Universidade Federal do Rio Grande do Sul
Faculdade de Medicina
Programa de Pós-Graduação em Ciências Médicas – Endocrinologia

Área de Concentração: Nutrição e Metabolismo
Mestrado

O EFEITO DO TRABALHO EM TURNOS NOS HÁBITOS ALIMENTARES: UMA REVISÃO SISTEMÁTICA

Renata Vieira de Souza

Orientadora: Profª Drª Jussara Carnevale de Almeida
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Porto Alegre, Novembro de 2017

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Formato da dissertação

Esta dissertação de Mestrado segue o formato proposto pelo Programa de Pós-Graduação em Ciências Médicas: Endocrinologia da Universidade Federal do Rio Grande do Sul, sendo apresentada através de uma breve revisão da literatura e manuscrito referente ao tema estudado:

Capítulo I. Referencial teórico
Capítulo II. Versão em português do artigo de revisão sistemática de literatura a ser submetido para publicação no periódico *Nutrition Reviews*, redigido conforme as normas do periódico.
O artigo será traduzido para língua inglesa antes do envio para revista.

Resumo da dissertação

O trabalho por turnos é definido como aquele realizado fora dos horários considerados "convencionais", por exemplo: pelo trabalho no turno noturno ou o trabalho de forma contínua, através do revezamento de equipes. Durante as últimas décadas, a proporção de trabalhadores que executam as atividades em escalas de turnos vem aumentando e, com as mudanças nas condições de trabalho, a organização do ambiente social, familiar, dos hábitos de vida e das necessidades básicas desses trabalhadores passou por significativas transformações, que podem causar danos saúde. O desenvolvimento de doenças crônicas não transmissíveis e distúrbios metabólicos em trabalhadores de turnos já é bastante evidenciado na literatura, e os estudos epidemiológicos demonstram associações consistentes entre o trabalho por turnos e a ocorrência de doenças, como obesidade, diabetes e síndrome metabólica. Além da relação entre alterações dos ritmos biológicos, disruptura do sistema circadiano e alterações metabólicas, mudanças comportamentais experienciadas pelos trabalhadores de turnos são apontadas como potenciais fatores de risco adicionais ao desenvolimento de doenças. Dentre as alterações nos hábitos de vida, a alimentação parece ser alterada em decorrência do trabalho por turno. Mudanças nos horários de sono, vigília, da atividade laboral, bem como na disponibilidade de alimentos e tempo para realização das refeiçoes em locais adequados, são fatores determinantes nas escolhas alimentares desses indivíduos. Ainda que estudos voltados à avaliaçao da alimentação de trabalhadores de turnos tenham sido propostos e bastante discutidos na literatura, a real influência do turno de trabalho nos hábitos alimentares é pouco elucidada. Assim, o objetivo desse trabalho foi revisar sistematicamente os resultados de estudos que avaliaram os hábitos alimentares de trabalhadores de turnos, de forma a esclarecer como o turno de trabalho influencia, positiva ou negativamente na alimentação. A sumarização de evidências permite a elaboração de condutas e estratégias nutricionais específicas a esse grupo de risco. Além disso, destaca aspectos importantes a serem considerados no desenvolvimento de futuros estudos, visando contribuir com a qualidade das informações obtidas.

Palavras chave: Trabalho em turnos; trabalho noturno; hábitos alimentares; comportamento alimentar.

Abstract

Shift work is defined as the one performed outside the "conventional" hours, for example by working the night shift or working continuously through the team relay. Over the last few decades, the proportion of workers performing turn-based activities has been increasing and, with changes in working conditions, the organization of the social, family, living, and basic needs of these workers has changed significantly which can cause health damage. The development of chronic noncommunicable diseases and metabolic disorders in shift workers is already well documented in the literature, and epidemiological studies demonstrate consistent associations between shift work and the occurrence of diseases such as obesity, diabetes and metabolic syndrome. In addition to the relationship between changes in biological rhythms, disruption of the circadian system and metabolic alterations, behavioral changes experienced by shift workers are indicated as potential additional risk factors for the development of diseases. Among the changes in life habits, food habits seems to be altered as a result of shift work. Changes in sleep schedules, wakefulness, labor activity, as well as food availability and time to make meals in appropriate places, are determining factors in the food choices of these individuals. Although studies aimed at evaluating the feeding of shift workers have been proposed and discussed in the literature, the real influence of work shift on eating habits is little elucidated. Thus, the objective of this study was to systematically review the results of studies that evaluated the eating habits of shift workers, in order to clarify how the work shift influences, positively or negatively in the diet. Summarizing evidence allows the elaboration of specific nutritional strategies and strategies for this risk group. In addition, it highlights important aspects to be considered in the development of future studies, aiming to contribute to the quality of the information obtained.

Keywords: Shift work; night work; eating habits; food behavior.

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CAPÍTULO I

REFERENCIAL TEÓRICO

1. TRABALHO EM TURNOS

O trabalho por turnos é definido como aquele realizado fora dos horários considerados mais comuns (entrada às 8h00 ou 9h00 e saída às 17h00 ou 18h00), pelo trabalho no turno noturno, ou ainda, o trabalho de forma contínua durante 24 horas com o revezamento de equipes (trabalho rotativo), ainda que cada empresa organize seus horários e rotinas de trabalho de forma específica (1, 2).

O trabalho em turnos não é um fenômeno novo. Com o progresso da civilização, as necessidades de comunicação e transporte tornaram-se mais importantes, resultando em atividades laborais noturnas como entregas de correio, navegação e transporte terrestre (3). Em 1882, após a invenção da luz elétrica como uma fonte confiável de força/energia, o crescimento do trabalho em turnos e/ou a noite teve o marco em sua história, já que tornou-se possível a utilização de equipamentos em tempo integral e a oferta de bens e serviços sem interrupção por 24 horas (1, 3). Após, os avanços na globalização econômica e tecnológica fomentaram a necessidade de reorganização dos processos de trabalho em grandes indústrias, como por exemplo, o aumento do horário de funcionamento e a flexibilização dos turnos de trabalho dessas instituições para atendimento às demandas de produção (3, 4).

Dessa forma, durante as últimas décadas, a proporção de trabalhadores de turnos vem aumentando. Estudos observacionais apontam que em países desenvolvidos, pelo menos um quarto da população trabalha em turnos que divergem do horário convencional das 08h00 às 17h00 (3, 5).

Com as mudanças nas condições de trabalho, a organização do ambiente social, familiar, dos hábitos de vida e das necessidades básicas desses trabalhadores de turnos passou por significativas transformações, que podem causar danos à saúde (4, 6, 7). Além disso, estar trabalhando no horário biologicamente destinado ao sono, por si só, leva a alterações dos sistemas que funcionam sob um ciclocircadiano, podendo levar à ocorrência de doenças e distúrbios psicossomáticos que podem ocasionar/levar à interrupção do trabalho (2, 8).

1.1 Trabalho em turnos e desfechos em saúde

Nas últimas décadas, pesquisas voltadas à saúde ocupacional têm sido realizadas na tentativa de investigar as relações entre condições de trabalho e doenças. Embora as evidências ainda sejam controversas, estudos observacionais apontam uma relação entre o trabalho em turnos e obesidade (9-12), Síndrome Metabólica (13-19), diabetes e eventos cardiovasculares (20-30), e, possivelmente, câncer (31, 32) e mortalidade (33, 34).

Estudos transversais sugerem que o excesso de peso é mais prevalente em trabalhadores de turnos quando comparados àqueles que desempenham suas tarefas durante o dia (9, 12). Em um estudo conduzido com amostra randomizada de 319 trabalhadores italianos, por exemplo, a proporção de pacientes com excesso de peso foi duas vezes maior entre os trabalhadores de turnos (20%), quando comparados aos trabalhadores do dia (9,7%; P <0,05) (10). No Brasil, a chance de um trabalhador noturno ter excesso de peso foi de quase três vezes maior [Razão de Chances (RC) = 2,94, IC 95% 1,14-7,66] do que dos trabalhadores do dia em uma amostra de 154 trabalhadores de uma companhia de ônibus do estado de Minas Gerais (12). Porém, revisão sistemática de literatura de estudos longitudinais observou que esta possível relação entre o trabalho em turnos e o ganho de peso perde força de associação quando considerados fatores de confusão tais como: idade, gênero, IMC, consumo de bebidas alcoólicas, tabagismo, gestação e/ou parto no período de cinco anos antecedentes ao estudo, tempo de trabalho em turnos (anos), carga horária de trabalho diária, nível atividade física e qualidade do sono. Ainda, os autores discutem que os estudos são heterogêneos e as evidências se tornam insuficientes para o estabelecimento de uma possível relação causal (35).

Além da obesidade geral, o excesso de gordura abdominal, importante marcador de risco metabólico, também tem sido associado ao trabalho em turnos (12, 13, 36-40). No Brasil, estudo realizado com 902 trabalhadores de um frigorífico, apontou a medida de circunferência da cintura como o parâmetro mais alterado dentre os marcadores de risco metabólico. Aproximadamente metade dos trabalhadores avaliados apresentou medidas de circunferência da cintura acima dos pontos de coorte estabelecidos (>80 cm para mulheres e >94 cm para homens) (14).

Considerando o conjunto de fatores de risco metabólico, estudo longitudinal avaliando o desenvolvimento de Síndrome Metabólica em trabalhadores apontou sua incidência aumentada entre a população de trabalhadores de turnos (18). Em uma amostra de

trabalhadores de diferentes empresas da Bélgica, a incidência de Síndrome Metabólica em trabalhadores que realizavam trabalho em turnos rotativos foi significativamente maior, comparados àqueles que trabalhavam de dia (RC = 1,46; IC 95%: 1,04- 2,07) (18). Em revisão sistemática realizada com dez estudos observacionais (15) a relação entre trabalho em turnos (noturno e/ou rotativo) foi discutida à luz das limitações metodológicas destes, uma vez que a maioria dos estudos que avaliam a população de trabalhadores não considera um fator independente para o desenvolvimento da Síndrome Metabólica que é o padrão de sono desses indivíduos (15). Mais recentemente, uma revisão sistemática seguida de metanálise de 13 estudos observacionais encontrou risco aumentado no desenvolvimento de Síndrome Metabólica entre trabalhadores noturnos (RR = 1,57; IC 95%: 1,24-1,98; *p*=0,001) (19) e uma possível relação dose-resposta entre o tempo de trabalho noturno e risco de síndrome metabólica (RR= 1,82; IC 95% 1,23-2,69).

A relação entre trabalho em turnos e diabetes também vem sendo estudada e os resultados indicam maior risco de desenvolvimento de diabetes na população de trabalhadores de turnos (23-24). Em estudo de coorte com 19873 enfermeiras na Dinamarca foi observado um risco aumentado de diabetes nas trabalhadoras do turno da noite (Razão de risco = 1,58; IC 95%:1,25 - 1,99) ou naquelas que realizavam atividades no turno da tarde e noite (Razão de risco = 1,29; IC 95%: 1,04 - 1,59) (24). Dados semelhantes foram encontrados no *Nurses' Health Study,*envolvendo duas coortes com mais de 170 mil enfermeiras americanas. Nesse estudo, mulheres que relataram mais de 20 anos de trabalho em turnos, apresentaram risco aumentado em 44% no desenvolvimento de Diabetes Melito tipo 2 (29). Em 2014, uma revisão sistemática seguida de metanálise de 12 estudos observacionais (oito longitudinais e quatro transversais) (23) confirmou uma associação positiva entre trabalho em turnos e Diabetes Melito tipo 2 (RC = 1,09; IC 95%: 1,05-1,12) (23).

O trabalho em turnos também já foi apontado como fator de risco para desenvolvimento de câncer (2, 32). Em 2010, o relatório da Agência Internacional de Investigação sobre o Câncer classificou o trabalho por turnos como um possível carcinógeno humano (41). A hipótese de uma possível relação causal é baseada em evidências experimentais onde a melatonina (fisiológica ou farmacológica ativa) exerce um papel protetor no desenvolvimento de células cancerígenas (42, 43). E no trabalho noturno, a exposição aumentada à luz reduz a produção de melatonina durante o seu pico de produção (noite) (43). Entretanto, em revisão sistemática com metanálise de 15 estudos observacionais (dez estudos de caso-controle e cinco coortes) foi encontrada fraca associação entre o trabalho em turno noturno e o risco de desenvolvimento de câncer de mama (Risco Relativo = 1,24; IC

95%: 1,00-1,47; *p*= 0,0056) (31). Os autores destacam que esses resultados devem ser avaliados com cautela, considerando a elevada heterogeneidade dos estudos (I^2= 76 %).

