.

Formação Complementar

2015 - 2015

Extensão universitária em Análise de Regressão Múltipla. (Carga horária: 40h).

Faculdade de Saúde Pública - USP, FSP-USP, Brasil.

2012 - 2012

Biologia do Sono. (Carga horária: 75h).

Universidade Federal de São Paulo, UNIFESP, Brasil.