Em relação a eventos cardiovasculares, uma revisão sistemática de seguida de metanálise de 24 estudos longitudinais e 10 estudos de caso-controles encontrou uma associação entre o trabalho em turnos e maior risco de infarto (RR = 1,23; IC 95%: 1,15-1,31), eventos coronarianos (RR = 1.24; IC 95%: 1.10-1.39) e acidente vascular cerebral isquêmico (RR = 1.05; IC 95%: 1.01- 1.09) (30).

Por fim, alguns estudos ainda têm avaliado associação entre trabalho em turnos com mortalidade total (33, 44). Na Suécia, estudo de coorte envolvendo 22.411 trabalhadores, observou que a mortalidade esteve associada, apenas para a amostra de mulheres trabalhadoras de turnos em que as atividades foram consideradas administrativas [Taxa de incidência = 2,61; IC 95%: 1,26- 5,41] (33). Resultados foram semelhantes em estudo de coorte com 18015 enfermeiras da Dinamarca, onde o trabalho noturno foi associado com maior mortalidade por qualquer causa, comparado ao trabalho no turno do dia (Razão de risco=1,26; IC% 1,05-1,51) (34).

Os possíveis mecanismos que tornariam os trabalhadores de turnos mais expostos a esses agravos ainda não estão completamente elucidados, mas sabe-se que fatores biológicos e comportamentais estão envolvidos e devem ser melhor compreendidos.

2. MARCADORES DO RITMO CIRCADIANO

As alterações nos horários de sono e vigília, experienciadas pelos trabalhadores de turnos, são um dos principais fatores que podem alterar o sistema circadiano (46-48). Nos mamíferos, grande parte dos processos fisiológicos - incluindo as secreções hormonais - seguem um padrão de variação em torno de 24 horas do dia. Além disso, determinados comportamentos de risco relacionados às escalas de trabalho, como consumo alimentar irregular, falta de rotina de sono, tabagismo, consumo excessivo de bebidas alcoólicas e bebidas estimulantes, além da presença de fatores de risco para doenças crônicas não transmissíveis são conhecidos como importantes componentes de alteração do ritmo circadiano, podendo potencializar os prejuízos causados pelo trabalho em turnos à saúde desses indivíduos (4, 48-50).

O sistema circadiano é formado por genes, denominados “genes-relógio”, localizados

no sistema nervoso central (SNC) e em tecidos periféricos que recebem, controlam e transmitem informações entre si (2, 46). Os genes do SNC exercem função reguladora, fornecendo um "tempo padrão" para todos os genes de tecidos periféricos. Entretanto, muitos órgãos/tecidos do corpo podem gerar ritmos circadianos independentemente ou não do SNC (51).

Estudos experimentais têm buscado elucidar a interligação entre o sistema circadiano e os ciclos metabólicos (48, 52-55). A desregulação de genes relógios é associada à ocorrência de distúrbios no metabolismo da glicose, gorduras e modulação hormonal, por exemplo (46). A compreensão sobre mecanismos moleculares que envolvem a regulação circadiana do metabolismo tem evoluído. Atualmente, sabe-se que, receptores ativados por proliferador de peroxissoma, conhecidos como PPAR, envolvidos na sinalização e produção hormonal e do metabolismo de nutrientes podem modular a transcrição de genes-relógio. Da mesma forma, a produção de hormônios é regulada por genes relógios localizados em tecidos periféricos, a exemplo da insulina, que possui genes relógios situados nas células pancreáticas (46, 56).

Estudos com humanos apontam que o aumento da atividade durante o período considerado “descanso”, bem como a interrupção do sono, têm sido associados ao aumento da prevalência da obesidade, diabetes e doença cardiovascular, além de cânceres e distúrbios inflamatórios (22, 46, 57). A duração do sono menor do que cinco horas foi associada, de forma independente, à obesidade geral (RR: 1.22; IC 95%: 1.03–1.4) e abdominal (RR = 1,3; IC 95%: 1,10-1,58) em estudo de coorte com 16.905 participantes do *Korea National Health and Nutrition Examination Surveys* (KNHANES) (58). Em nosso meio, indivíduos trabalhadores do sul do Brasil com menos de cinco horas de sono por dia tiveram 70% mais chance de apresentar Síndrome Metabólica do que aqueles com maior tempo de duração de sono (RC = 1,70; IC 95%: 1,09- 2,24; p = 0,017) (14).

A regulação hormonal também tem sido descrita como possível fator mediador desses distúrbios, considerando o padrão de oscilação circadiano de hormônios metabólicos (leptina, grelina, insulina, cortisol, etc.) (59-62). O metabolismo da glicose, por exemplo, apresenta variações ao longo do dia, onde a tolerância oral à glicose está diminuída no período da tarde-noite, e esse controle se dá pelo ritmo circadiano da produção de insulina e da sensibilidade ao hormônio em tecidos periféricos (63, 64).

Além disso, estudos têm discutido a relação entre a alimentação e o ritmo circadiano (65-69). Tipos e horários de alimentos consumidos podem afetar diretamente a expressão dos genes relógio nos tecidos periféricos como, por exemplo, o ajuste na expressão de genes relógio no fígado e tecidos periféricos a partir do consumo de refeições periódicas (70).

Estudo realizado com ratos mantidos em condições normais (12 horas de ciclo claro/escuro) e alimentados com uma dieta hiperlipídica demonstrou uma redução da expressão dos genes relógio no tecido adiposo e no fígado, levando a um maior consumo energético no período em que os animais normalmente comeriam menos (ciclo claro) (71).

O funcionamento adequado dos "relógios periféricos" mantém processos metabólicos em sincronia com o ambiente, que é fundamental para a manutenção da saúde do organismo. No trabalho em turnos a reorganização das atividades noturnas e diurnas implica em alterações no comportamento alimentar, que divergem do "padrão" de alimentação biológico (46), ou seja, o mecanismo de controle da alimentação via SNC é desregulado pela "informação" de alimentação recebida em genes-relógios periféricos sensíveis a nutrientes.

Considerando que variações circadianas dos hormônios envolvidos na digestão, absorção, metabolismo, bem como na motilidade intestinal (48, 72) também podem ser influenciadas pelo horário das refeições e o tipo de alimento consumido (66, 70, 72), esses fatores podem ter impacto na integração dos sistemas circadiano e metabólico. Desta forma, esses achados demonstram o importante papel que a alimentação desempenha na saúde desses trabalhadores.

3. HÁBITOS ALIMENTARES E TRABALHO EM TURNOS

O turno de trabalho pode afetar os hábitos alimentares dos trabalhadores de diversas maneiras. Por exemplo: os trabalhadores não conseguem realizar suas refeições regularmente junto à família, o consumo de alimentos e bebidas ocorre tanto durante o dia, quanto à noite, o acesso aos alimentos durante o turno de trabalho é dificultado, variando os tipos de alimentos e lanches disponíveis (73, 74). Neste sentido, tem sido crescente a investigação sobre as modificações nos hábitos alimentares decorrentes ao trabalho em turnos.

Em epidemiologia nutricional, a avaliação de hábitos alimentares é feita a partir de inquéritos dietéticos prospectivos ou retrospectivos. Os inquéritos dietéticos mais utilizados para a obtenção de dados sobre consumo alimentar em epidemiologia são inquéritos recordatórios de 24h, registros alimentares (RA) e o questionário de frequência alimentar (QFA) (75). Esses instrumentos tem como vantagens de utilização o baixo custo, o tempo reduzido de aplicação, não provocam alterações nos hábitos alimentares, além de não exigir muitas habilidades do respondente. Por outro lado, a mensuração adequada depende da

memória do entrevistado e pode ser dificultada por sub ou superestimavas das quantidades consumidas (75). Outra limitação refere-se à capacidade do instrumento em medir a ingestão habitual do indivíduo - por exemplo, a aplicação de apenas um recordatório de 24h que fornece informações restritas a um período específico. (75). No contexto da epidemiologia nutricional, considerando que os efeitos da ingestão inadequada podem surgir somente após uma exposição prolongada, faz-se necessária a avaliação da alimentação habitual dos indivíduos (75,76).

As informações obtidas pelos inquéritos alimentares podem ser apresentadas em composição nutricional (calorias, macro e micronutrientes) ou alimentos (grupos alimentares ou padrões alimentares) (75,76). Ainda, outros componentes estão presentes no hábito alimentar dos indivíduos (horários, freqüência, tipo de refeições consumidas, sentimentos associados ao ato de alimentar-se) e devem ser considerados na "história alimentar" (77-79).

Em 2009, Crispim e colaboradores publicaram uma revisão integrativa da literatura, abordando aspectos relacionados aos hábitos alimentares específicos em trabalhadores de turnos. Dentre os fatores relacionados às mudanças na alimentação, o ambiente é destacado como principal modificador do comportamento alimentar. As condições para alimentação (local para comer, alimentos disponíveis, tempo para refeições e o isolamento da família durante a refeição devido à incompatibilidade de horários e rotinas diárias), dificultam a realização de uma refeição prazeirosa e com calma (79).

A privação de sono, além -e através- de seus efeitos na alteração dos ritmos circadianos, tem impacto importante na mudança de comportamento alimentar, e o trabalho em turno noturno ou alternado está associado à curta duração e/ou baixa qualidade do sono (79). Recentemente, outra revisão não sistemática sobre hábitos de vida de trabalhadores de turnos foi publicada e algumas modificações no comportamento alimentar desses inidivíduos são destacadas (80). Muitas alterações decorrem de barreiras no próprio setor de trabalho, como escassez de intervalos, padrões de turnos de trabalho, baixa variedade de alimentos disponíveis, horários de abertura da cantina, falta de tempo e cansaço devido a longas horas de trabalho (80).

Diante dessas diferentes variáveis que compõem o hábito alimentar, é possível perceber que o turno de trabalho pode influenciar na alimentação dos trabalhadores. O número de refeições realizadas, intervalo entre as refeições, locais onde se realizam essas refeições e possíveis sentimentos relacionados ao ato de comer podem ter importante influência nas escolhas alimentares (77-79), e essas escolhas alimentares parecem predizer hábitos associados ao risco de doenças e deficiências nutricionais.

JUSTIFICATIVA

Durante as últimas décadas, a proporção de trabalhadores que cumpre jornadas de trabalho fora do horário normal vem aumentando em economias urbanas. As mudanças nas condições de trabalho resultam em alterações dos ritmos biológicos desses indivíduos. Os trabalhadores noturnos, por exemplo, por estarem acordados em um período biologicamente reservado ao sono, podem experienciar problemas decorrentes da ruptura do ritmo circadiano (48, 62, 82, 83).

Adicionalmente, determinados comportamentos de risco relacionados às escalas de trabalho, como consumo alimentar irregular, falta de rotina de sono, tabagismo, consumo excessivo de bebidas alcoólicas e bebidas estimulantes; podem ser agravantes às condições de saúde dos trabalhadores, ou mesmo, sendo importantes mediadores na relação entre trabalho em turnos e doenças crônicas não transmissíveis (8, 15, 22, 57, 79).

Diversos pesquisadores têm avaliado a relação entre turno de trabalho, dieta e desfechos em saúde, porém a influência dessa nova organização de trabalho nos hábitos alimentares dos indivíduos ainda é uma questão pouco elucidada e ainda não foi foco de sumarização sistemática de evidências. Além disso, não existem atualmente recomendações dietéticas específicas para esse grupo de indivíduos.

A elucidação dessa questão faz-se importante diante da necessidade de medidas efetivas de prevenção e promoção de alimentação saudável dentro e fora das organizações. Afinal, estratégias como essas podem contribuir de forma significativa nas condições de saúde do trabalhador, qualidade de vida, prevenção da obesidade e doenças crônicas não transmissíveis e, por consequência, reduzir os custos com acidentes de trabalho, afastamentos e licenças-saúde, dentre outras onerações envolvidas.

Sendo assim, o objetivo dessa dissertação é sumarizar as evidências relacionadas à alteração de hábitos alimentares em trabalhadores de turnos, a partir de uma revisão sistemática de literatura.

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CAPÍTULO II

Artigo de revisão para publicação no periódico *Nutrition Reviews,* redigido conforme as normas do periódico com posterior tradução na língua inglesa para publicação

Lead Article

The effect of shift work in eating habits: A Systematic Review

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ABSTRACT

The aim of this systematic review was to evaluate the association between working in shifts and eating habits. The protocol of this review was registered in PROSPERO (number 42015024680). Articles published up to September 2017 were recovered in *PubMed, EMBASE, Scopus and Web of Science and a total of* 33 observational studies were included. The methodological quality of studies was assessed using the *New Castle Ottawa scale.* The majority of the studies presented a quality score <70%, with high risk of bias for comparability, sample selection and non-respondents. Shift workers show changes in meal pattern, skipping more meals and consuming more food at unconventional times. They also seem to consume foods enriched with saturated fats and lower amount of fibers. This review suggests that dietary quality could be altered by shift work, but new studies, especially longitudinal studies, are necessary to confirm this association, considering the time of exposure to shift work, duration of the workday and sleep pattern.

Keywords: Shift work; Sleep disorders; Night work; Food habits, Food patterns, Meal patterns

INTRODUCTION

Shift work is characterized by that which takes place outside of the most common work hours (for example, in Brazil, starting at 8 or 9 am to 5 or 6 pm) [1, 2]. Night work (and rotating shift) and work that takes place continuously for 24 hours with rotation teams[2.3] also fall within this definition. During the last few decades, the proportion of workers who work in shifts is increasing [2.4]. This working system has been described as an important risk factor in the etiology of metabolic disorders and chronic diseases [1.5-10.]

The causal mechanisms of this association are not fully elucidated, but observational studies indicate that changes in work schedules result in physiological and behavioral changes in shift workers [11-14]. These individuals suffer from a disruption of the circadian rhythm and therefore, hormonal alterations due to being awake at the time biologically reserved for sleep [11,15,16]. In addition, in shift work, the reorganization of nighttime and daytime activities, involves changes in lifestyle, including eating habits [7,14,17,18].

Working in shifts can affect food habits in a variety aspects. Epidemiological studies show differences in relation to consumption of calories and macronutrients and especially the quality of the food eaten by shift workers[7,11,17,19]. Changes in food consumption patterns such as skipping meals, increased eating of snacks and change in meal times have already been previously associated to changes in work schedules and / or sleep deprivation [17,20,21].

Therefore, knowing the influence of shift work on eating habits is critical in understanding the relationship between work shifts and metabolic disorders or chronic diseases. The aim of this study was to systematically review the available evidence on the possible association between shift work and eating habits. We hypothesize that shift workers present alteration in their food habits when compared with day workers.

METHODS

A systematic literature review was carried out to summarize the results of of observational

studies that evaluated the impact of different work shifts on the eating habits of individuals. The protocol of this review was carried out in accordance with the *Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA)* [22] and *Meta-analyses Of Observational Studies in Epidemiology Check List (MOOSE)* [23] and registered in PROSPERO (number 42015024680). The "PICO" strategy was used to construct the research question **(Table 1)**. The articles were selected according to the following inclusion criteria: 1) have as an outcome the evaluation of eating habits (consumption of calories, nutrients, food groups or meal patterns); 2) compare individuals in different shifts (rotating or night *vs.* regular or day shift workers); 3) original articles; 4) full text available for reading. The searches were conducted in *PubMed, Scopus, EMBASE and Web of Science* from February to June 2017. Articles published by September 2017 were included. The descriptors are defined according to *"Medical Subject Headings" (mesh)* for searches performed in *PubMed* and *"EMBASE Subject Headings" (Emtree)* for searching *EMBASE*. The research strategy used in *PubMed* is presented in **Table 2**. Additional studies were identified in the references of articles selected.

Two independent investigators (RV and RAS) performed the initial selection of the articles by reading all of the titles and abstracts. Endnote X7 software was used. In a second step, the two reviewers performed the complete reading of the articles according to the inclusion criteria. In case of divergence between the two researchers, a third researcher (RC) was consulted for final decision. Afterwards, the data from the studies that met the criteria were extracted and the following information was considered: sample characteristics, losses (%), exposure classification (shift work), assessment tool of eating habits, classification of food consumption and main results. Authors were contacted when the information was not available in its entirety [24-26].

The *"Newcastle - Ottawa Scale Assessment" (NOS)* instrument was used to assess the quality

of studies [27]. In cross-sectional studies, we used an adaptation to specific criteria for sampling, non-response rate and statistical tests employed as proposed by Herzog et al [28. 27.28] The instruments include items divided in three areas: selection, comparability and outcome. All items received a maximum score of "1" when the evaluated criteria was met and "0" if not identified. In cross-sectional studies, a maximum of "2" points could be attributed when the "best criterion" was identified in the questions that assess the definition of exposure, control for confounding factors (comparability) and outcome measurement. Two researchers carried out all evaluations independently (RV and RAS). In case of disagreement, the third researcher was consulted (RC).

The percentage score of quality evaluation was set as follows: total score of each study, divided by the maximum score applied to the *checklist* (ten for cross-sectional studies and nine longitudinal studies), and finally multiplied by one-hundred. In a second stage, a general evaluation of the quality of the articles was performed for each item evaluated in the instrument. Studies that received 1 to 2 points for each domain were considered "low risk of bias" and "0" was considered "high risk of bias".

RESULTS

The results of the article selection procedure are represented in **Figure 1.** The initial search resulted in 2,660 articles. After the exclusion of duplicates, 2,432 were selected for titles and abstracts. Under consensus of the two reviewers, 118 papers were selected for complete reading. Ninety-two articles were excluded, as they did not meet the inclusion criteria in relation to the outcome (n = 48) and group comparison (n = 43). At the end, 27 studies were included and, added to 6 articles retrieved from their bibliographic references, 33 studies were included for this review. There was agreement between the reviewers with kappa value = 0.835.

Table 3 presents the characteristics of the articles. Of the total 33 studies included, 10

included only female subjects [21.29 - 37], 13 studies included only males [6,7,11,20,38-46] and 10 studies included both sexes [17,19,26,47-53]. Workers from different sectors were evaluated, as follows: workers in industries and plants (n = 10) [6,11,17,29,37,39-42,44], hospitals (n = 10) [26,30-36,47,49], transportation company workers (n = 4) [7,38,45,48] and the general population (n = 9) [19-21,26,43,46,50-53]. The sample sizes ranged from 22 [40] to 107,615[30] subjects with ages between 20 and 65 years old. We selected two retrospective cohort studies [21,30], a case-control study [32] and 30 cross-sectional studies [6,7,11,17,19,20,26,29,31,33,34,36-54]. In the individual assessment of the quality of studies, only nine studies showed scores above 70% [17,19,21,30,34,38,48,52,53]

Figure 2 shows the result of quality evaluation according to each criterion. Most studies (75%) presented a high risk of bias in comparability between the exposed / non-exposed, and did not present adjusted analysis for confounding factors. Over 60% of studies did not consider the description of non-respondents. Nevertheless, in relation to the selection, more than half of the studies did not present calculation of sample size.

Considering the different forms of assessment of dietary habits, the results of the studies are divided into consumption of calories and nutrients **(Table 4)**; food groups and food pattern **(Table 5)**; or mixed, when studies evaluated both power variable **(Table 6).**

Table 4 shows that studies[11,36,40,42,44,45] which only evaluated the intake of calories and nutrients, using 24-hour dietary recall (24HR)[40] and dietary records[11,36,42,44,45]. All studies were cross-sectional and showed a quality score lower than 70%. On the other hand, **table 5** shows studies which evaluated the intake of food groups[38,17,38,48,51], eating pattern scores [5,17,29,32,33,52-54] and eating pattern, [39,51] through food frequency questionnaires (FFQ) [5,17,38,48,51,53] and, questionnaries about meals and food patterns [29,32,33,39,54] and 24HR[52]. Eleven studies were cross-sectional [6,17,29,32,33,35,38,39,48,51-53] and one [32] was a case-control study. Regarding the quality of the studies, only five presented scores over 70% [17,38,48,52,53.] The 15 studies that evaluated both aspects relating to the intake of calories

and nutrients, as well as the consumption of food groups and eating patterns are described in **table 6.** The dietary intake assessment tools range from food frequency questionnaires[6,19,21,30,34,26,41,49,50], 24HR[20,43,46] and dietary records[20,43,37,]. Two studies were longitudinal[21,30] and four studies had quality scores greater than 70% [19,21,30,34.]

Calorie intake was evaluated in 16 studies[11,19,21,30,34,36,37,40-46,50,51] and out of these, 13 studies also macronutriuentes [11,19,20,36,37,40-46,50] **(tables 4 and 6).** Five studies observed a higher intake of total calories in the evening shift workers [11,21,36] and rotating shifts [19, 34] although two other studies show lower caloric consumption among these workers [37,40].

Differences in macronutrient intake were found in nine studies [11,19,36,37,40,41,43,44,50] with results in different directions. If on the one hand, three studies observed a lower protein intake between nigh-time workers[37] and workers with a rotating shift [19, 40], on the other hand one study found increased protein intake by nighttime shift workers[11]. Three studies found lower carbohydrate intake for night workers[11,37,40] and two studies found a greater consumption of carbohydrates[36,43.] Two studies also showed lower consumption of fibers in night shift workers[40] and rotating shift workers[41]. Regarding lipids, shift workers had higher intake of total lipids in two studies[11,36] and lower consumption of it in two other studies [37,40]. Five studies evaluated the type of fat consumed [19,40,41,44,50] and three [41,44,50] studies observed a higher consumption of saturated fat by rotating shift workers and one study [40] observed lower consumption of saturated fat in the night shift.

Evaluation of micronutrients intake was performed in only three studies[37,40,41] and two studies found a lower consumption of calcium in rotating shift [41] or [37] overnight workers. Lower consumption of potassium and vitamins A and B1 were also observed in rotating shift workers aged 20 to 29 years[41] as well as were lower consumption of iron by night shift workers [37.]

The evaluation of food groups was performed in 14 studies [7,19-21,26,30,31,34,38,43,48-51] **(tables 5**

and 6), and 11 of them found associations in different directions [7,19 21,26,31,41,43,48,50,51]. In some studies, rotating shift workers or night shift workers presented a higher consumption of starchy foods, [19,26] breads and cereals, fruits and vegetables[7,20,31,43], meats and animal foods [7,19,26, 43], sugar and candies [46, 21,26,43,50], soft drinks, oils and fats and alcoholic beverages [6.20 51,39,43]. On the other hand, in other studies, these workers had lower consumption of starchy food, breads and cereals [20,43], fruits and vegetables [7,48,51], meats and animal foods[20,41,43], sugars, sweets and/or [19] desserts, oils and fats and alcoholic beverages [48 20,21,39,43,51].

Scores and eating patterns were evaluated by seven studies[5,17,19,21,34,42,52]. In Barbadoro et al., working in a rotating shift system was inversely associated with an increased cardiovascular risk dietary patterns[5]. Whereas in two other studies, it was positively associated with consumption of an unhealthy eating pattern and inflammatory potential, characterized by the consumption fatty and fried foods [21, 52] (**tables 5 and 6**). Finally, 12 studies have investigated the pattern of meals under different aspects. The number of meals consumed was evaluated in six studies[17,20,31,32,43,47] being higher among night shift workers in two studies[17,20]. Of the ten studies[17,20,31,33,39,43,44,47,50,51] which compared the type of meals, seven had the following associations: nighttime and rotating shift workers omitted more meals at lunch and breakfast in the four studies that evaluated this behavior [17,31,33,50]. Of the six studies that evaluated the time of food intake, five studies[17,20,31,39,44] showed higher consumption of food at night by night shift and rotating shift workers. Still, at least one study showed higher consumption of breakfast at inappropriate times for night workers and dinner for daytime workers [17.

When the results were analyzed according to the shift characteristic (fixed or rotating), a higher consumption of soft drinks and sweetened beverages by night shift workers compared to day shift was identified [20,21,43,50].

DISCUSSION

This systematic review of literature included results from 33 observational studies that investigated associations between shift work and eating habits. The evidence found suggests that shift work (night and rotating) can lead to changes in workers' eating habits when the pattern of meals consumed was evaluated. Aside from the omitted meals, the studies included in this review have shown that shift workers present differences in the distribution of food intake, with increased food consumption during the night, especially for the night shift workers, compared to those in range of rotating shifts. In addition, there seems to be a relation towards greater consumption of food richs in saturated fats and with lower amounts of proteins and fibers among these workers. Similarly, night shift workers seem to consume more soft drinks compared to day shift workers[40,41].

Studies with workers and the general population have shown that changes in the pattern of meals are independent risk factors for weight gain, [55] glucose intolerance, insulin resistance, dyslipidemia and obesity [56-58]. Skipping breakfast is associated with excess weight and changes in metabolic markers, regardless of total calories intake [59-61]. In addition, the increased consumption of food and calories during the night have also been associated with metabolic changes and weight gain [62-64]. Experimental studies have shown that animals fed during the period considered "inactive" have greater weight gain and increased body fat, regardless of the type of diet provided [65-67]. In humans, increased food consumption in later hours of the day was positively associated with overweight in healthy men and women[64,68,69]. Additionally, individuals undergoing a weight loss program who ate during at later hours, show less weight loss compared to those with the same diet and food distributed "earlier" in day [57.]

The causal pathway that links changes in eating patterns to metabolic disturbances can be explained by circadian rhythm disruption. The production of hormones and metabolic function is synchronized with the circadian rhythmicity system [36,67-69.] Experimental [25,69] and

epidemiological studies[59,60,63] show that healthy individuals with changes in biological patterns of sleep and wakefulness may have reduced production of leptin, increased ghrelin and increased insulin resistance. Thus, changes in regulation of body temperature, digestion, energy metabolism and hormonal responses are experienced by individuals who ate during the rest period [63,68,70].

Changes in the consumption of food groups that make up a food pattern unhealthy were also identified among shift workers. Increased intake of saturated fats, reduced fiber intake, and adoption of a dietary pattern pro inflammatory and unhealthy were identified through qualitative analysis of shift workers' diets. These findings suggest the recognition of eating habits as possible additional factors to the development of chronic diseases, such as cardiovascular diseases. The occurrence of cardiovascular events has been positively associated with shift work. In a literature review and meta-analysis of observational studies was found a higher risk of infarction and coronary events among workers performing shift work activities[71].

When the results are analyzed according to the shift, night shift workers had higher consumption of soft drinks than day workers. These workers - already exposed to chronobiological and hormonal changes as a result of working hours - may present additional risk factors for the development of metabolic alterations due to the excessive consumption of these products, which contribute to excess weight, obesity and the development of non-transmittable chronic diseases[72].

The results of this review should be interpreted in the light of the methodological characteristics of the included studies. It is known that longitudinal studies are considered the most appropriate for the evaluation of risk factors. However, this review included only two longitudinal studies [21,30]. The articles were evaluated with low methodological quality, mainly in relation to the control for confounding factors. In most studies, the association between

eating habits and shift work was not the main objective, so the analyses did not consider possible confounding factors. Sleep pattern, for example, is an important mediating factor of circadian and metabolic disorders[1,5,64,73]. Thus, studies evaluating the relation between working shifts and eating habits, should consider the aspects related to quality and duration of sleep. Another criterion evaluated with a high risk of bias was the selection of workers. Samples for convenience, without description of the sample population, as well as the lack of information on the number and characteristics of non-respondents, allow for selection bias.

Still, differences in exposure ratings should be considered. The routine of workers subjected to fixed night or day work may differ from those who perform their activities on a rotating shift scale, implying different feeding, sleep and leisure times between groups and limiting comparability between them. In addition, some studies were not clear in the shift system rating [33,38,48,51,52] and none of the studies presented an instrument for the classification of shifts, for example, payroll, registration form or access to information recorded at the workplace. It is known that the self-report of the working shift system has low sensitivity and moderate specificity, compared with objective data [74].

Methods of assessing eating also varied between studies. The choice of instrument to assess food consumption should be considered as a predefined objective, for example: quantitative assessment of nutrient intake; assessment of the consumption of food or food groups, or eating pattern evaluation [75.] The studies included in this review presented collection methods adequate to their objectives. The "quantitative" evaluation of feeding was performed from dietary records of two to seven days or 24HR. On the other hand, the evaluation of food group consumption and eating patterns was carried out using FFQ validated to population studied. Except for one study[52], all included studies repeated applications (two or more) of dietary questions about the previous 24HR and dietary records by reducing the limitation of

these methods to assess the individuals' usual intake. The evaluation of the usual diet is important since the effects of inadequate food intake can occur only after a prolonged exposure to shift work [75].

The investigation of eating habits by the studies included in this review was conducted under different contexts. Although the outcomes are divided into nutritional composition or food and food groups in most articles, the summarization and joint evaluation of these results allow a broad understanding of dietary habits. Likewise, the collection of information that characterizes an eating pattern (both quantity and quality of food) allows adequate identification of risk behaviors and interventions that contemplates modifying them.

CONCLUSION

This was the first systematic review of literature to investigate the association between shift work and eating habits. Although quantitative differences in calorie intake are not influenced by the shifts of work, the timing of meals consumed and pattern of eating seem to be different in shift workers. They also have a higher consume of foods rich in saturated fats and with lower amounts of fibers. The alterations in the sleep-wake cycles added to the unhealthy food habits have a possible mediating role in the relation between working in shifts and chronic diseases.

The results of this review highlight the need for attention to the quality of food these workers eat, and the need for future specific studies regarding the association between shift working and eating habits. The methodology of these studies should consider the use of longitudinal designs, the power and representativeness of the sample, objective methods for work shift measurement, food habits assessment under different aspects (calories, nutrients, food and meal patterns) and the control for possible confounding factors, such as sleep characteristics, time of exposure to shift work and duration of the work shift. These studies are fundamental in proposing nutritional guidelines specific to the population of shift workers.

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Table 1. The PICO (Population, Intervention, Comparison, Outcome) criteria

Criteria	Definition
Population	**Health (non-sick) workers**
Intervention/exposure	**Shift work, night work**
Comparison	**Day work, regular work**
Outcomes	**Food habits (number of meal, caloric/macro or micronutrient intake), foods intake, meals intake.**

Table 2. Search strategy for PUBMED database / MEDLINSP

Exhibition: **"Shift work"**	*"Shift systems" OR "shift system" OR "Shift work" OR "Shift-work" OR "Night shift work" OR "Night shift-work" OR "Night-work" OR "Night worker" OR "Night workers" OR "shift workers" OR "shift worker" OR "Sleep disorder" OR "Sleep disorders" OR "Circadian Rhythm" OR "Circadian Rhythms" OR "rotating shift work" OR "rotating shift-work"*
Outcome: **"Food habits"**	*"Meal frequency" OR "meal frequencies" OR "meals" OR "meal time" OR "mealtime" OR "mealtimes" OR "meal times" OR "eating frequency" OR "eating frequencies" OR "eating episodes" OR "meal pattern "OR" meal patterns "OR" eating pattern "OR" eating patterns "OR" behaviors eating "OR" eating behavior "OR" dietary pattern "OR" dietary patterns "OR" dietary habits "OR" diet habit "OR" diet habits "OR" food intake "OR" foods intake "OR" nutrient intake "OR" nutrient intake "OR" caloric intake "OR" caloric intake "*
Type of study:	*"Observational Study" OR "Case-control study" OR "case control study" OR "epidemiological study" OR "retrospective study" OR "cohort study" OR "incidence study" OR "cross-sectional study" OR "cross sectional study" OR "prevalence study" OR "longitudinal Study" OR "follow-up study" OR "prospective study" OR "ecological study"*
Limit	*"Humans"*

Figure 1. Search processes and selection of articles for systematic review (review according to PRISMA 2009)*

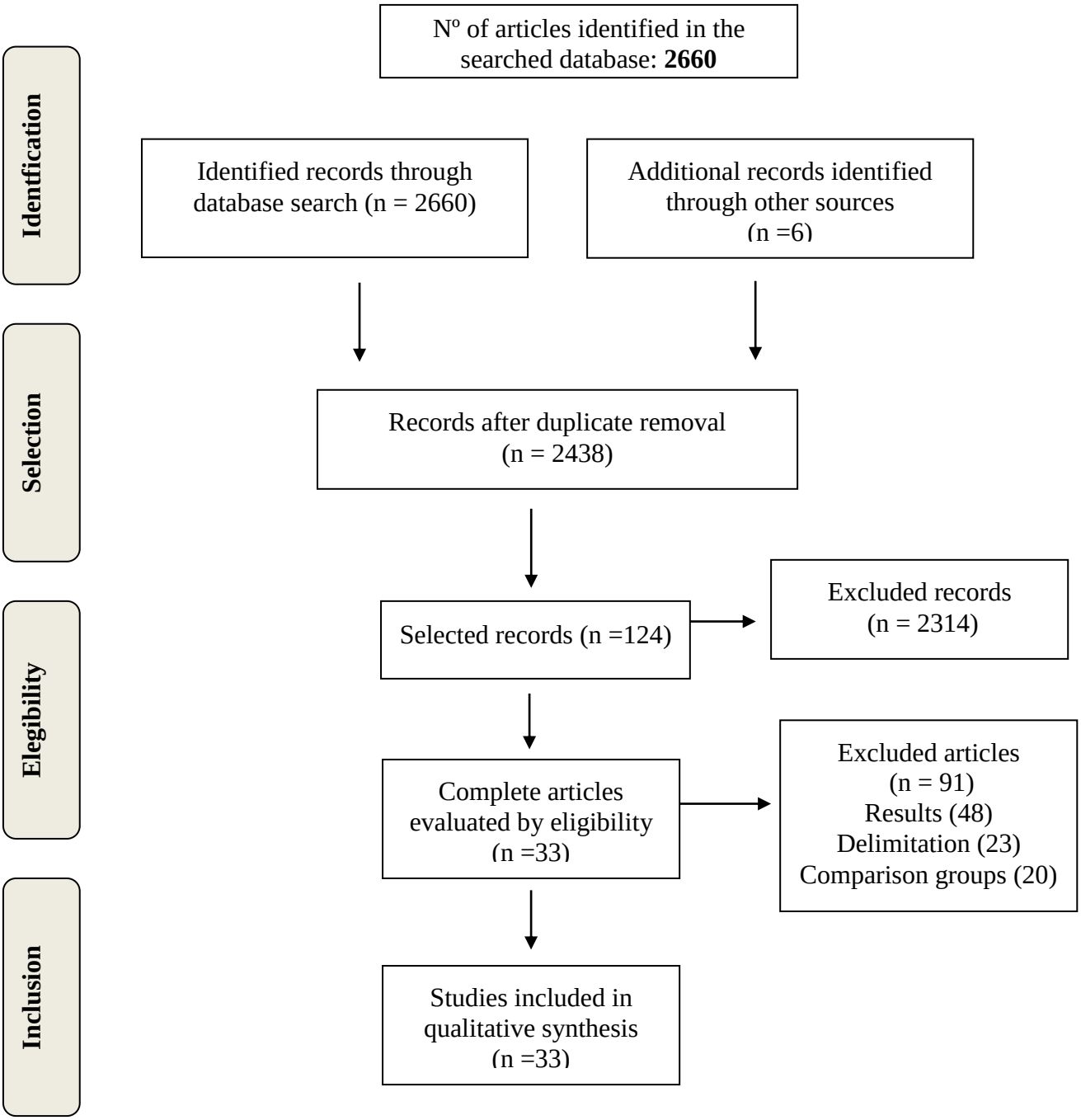

Figure 2. Quality escore of items according to the "New CastleOtawa" - Cross-sectional studies (n = 30), case-control study (n = 1) and cohort (n = 2)

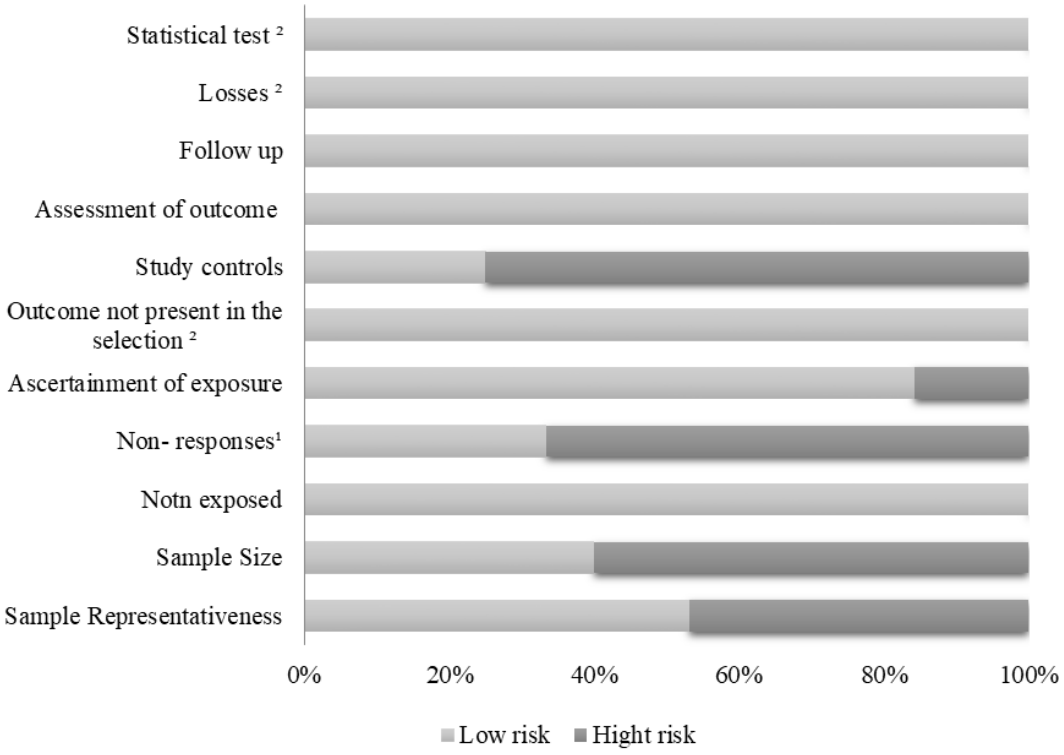

Table 3. Characteristics of studies (n = 33)

Author-Year	Year – Data collection	Population	N (% Loss)	Age (years)		Scores assigned from the quality analysis
Cohort						
Vimalananda, VG. Et al, 2015 [21]	1995- 2005	African-American women (readers / magazine subscribers)	28041 (10%)	21-69		88.9%
Pan, A. et al, 2011 [30]	1988-2008 (NHS I) and 1989 to 2007 (NHS II)	Women NHS I and NHS II	69269 **(NHS I)** 107615 **(NHS II)** (20%)	53.9 (study I) and 34.3 (study II)		77.8%
Case-control						
Zverev, Y. 2005 [32]	2005	Women alawi- nurses	24	-		55.6%
Cross						
E. Freitas et al, 2015 [17]	2010	Brazilian men and women – slaughterhouse workers	1206	30.5±9.7		88.9%
Husegge, G. et al, 2016 [19]	1993-2014	Dutch men and women – population-based	7856	42.7±10.1		88.9%
Chen, C. , et al 2010 [38]	Jul-Aug / 2004	Chinese men, bus drivers	184	42.2±0.6		77.8%
Haupt, CM. et al, 2008 [53]	1997-2001	Men and women- German population	2510	**Regular** 61.5±10.1	**Shifts** 62.3±9.3	77.8%
Hemiõ, K. et al, 2015 [48]	2006 – 2009	Men and women – aviation company in Finland	1478	-		77.8%
Wirth, M. et al, 2014 [52]	2005-2010	American Men and women – population-based	7643	20 – 80		77.8%
Cody, A. 2015 [34]	1989 -2009	American women – nurses	54724	25-42		77.7%
Kin, M. et al, 2013 [33]	2011	Korean women, nurses	9989	33.2		66.7%
Li, Y. et al, 2011 [51]	1987-1990	Japanese men and women – population-based	6712	20 to 59		66.7%
Barbadoro, P . et al, 2013 [6]	2008	Italian men – steel workers	339	**Day** 42.1±12.2	**Shifts** 48.6±8.3	66.7%
Lin YC. Et al, 2009 [29]	2002-2007	Chinese women- electronics factory	387	32.8 ± 7.9		66.7%
Lin YC. Et al, 2014 [39]	2002-2007	Chinese men – electronics factory	1196	32.5 ± 6.0		66.7%
Zhao, I. et al 2011 [35]	2006-2008	Women, Australian, New Zealand and	2494	42.8 ± 9.9		66.7%

		British, nurses					
Lennernas, M. et al, 1994 [40]	1994	Swedish men – steel workers	22	35.7 ± 7.2			66.7%
Lasfargues, G. et al, 1996 [50]	1996	French men and women – population-based	2400	30-29			66.7%
Balieiro, LC et al., 2014 [7]	April-Dec / 2012	Brazilian men, bus drivers	150	**Day** 46.7±9.9	**Night** 44±8.5		55.6%
Rodriguez, M. et. Al, 2009 [26]	2000-2001	Spanish men and women, hospital workers	417	24-65			55.6%
Morikawa, Y. et al, 2008 [41]	2003	Japanese men- metal company	2254	20-59			55.6%
Monique R. et al, 1992 [42]	1988 -1989	French men – plant operators	63	**Day** 32.4	**Shifts** 31.9		55.6%
Han, K. et al, 2016 [31]	2012	Korean women, nurses	340	22-40			55.6%
Assisi, MA. Et al, 2003 [20]	1999	Brazilian men, garbage collectors	66	20-44			44.4%
Assistance, M. et al, 2003 [43]	1999	Brazilian men, garbage collectors	66	20-44			44.4%
Esquirol, Y .et al, 2009 [44]	2001-2002	French men – chemical plant workers	198	39-60			44.4%
Cardozo, D. et al, 2013 [36]	NR	Women Brazilian hospital cleaning-service	24	20 – 40			44.4%
Crispin, CA. Et al, 2011 [11]	NR	Brazilian men, steel workers	22	**Day** 26.7±2.6	**Morning** 31.8±1.5	**Night** 30.1±1.4	33.3%
Sampedro, E. et al, 2010 [49]	2007	Spanish men and women, hospital workers	311	39 ± 8			33.3%
Pasqua, IC. Et al, 2004 [45]	not reported	Brazilian men – railway transportation	28	32.8 ± 5.3			33.3%
Sudo, N. et al, 2001 [37]	1998	Japanese women – computer factory	137	**Day** 28 (25,3-31)	**Morning** 26 (24-29)	**Afternoon** 25 (20 -28) [1]	33.3%
Waterhouse, J. et al, 2003 [47]	not reported	British men and women – nurses	93	**Day** 25 (22-27)		**Night 1** 26 (24-29) **Night 2** 43 (40-46)	33.3%
Bonell E. K. et al, 2017 [46]	not reported	Australian men – firefighters	41	36 (30, 52)			33.3%

NHS = Nurses Health Study; NR = not reported.
Age (years) expressed in mean ± standard deviation, age (up minimum) or median (interquartile range)
Check list * The New Castle-Ottawa Scale- version orginal [27] and adapted to cross-sectional studies [28]

Table 4. Results of studies evaluating nutrient intake and calories

Study	Work shift	Dietary assessment	Information assessed eating habits	Significant results		
Crispin et al, 2011 [11]	Morning = 06:00 to 14:00 Day = 8:00 to 17:00 Night = 22:00 to 6:00	DR - 7 days	Energy intake (kcal / day) and macronutrients (EI%)	**Morning** EI = 2649 ± 366,63kcal [a] PTN = 20.2 ± 1.1% [a] CHO= 45.3 ± 1.6% [a] LIP = 34.4 ± 1.9% [a]	**Day** 3549 ± 365 kcal [b] 16.2 ± 0.6% [b] 59,6,3 ± 1.4% [b] 24.2 ± 1.3% [b]	**Night** 3461 ± 114 kcal [b] * 23.1 ± 0.5% [c] ** 48.7 ± 1.6% [a] ** 28.2 ± 1.7% [a] **
Esquirol et al, 2009 [44]	Fixed = beginning at 08:00 Rotating = start at 05:00, 13:00 or 21:00 Duration of journey: 8h	DR - Fixed: 3 working days Rotating: 4 = 1 day 1 every on each shift + day off	Energy intake (kcal / day), consumption of macronutrients (g / day) and energy contribution percentage meals (% EI): Breakfast (BK) Snack 1 (S1) Lunch (L) Snack 2 (S2) Dinner (D) Snack 3 (S3)	**Fixed** Frequency of meals / day: 0.1 ± 4.69 Saturated fatty acids (g / day): 32.3 ± 0.96 BK: 13.85 ± 0.83% EI L: 41.18 ± 0.76% EI S2: 2.32 ± 0.34% EI S3: 0.38 ± 0.1% EI		**Rotating shift** 5.19 ± 0.08 ** 35.78 ± 0.99 ** 9.95% ± 0.70 ** 38.3% ± 0.76 ** 3.48% ± 0.42 * 3.84% ± 0.44 **
Pasqua; Moreno, 2004 [45]	Morning 7 am to 15.30 = Afternoon = 15:15 to 23:15 Night = 23:00 at 7:30 am	DR - 2 working days + 1 off	Energy intake (kcal / day) and macronutrients (g / day)	**NS**		
Romon Monique et al, 1992 [42]	Day: administrative work Rotating = alternate shifts every 2 days. Beginning at 6:00, 14:00 and 22:00.	DR - 3 days	Energy intake (kcal / day), macronutrients (g / day), ethanol (g / day), sugar (g / day) and coffee (ml / day)	**Daytime** Ethanol (g/day): 15.64 (0.97 to 252)		**Rotating shift** 9.3 (0.53 to 157) *
Cardozo et al, 2013 [36]	Day = "business hours" Night = 19:00 to 7:00 am	DR - 3 days	Energy intake (kcal / day) and macronutrients (g / day)	**Daytime** Calories (kcal) 317.83 ± 1623 Macronutrients (g / day) CHO: 217.74 ± 64.64 LIP: 50.39 ± 12.47	**Night-time** 315.88 ± 2043 ** 281.26 ± 65.37 * 65.76 ± 23.38) *	
Lennernas, M. 1994 [40]	Even individual working different shifts = 5:30 am to 14:00 Afternoon = 14:00 to 22:30 Night = 22:30 to 5:30	24HR 4: 1 hour at every shift + 1	Energy intake and macronutrients during each work shift over 24 hours (%)	**Morning** Kcal: 47 ± 17% PTN (g): 47 ± 16% CHO (g): 47 ± 14% Sucrose (g): 43 ± 25% Fibers (g): 46 ± 20% LIP (g): 46 ± 21% Saturated f. acids (g): 46±21%	**Afternoon** 51 ± 16 48 ± 18 53 ± 16 59 ± 24 52 ± 21 48 ± 18 47 ± 19	**Night** 35 ± 10 ** 35 ± 10 ** 35 ± 11 ** 35 ± 18 ** 34 ± 16 ** 35 ± 13 ** 37 ± 13 **

Data presented as mean (± standard deviation), DR = Dietary record; PTN = protein; CHO = carbohydrates; Lipids = LIP; NS = not significant; 24HR = 24-hour dietary recall

Different letters indicate statistically significant differences: * $p < 0.05$; ** $p < 0.01$

Table 5. Results of studies with evaluation of food groups, meal and eating patterns

Study	Work shift	Dietary survey useld	Information assessed - eating habits	Significant results		
Chen et al, 2010 [38]	Regular = nonrotating Rotating = Start rotating at different times on different days or weeks Rotating working time > 10 years <10 years	FFQ	Food groups: alcohol, coffee, fruits and vegetables	**NS**		
Barbadoro et al, 2013 [5]	Fixed = from 7/8 to 16h / 17h Rotation = 2 days in each shift Morning = 6:00 to 14:00 Afternoon = 14:00 to 22:00 Night = 22:00 to 6:00	FFQ = Rate Your Plate Eating Pattern Assessment	Risk score for cardiovascular disease (cholesterol intake, saturated fats and fried foods) Higher score = higher risk	**Fixed** Score: 37.7 ± 5.6		**Rotatimg shift** 36.1 ± 5.8 *
Haupt et al, 2008 [53]	Fixed NSP = Rotating self-report = (yes or no)	FFQ	Food score according to the recommendations of the German Society for Nutrition Higher score = more appropriate	**NS**		
Kim et al, 2013 [33]	Regular = NSP Shifts NSP = Working time in shifts: Tertile 1: 0.08 to 3 years Tertile 2: 3.08 to 6.75 years Tertile 3: 6.83 to 38	Meal pattern questionnaire	Meal consumption = breakfast, lunch and dinner	**Regular** Skip Breakfast: 29.2% Skip Lunch: 0.5% Skip dinner: 0.8%	**Shifts** 43.1% ** 2.5% ** 1.1% **	**Tertile – shifts** Skip breakfast 1st tertile: 43.2% ** 2nd tertile: 47.1% ** 3rd tertile: 38.4% ** Skip lunch Tertile 1: 2.9% ** 2nd tertile: 2.0% ** Tertile 3: 1.1% ** Skip dinner (%) Tertile 1: 1.2% ** 2nd tertile: 1.3% ** Tertile 3: 0.8% **

Y. Li et al, 2011 [51]	Day = NSP Rotation self-report = (yes or no)	FFQ	Frequency of food consumption: Vegetables: ≤ 1 time / day; ≥2 times / day Habitual consumption of alcoholic beverages (%) and ethanol ml/day; Frequency of snacks intake (yes or no)	**Daytime** Vegetables ≤1 time / day: 54.24% ≥2vezes / day: 45.76% *"Snacks"* No: 67.86% Yes: 32.14% Alcoholic beverages: Unusual: 68.49% Habitual: 31.51% % Ethanol (ml / day) ≤23 ml/day = 19.48% to 46 ml/day: 9.46% ≥69 ml/from: 2.57%	**Shifts** 59.42% ** 40.58% ** OR = 0.60 (95% 0,39- 0.82) 60.22% ** 39.78% ** OR = 1.45 (95% 1,02- 2.06) * 56.9% ** 43.1%** OR= 1.28 (95% 1,03- 1.50) * 25.38%** 13.8% ** 3.93% **		
Lin YC et al, 2009 [29]	Day = starts at 07:30 Rotating = 6 workdays during the day (start at 07:30), 3 of rest + 6 work at night (start at 19:30) and 3 days of rest. Different answers between shifts in 2002 and 2007 Rotary persistent = Same shift response in 2002 and 2007	Meal pattern questionnaire	Usual snacks consumption (> 3 days / week) before sleep and between meals	**NS**			
Lin YC , et al, 2014 [39]	Day = starts at 07:30 Rotating = 6 workdays during the day (start at 07:30), 3 of rest + 6 work at night (start at 19:30) and 3 days of rest. Different answers between shifts in 2002 and 2007 Rotary persistent = Same shift response in 2002 and 2007	Meal pattern questionnaire and alcohol	Usual snacks consumption (> 3 days / week) before sleep and between meals Regular intake of alcohol = ≥1 time / week, for a year	**Day-shift** Snacks before bed: 35.5% Regular consumption of alcohol: 7.2%		**Rotating shift** 42.8% 10.4%	**Persistent Rotating shifts** 49.4% ** 11.6% *
Wirth et al, 2014 [52]	Shifts (NSP) Subjects classified into day / regular; afternoon / evening; and any rotating shifts (combination of afternoon / evening shift and rotation shifts)	24HR	Inflammatory index diet score IID> 0: pro-inflammatory IID <0: anti-inflammatory	**Regular** IID: 0.86 (079- 094) [a]	**Afternoon / evening** 0.96 (0,80- 1.13) [a]	**Rotating** 1.07 (0.92 to 1, 22) [b] **	**Any rotating shift** 1.01 (0.89 to 1.13) [b] **

Zhao et al 2011 [54]	Hours NSP Daytime: Daytime work and fixed Rotating: includes 5 different shift scales: Continuous, only late afternoon, only night, morning and late afternoon and late afternoon and evening	Dietary quality questionnaire: Australian Recommended Food Score (ARFS)	Food score of 74 points Higher scores = better diet quality	**NS**		
Zverev, Y. 2005 [32]	Day = fixed shift without night work Rotating = 5 working days from 7:00 to 17:00; 3 nights from 17:00 to 7:00 am and 5 days off	Meal pattern questionnaire	Number of meals (main and snacks) on working days and rest	**Daytime** Work days Meals: 2.26 ± 0.59 [a]		**Rotating shift** Day = 2.06 ± 0.68 [a] ** Night = 1.12 ± 0.50 [b] ** Day off = 2.44 ± 0.81 [a] **
Hemið et al, 2015 [48]	Day = 6:00 to 18:00 Rotating "in flight" = pilots or flight attendants Rotation (NSP)	FFQ	Consumption of food groups stratified by sex Vegetables≥ 1 serving/day (%) Fruits ≥ 1 serving/day (%) High-fat Milk (HFM) (dL/day) Bread (slices/day) Oil/fat breads = yes or no (%) Cheese (slices/day) Sweetened beverages (dl/day) Liqueurs (serving/week)	**Daytime** Vegetables[1]: 63% Fruits[1]: 44% [1] HFM[2]: 1.3 [a] Breads[1]: 3.2% Oils for breads: 75%; 67% Cheese[2]: 2.7%	**Irregular** 49% 38% 1.2 [b] 3.4% 70%; 65% 3.2%	**"In flight"** 64% ** 52% * 1.5 ** [b] 2.6% ** 57%; 54% ** 6.9% * Others = **NS**
Freitas et al, 2015 [17]	Day: start at 6:00 Night: beginning at 18:00 Duration 8h	FFQ and meal intake questions	Number and type of meals eaten throughout the day (%) Meals in "inappropriate" times outside the following times: Breakfast = 6 am to 8:30 am Lunch = 11h -14h Dinner = 18h - 21h. Score food risk. Risk consumption> = 3rd tertile.	**Daytime** **Meals consumed (%)** > 3 meals/day: 28.1% Breakfast: 62.6% Dinner: 90.5% Night snack: 5.3% Inadequate hours (%) Breakfast: 5.8% Dinner: 74.2%		**Night-time** 36 ** 50.6 ** 89.1 ** 18.4 ** 96.7 ** 40.2 ** Others NS =

Data are presented as mean (± SD) mean (95% confidence interval) and percentage (%) = FFQ food frequency questionnaire; 24HR = 24-hour dietary recall; NS = not significant; NSP = not specified; [1] Significant results only for male workers; [2] Significant results only for female workers Different letters indicate statistical difference; * p *<0.05;* ** p *<0.01*

Table 6. Results from studies evaluating calorie intake, nutrients, food groups and eating patterns

Study	Work shift	Dietary survey used	Information assessed eating habits	Significant results		
Assis et al., 2003 [43]	Morning: 7:00 to 13:00 Afternoon: 15:00 to 21:00 Night: 21: to 03:00	24HR 1 and DR 2	Energy intake (kcal / day) and macronutrients (g / day) Energy intake (kcal / day) of the following food groups: fruits and vegetables (FV), starches, baked foods, animal protein, alcoholic beverages, fats and sweets Frequency of meals and snacks in the after dawn, morning, midday, afternoon and evening.	**Morning** CHO (g): 407.6±13.4 [a] FV: 110 ± 10.5kcal Starches: 1234 ± 35.1 kcal [a] Animal protein: 1230 ± 35.1 kcal Alcoholic beverages: 81±9.0 kcal [b] Candy: 488±21.2 kcal Soda: 403.1±62 ml	**Afternoon** 459.9 ± 21.1 [a] 151 ± 12.3 1344 ± 36.7 [a] 975 ± 31.2 96 ± 9.8 [a] 517 ± 22.7 572 ± 48	**Night** 503.4 ± 27.5 [b] ** 272 ± 16.5 * 1207 ± 34.7 [b] ** 1019 ± 31.9 * 164 ± 12.8 [a] ** 517 ± 22.7 ** 677.7 ± 78 *
Assis et al., 2003 [20]	Morning: 7:00 to 13:00 Afternoon: 15:00 to 21:00 Night: 21: to 03:00	1 and IR24h 2DR	Relative contribution of foods in caloric intake Consumption of food groups according to high nutrient density and high energy density Eating episodes (total, complete meals or snacks) Energy intake (% EI) at different times of day (after 03:00, morning, afternoon or evening)	**Morning** *(% EI)* Meat: 22.3 ± 1.7% [a] Breads: 12.4 ± 1.2% [a] Additional Fat: 5.5 ± 0.4% [a] Soda: 4.7 ± 0.7% [a] Fruits and Vegetables: 3.1 ± 0.5% [a] *Eating episodes/day:* Total: 5.3 ± 0.2 *% EI* Overnight: 1 ± 0.5 % [a] Morning: 28.0 ± 2.0 % [b]	**Afternoon** 20.0 ± 1.4% 14.0 ± 0.6% [a] 5.9 ± 0.5% [a] 6.7 ± 0.7% 4.0 ± 0.9% 5.5 ± 0.9 0.6 ± 0.4% [a] 19.6 ± 2.3% [a]	**Night** 17.2 ± 1.3 % [b] * 8.0 ± 0.9 % [b] ** 7.6 ± 0.4 %[b] ** 6.9 ± 0.7 % [b] * 7.1 ± 0.9 % [b] ** 6.2 ± 1.2 ** 9.6 ± 1.5% [b] ** 13.1 ± 1.7% [a] **
Balieiro et al., 2014 [6]	Day (NSP) Night (NSP)	FFQ	Consumption of food groups (servings/day) and prevalence of inadequate intake according to the Adapted Food Pyramid	**Day shift** **Servings / day** Meat and eggs: 2.0 ± 0.7 * Fruits: 0.7 ± 0.9 * **Inadequate intake** Vegetables: 92.7% Oils: 24.6%	**Night shift:** 2.3 ± 0.9 * 0.9 ± 0.4 ** 100 %** 40.7 %*	

Diaz-Sampedro et al, 2010 [49]	Fixed = day without night Rotation = Includes rotating night shift	FFQ	Adequate intake according to the Spanish Society of Community Nutrition (2004)	NS		
Rodriguez et al, 2009 [26]	Fixed = only morning, afternoon or evening Rotating = morning, afternoon and evening on a rotating basis	FFQ	High, medium and low intake distribution according to tertiles of each food group	**Fixed shift vs. rotating shift**	RC (95%) **Meat** Moderate: 1.95 (1.13 to 3.34) High: 1.44 (0.83 to 2, 51) **Eggs** Moderate: 0.96 (0.61 to 1.53) High: 1.74 (1.07 to 2.85) **Rice and pasta** Moderate: 1.73 (1.12 to 2.68) High: 0.94 (0.55 to 1.61) **Juices** Moderate: 1.34 (0.81 to 2.20) High: 1.75 (1.11 to 2.77)	
Sudo et al, 2001 [37]	Fixed = 8:30 to 17:45 Rotation = early morning (6:00 to 13:45) or afternoon / evening (13:40 to 22:25)	DR-4 days	Nutrient adequate rate (NAR) for calories, macronutrients (g) Calcium (mg) and iron (mg). NAR $_{energy}$: NAR for calories consumed from snacks, breakfast, lunch and dinner NAR = amount consumed / RDA 100	**Fixed shift**	**Shift: Morning**	**Turn afternoon / evening**
				Worked days		
				Calories: 1954.9 ± 392 kcal	1700.9 ± 426.2	1530.1 ± 629 *
				PTN: 71.2 ± 17.9 g/day	60.7 ± 60.0g	54.2g ± 17.8 *
				LIP: 58.0 (42.6 67.6 %)	46.8 (37.9% 60.3%)	37.2 (52.3% 29.2%) *
				CHO: 277.5 (241.0% 309.8%)	238.0 (195.4% 281.4%)	200.0 (163.6% 262.3%) *
				Calcium: 499.8 (372.3% 652.8%)	422.7 (295.7% 552.7%)	349 (226.7% 493.3%) *
				Iron: 9.2 (7.5% 11.9%)	8.0 (6.7% 10.4%)	7.1 (5.9% 8.3%) *
				Days off:		
				CHO: 243.5 (190.9% 292.5%) *	200.6 (156.9% 239.0%) *	180.2 (143.4% 289.9) **NS**
				NAR (%)		
				Worked days		
				Energy : 108.5 ± 24[a]	93 ± 23.2[b]	84.7 ±35.2[b] *
				Protein: 116.2 ± 30.1[a]	99.5 ± 27.0[b]	89.9 ± 30.0[b] *
				Carbohydrate: 97.7 ± 21[a]	87.1 ± 23.4	79.9 ± 31.2[b] *
				Fat: 132.2 (157.7% 86.3%) [a]	105.3 (89.0% 131.0%)[b]	85.5 (64.3; 112.4)[b] *
				Calcium:83.3 (60.8, 108.3) [a]	77.0 (47.3; 91.7)	58.8 (38,9% 89,7%)[b] *
				Iron: 76.8 (62.5% 99.2%) [a]	63.7 (54.0; 84.7)	59.0 (48.9; 69.0) [b] *
				NAR $_{energy}$		
				Breakfast: 24.5 ± 8.2%[a]	24.3 ± 11.4 [a]	11.1 ± 14.8 [b] *
				Dinner[a]: 38.7 ± 12.6% [a]	26.2 ± 15.0 [b]	28.2 ± 10.3 [b] *

Vimalananda, VG. et al, 2015 [21]	Daytime Night (0h to 8h) 1 and 2, 3 to 9, ≥10 years	FFQ	Average energy intake (kcal). Frequency of regular food consumption: Coffee> 1 cup / day Decaffeinated coffee> 1 cup / day Soft drinks> 1 cup / day Diet soft drinks> 1 cup / day Dietary pattern: 5th quintile of food groups intake: "Fruits and vegetables" (FV): More healthy; "meat/ fried foods" (CF): Less healthy	**Daytime** Calories: 1434 kcal Alcohol: 26% Coffee: 8% Decaffeinated coffee: 2% Soft drinks: 5% Diet soft drinks: 2% 5th quintile consumption: FV: 20% SC: 19%	**1 to 2 years** 1501 25 9 2 6 1 19% 21%	**3 to 9 years** 1570 25 11 2 7 2 18% 21%	**≥10 years** 1603 * 23 * 11 * 1 * 9 * 2 * 18% * 22% *
Han, k. Et al. 2016 [31]	= Fixed day or later Rotating = with night shifts / without night shifts	Food habits questionnaire	Irregular meals consumed/day (yes or no); Frequency of meals/day Hours of full meals and snacks. Consumption of food according to Korean recommendation: Dairy; proteins; vegetables; fruits; fried food; fatty foods and carbohydrates snacks	**Fixed** Irregular meals (yes) 37.7% Frequency of meals/day (%) 1-2 meals/day: 35.8% 3 meals/day: 54.7% Irregular: 9.4% Skip Breakfast: 26.4% Time of snacks: Morning: 11.3% Afternoon: 49.1% Late (after dinner): 30.2% Night (after 22h): 5.7% Fruits => 1 serving/day: 62.3%	**With night** 86.9 56.0 20.6 23.4 40.9 4.0 23.8 22.6 44.0 54.4	**No night** 65.7 ** 45.7 ** 40.0 ** 14.3 ** 25.7 * 5.7 ** 42.9 ** 25.7 ** 25.7 ** 77 *	
Cody, A. 2014 [34]	Fixed / day Morning (4am to 9am), day (07h to 15h) or afternoon (15h to 23h) Night / rotating Only night or rotating shift including night shifts(23h at 7:00 am)	FFQ	Alcohol intake (g/day), caffeine (mg/day) and calories (kcal/day). Healthy diet score (AHEI) ranging from 0 (no adhesion) to 110 (perfect adhesion)	**Fixed shift/day** Caffeine intake (mg/day): 167 ± 136 Total energy (kcal / day): 1772 ± 547 AHEI score: **NS**	**Night/rotating shift:** 184 ± 142 ** 1822 ± 562 ** **OR (95% CI) -** Caffeine intake (> 131 mg): 1.16 (1.12 to 1.22) **OR (95% CI)** Total energy (>1715 kcal/day): 1.09 (1.04 to 1.13)		

Hulsegge [19]	Fixed: Any shift not considered rotational Rotation = late (up to 00h); night (after 00h); "Sleep" (sleep at work) Number of working nights (between 00 and 5:00 a.m.) = no; 1 to 4 or> 5	FFQ	Energy intake (kcal/day) and percentage of macronutrient contribution (% EI) Average intake (g/day) and percentage contribution of calories from food groups (% EI) Mediterranean dietary pattern score (MDS) and WHO recommendations (HDI). Highest score = healthier eating pattern	**Fixed shift** Kcal/day: 1990 (IQR 1670-2391) PTN: 15.9 (IQR 14.5 - 17.5) Cholesterol (mg): 211 (IQR 167-261) Cereals (g/day) 49 (26-77) Fishs (g/day): 8.0 (IQR 3.3 -14.9) Meat (g/day): 102 (IQR 62-136) Milk (g/day): 346 (IQR 197-541) Cakes/cookies (g/day) 25 (13-41) HDI SCORE: NS	**Rotating shift** 2222 (IQR 1826-2700) β: 56kcal/day (95% CI 10-101) * 15.8 (IQR 14.4 to 17.3) β : 0.29 (95% 0,11- 0.46) * 232 (184- 287); β 10 (95% CI 4-17) * 58 (34-96); β 8 (95% CI 3-12) * 8.2 (3.7-14.8); β 0.9 (95% CI : 0.1- 1.8) * 118 (78-159); β 31 (95% CI 6-56) * 358 (181-580); β 56 (95% CI 10-101) * 23 (11-40); β : - 0.3 (95% CI - 0.6 to - 0.1) * Number of nights worked/month > 5 nights / month: Energy intake: β 103 (29-176) * Meat (g/day): 12 β (4-19) ** Cholesterol: β 15 (5-26) **
Morikawa et al, 2008 [41]	Fixed= non-rotatating Rotating = shifts alternating every 5 days. Beginning at 8 am, 16: 30h and 00: 15h + rest of the weekend; or alternated every 3 to 4 days, starting at 6:30 a.m., 21:30 + 3h or resting one day every shift change RWM= work without rotating at midnight RM = Rotating work with midnight	FFQ	Energy intake (kcal/day), percentage of calories macro and micronutrients (% EI), consumption of nutrients (mg/1000kcal) of calcium, iron, sodium, potassium, Vitamins: A, B1 and C; alcohol fibers. Stratification by age Consumption of food groups (g/1000kcal): vegetables, meats and dairy products)	**Fixed** **20 to 29 years:** SFA: 5.9 ± 1.7% EI Calcium: 180.8 ± 85.7 mg/1000kcal Potassium: 895 ± 254 mg/1000kcal Vit.A: 314 ± 166 mg/1000kcal VitB1: 0.345 ± 0,108mg/1000kcal Milk: 27.2 ± 3.2 g/1000kcal **30 to 39 years [a]:** Energy: 2,129 ± 610kcal Vitamin B1: 0.328 ± 0.091 **40 to 49 years:** PUFA: 5.4 ± 1.7% EI Meat: 15.8 ± 2.1 g/1000kcal Oils: 8.1 ± 1.7 g/1000kcal **50 to 59 years:** Energy: 2,109 ± 604kcal Fibers: 5.37 ± 1.62 g/1000kcal Vegetables: 35.2 ± 2.1g/1000kcal	**RWM** 6.1 ± 2.2 188.6 ± 70.1 904 ± 251 336 ± 182 0.35 ± 0.096 31.0 ± 3.2 2,182 ± 627 0.653 ± 0.131 5.2 ± 1.5 18.9 ± 1.8 7.7 ± 1.6 2,181 ± 720 5.06 ± 1.38 31.8 ± 1.9	**RM** 5.4 ± 2.1 * 161.6 ± 67.9 ** 830 ± 237 ** 239 ± 142 ** 0.317 ± 0.096 ** 18.5 ± 3.6 ** *Other nutrients: NS* 2,356 ± 781 ** 0.312 ± 0.082 * 5.0 ± 1.6 * 13.7 ± 2.2 ** 7.0 ± 1.7 * 2,276 ± 725 * 5.04 ± 1.38 * 30.0 ± 1.9 *

An Pan et 2011 [30]	Rotating (RT): day shift + 3 nights / month Time in work shift: Never, 1 or 2; 3 to 9; 10 to 19; > 20 years	FFQ	Energy and macronutrients intake Diabetes Score: low-risk diet, "poor" in trans fat and glycemic index, high in fiber and higher ratio of polyunsaturated / saturated fat Consumption of food groups	**NS**	
Waterhouse. J et al, 2003 [47]	Day: 09:00 to 18:00 Night: 20:00 at 6:00	Food habit questionnaire	Meal Frequency (cold, hot meals small, large hot meals) and snacks during the working days.	**Daytime** Snacks: 0.21 Hot meals: 0.10 Cold foods: 0.65 Hot foods: 0.36	**Night-time** 0.42 * 0.04 ** 0.76 * 0.23 *
Bonell E. K. et al, 2017 [46]	Same subject working in different shifts = 2 working days (10h), followed by 2 days of working nights (14h) +4 days off	4 24HR (2 each working schedule)	Energy intake (kcal/day), percentage (% EI) macronutrients, number of meals consumed, energy density (ED- kcal/g/day)	**Daytime** % (EI) Sugars: 15.5% (11.3- 19,7) Food consumed: 27.5 (21.5- 30) ED: 5,52kcal/g/day (4.72-5.83)	**Night-time** 16.8% (14.2-19,6) * 25 (20- 30) * 5,73kcal/g/day (5.08-6.88)*

Lasfargues et al, 1996 [50]	Day= NSP Night = NSP	FFQ and food habits questionnaire	Frequency of meals and consumption of food groups. Fat intake frequency:> 130g / (men); > 95 (women) and cholesterol:> 550mg (men); > 450mg (women).	**Daytime**	**Night-time**
				Not eat breakfast every day: Men: 25.1%	32.8 **
				Not eat lunch> 1time/week: Men: 3.2%; Women: 6.7%	35.3 **; 49.6 **
				Water consumption <1 liter/day Men: 68.5%; Women: 72.5%	55.9 **; 60.4 **
				Sweet drinks> 0.5 liters/day: Men: 7.6%; Women: 2.6%	12.1 **; 6.2 **
				Dairy products (<3 times per week) Men: 85.4%; Women: 78.1%	79.4 **; 69.9 **
				Bread (> 200 g/day) Men: 21%	25.7 *
				Calcium (mg/day) Women: 1020 ± 170	996 ± 170 *

Data presented as mean (± standard deviation) Average (95% confidence interval) Median (25%, 75%); Median (interquartile range -IQR) and Percent (%); FFQ = Food Frequency Questionnaire; DR= Dietary record; 24HR = 24-hour dietary recall; NS = not significant; NSP = not specified; Different letters indicate statistical differences; * p *<0.05;* ** p *<0.01*

ANEXO I- Chek list MOOSE

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	Page 1
2	Hypothesis statement	Page 1
3	Description of study outcome(s)	Page 1
4	Type of exposure or intervention used	Page 2
5	Type of study designs used	Page 2
6	Study population	Page 2
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	Page 2
8	Search strategy, including time period included in the synthesis and key words	Page 2 Table 2
9	Effort to include all available studies, including contact with authors	Page 2
10	Databases and registries searched	Page 2
11	Search software used, name and version, including special features used (eg, explosion)	Page 2
12	Use of hand searching (eg, reference lists of obtained articles)	Page 2
13	List of citations located and those excluded, including justification	Figure 1
14	Method of addressing articles published in languages other than English	Page 2
15	Method of handling abstracts and unpublished studies	Page 2
16	Description of any contact with authors	Page 2
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Page 2 and figure 2
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Page 2
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	Page 2
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	Page 4 and figure 2
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	Page 4 and figure 2
22	Assessment of heterogeneity	Not applicable
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Not applicable
24	Provision of appropriate tables and graphics	Table 2 to 6; figures figure 2.

Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Not applicable
26	Table giving descriptive information for each study included	Table 3
27	Results of sensitivity testing (eg, subgroup analysis)	Not applicable
28	Indication of statistical uncertainty of findings	Not applicable

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	Page 1
2	Hypothesis statement	Page 1
3	Description of study outcome(s)	Page 1
4	Type of exposure or intervention used	Page 2
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9	Effort to include all available studies, including contact with authors	Page 2
10	Databases and registries searched	Page 2
11	Search software used, name and version, including special features used (eg, explosion)	Page 2
12	Use of hand searching (eg, reference lists of obtained articles)	Page 2
13	List of citations located and those excluded, including justification	Figure 1
14	Method of addressing articles published in languages other than English	Page 2
15	Method of handling abstracts and unpublished studies	Page 2
16	Description of any contact with authors	Page 2
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Page 2 and figure 2
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Page 2
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	Page 2
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	Page 4 and figure 2
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	Page 4 and figure 2
22	Assessment of heterogeneity	Not applicable
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Not applicable
24	Provision of appropriate tables and graphics	Table 2 to 6; figures figure 2.
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Not applicable
26	Table giving descriptive information for each study included	Table 3
27	Results of sensitivity testing (eg, subgroup analysis)	Not applicable
28	Indication of statistical uncertainty of findings	Not applicable

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Reporting of background should include		
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2	Hypothesis statement	Page 1
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Reporting of search strategy should include		
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9	Effort to include all available studies, including contact with authors	Page 2
10	Databases and registries searched	Page 2
11	Search software used, name and version, including special features used (eg, explosion)	Page 2
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16	Description of any contact with authors	Page 2
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Page 2 and figure 2
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Page 2
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	Page 2
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	Page 4 and figure 2
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	Page 4 and figure 2
22	Assessment of heterogeneity	Not applicable
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Not applicable
24	Provision of appropriate tables and graphics	Table 2 to 6; figures figure 2.
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Not applicable
26	Table giving descriptive information for each study included	Table 3
27	Results of sensitivity testing (eg, subgroup analysis)	Not applicable
28	Indication of statistical uncertainty of findings	Not applicable

Item No	Recommendation	Reported on Page No
Reporting of discussion should include		
29	Quantitative assessment of bias (eg, publication bias)	Not applicable
30	Justification for exclusion (eg, exclusion of non-English language citations)	Figure 1
31	Assessment of quality of included studies	Table 3 and figure 2
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	Page 07 to 10
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	Page 10
34	Guidelines for future research	-
35	Disclosure of funding source	Not applicable

From: Stroup DF, Berlin JA, Morton SC, et al, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. *JAMA*. 2000;283(15):2008-2012. doi: 10.1001/jama.283.15.2008.

Transcribed from the original paper within the NEUROSURGERY® Editorial Office, Atlanta, GA, United Sates. August 2012.

ANEXO II- Normas para publicação de artigo

Nutrition Reviews

Article types

Nutrition Reviews publishes review articles in both the narrative and systematic review formats. Systematic reviews must address a clearly defined research question that is articulated in the abstract; they must also follow recognized approaches to the literature selection, analysis, and conclusions, as outlined in accepted guidelines, such as PRISMA or MOOSE. Scoping reviews that investigate the available literature on a topic in order to determine if more research is required, or if there is sufficient available literature for a full review, fall outside of the journal's scope and are not considered for publication. Submissions in the following article categories are welcome:

- *Lead Article:* Comprehensive review of a broad topic;
- *Special Article:* Comprehensive review focused on a niche topic, a specific aspect of a broad topic, or new methods in nutrition science;
- *Nutrition in Clinical Care:* Presentation of clinically relevant brief reviews of evidence-based information and tools to facilitate translation into clinical practice;
- *Emerging Science:* Discussion of an important current study or group of studies in nutrition research presented in the context of the larger body of research on that topic;
- *Nutrition Science ↔ Policy:* Review of the interaction between scientific research and national and international health and nutrition policy;
- *Letter to the Editor:* Addition to the discourse regarding certain topics covered in recent issues of the journal.

Systematic reviews may be submitted for any category except Emerging Science and Letter to the Editor. Articles in the categories of Lead Article, Special Article, Nutrition in Clinical Care, Emerging Science, and Nutrition Science ↔ Policy are subject to peer review. Letters to the Editor are published at the discretion of the editors.

Terms of consideration

All manuscripts submitted to the journal must be original works of authorship that are not under simultaneous consideration elsewhere and do not infringe the intellectual property rights of any individual or organization. All previously published information, whether by the authors themselves or other individuals, groups, or entities, must be appropriately cited. The final version must have been read and approved by all of the individuals named as authors.

The work must present novel information that differs substantially from that presented in works published by the authors previously. Authors should attest to these terms in their cover letter.

Authorship and originality

To qualify for authorship, individuals must meet all of the following criteria: 1) contributed significantly to the work's conception, design, data collection (as applicable), or data interpretation and analysis; 2) participated in the writing or critical revision of the article in a manner sufficient to establish ownership of the intellectual content; and 3) read and approved the version of the manuscript being submitted. All authors share responsibility for ensuring the manuscript complies with the journal's style requirements and terms of consideration. Any requests for changes to author names, or order of appearance, that are received post submission will need to be approved in writing by all authors.

Funding and sponsorship

All sources of funding for the article's research, preparation, and publication should be noted in the article's Acknowledgments section under the subheading "Funding" and be acknowledged in the cover letter. The full name of the funding agency should be provided and grant numbers should be supplied. If grants or other funding were given to specific authors, the relevant individuals should be identified by their initials in parentheses.

The role any sponsor played in the study design, data collection and analysis, manuscript preparation and revision, and publication decisions should be made clear in the Funding declaration in the Acknowledgments section. Authors should also indicate whether they received complete access to data pertaining to the publication that was owned by the sponsor.

Crossref Funding Data Registry

In order to meet your funding requirements authors are required to name their funding sources, or state if there are none, during the submission process.

Competing interests

All authors are required to disclose relevant competing interests by noting them in the Acknowledgments section of the manuscript under the subheading "Declaration of Interest." Guidelines regarding what constitutes a competing interest are included in the Declaration of Interest form. Completed Declaration of Interest forms for each author should be uploaded as Supporting Information at the time of manuscript submission.

Manuscript preparation

Cover letter. The cover letter should address the following topics: description of the work and its novelty; authorship; and originality. The description of the work should clearly indicate what novel contribution the submitted article makes to the existing literature. A statement should indicate that all listed authors meet the criteria for authorship (see *Authorship and Originality* entry above) and that no individual meeting these criteria has been omitted. Regarding originality, the following should be declared or, if untrue, explained: 1) the submitted article represents the original work of the authors; 2) the article is not currently under consideration elsewhere, nor has it been previously published in the same or substantially similar form; and 3) no copyright to any other work was breached in the manuscript's creation.

Manuscript format. Manuscripts should be prepared electronically using word-processing software, preferably Microsoft Word. Article pages should be formatted as double-spaced and left-justified text with 1-inch margins and 12-point type. Pages and lines must be numbered.

Length restrictions. Articles in any category must be formatted as indicated in the *Manuscript format* guidelines section and may not exceed 50 double-spaced pages in length, including references and illustrative material. Each article should provide a focused, concise, and objective investigation of a clearly defined topic.

Supporting information. The option to publish certain material as "Supporting Information" in an online-only format is provided. Authors are encouraged to make use of this option to accommodate material that may be of interest to the reader but is not integral to the work itself. Examples would include extensive summary tables and appendices. It is particularly important that the main text of an article include everything essential for a complete understanding of the review and that the main text stand alone from the Supporting Information. Readers should not need to toggle between documents to obtain or understand information. If references are included in Supporting Information documents, they should be listed at the end of each document and appear in a numerical sequence pertaining solely to that document.

Cover page. The following information should be included on the cover page:

- *Article type*. Choose one of the article types in which the journal specializes. Editors may change this designation if they find the article is better suited to another category.
- *Title*. The title of the article should be short (200 characters or less), specific, and accurately describe the topic of the work. Abbreviations and acronyms should not be used

unless they are widely recognized and generally understood, e.g. HIV, DNA. Articles and phrases such as "the use of," "the treatment of," and "a report of" should be avoided.

- *Author names.* Please list the first name, middle initial(s), and last name of each author in descending order of their contributions to the article. Individuals who provided technical or administrative support should be recognized in the Acknowledgments section.
- *Author affiliations.* The names of all authors affiliated with a particular institution should be listed directly above the affiliation. Each affiliation should include the department, institution, city, state (spelled out, if applicable), and country.
- *Corresponding author.* The name, complete mailing address, telephone and e-mail address should be provided for the author responsible for correspondence.
- *Abstract.* An abstract clearly outlining the topic and primary objective of the review, methods of data sourcing and extraction, data synthesis (as applicable), and conclusions must be included with each article. The length should not exceed 170 words for Lead, Special, and Nutrition Science ↔ Policy papers or 125 words for Emerging Science and Nutrition in Clinical Care papers. Abstracts exceeding these word limits will be shortened during copyediting. References, tables, and figures should not be cited in the abstract.
- *Key words.* At least three to five key words or phrases should be provided.

Sections and headings

Narrative reviews. Each manuscript should contain the following sections in addition to the abstract:

- Introduction (directly following the abstract)
- Conclusion (at the end of the text)
- Acknowledgements (after the Conclusion)
- Funding and sponsorship (as part of the Acknowledgments)
- Declaration of interest (as part of the Acknowledgments)
- References (after the Acknowledgments).

Between the Introduction and Conclusion, headings and subheadings are at the discretion of the author. They should be used to organize the text and guide the reader.

Systematic reviews. Articles of this type should be prepared in accordance with relevant, existing guidelines (e.g., PRISMA, MOOSE) and be structured accordingly. If the guidelines used include a checklist, the completed checklist should be uploaded as Supporting Information during the manuscript submission process. Questions regarding the acceptability of chosen guidelines can be sent to the journal's editorial office via e-mail (nutritionreviews@ilsi.org).

Abbreviations and acronyms. Abbreviations and acronyms should not be used unless they are widely recognized and generally understood, e.g. BMI, FDA. These should only be used for terms used more than four times in the text. If that criterion is met, the term should be spelled out on first use followed by the abbreviation or acronym in parentheses. The abbreviated form should be used consistently thereafter, except in section headings, where it should continue to be spelled out.

References. The number of references cited should be tailored to the material being reviewed and be from reputable sources. As a general rule, articles in the Lead, Special, and Nutrition Science ↔ Policy categories do not typically include more than 200 references, while articles in the Emerging Science and Nutrition in Clinical Care categories do not typically have more than 120.

References should be numbered sequentially upon first appearance in text, tables, and figures. They should be typed as superscripts and placed after commas and periods but before colons and semicolons. When citing a series of consecutive numbers, provide the first and last with a dash between them (e.g., [5–7]). When referring to a group of authors in the text, the format "Smith et al.[23]" should be used.

References cited only in figure or table legends should be numbered according to the first mention of the graphic in the text and should be cited in the text at that point. Reference to unpublished work or personal communications should be avoided but, when essential, should be identified in the text as "unpublished data" or "personal communication from …", not in the reference list. To ensure long-term accessibility, internet citations should only be used if that is the sole source of the information.

The reference list should be formatted according to AMA style. For each citation, sufficient information must be provided to allow a reader to know in what medium the material appeared and to access the information. Please list all authors if there are six or fewer; for seven or more authors, list the first three followed by "et al." Examples of AMA style are as follows:

Journal article: Gordon KB, Papp KA, Hamilton TK, et al, for the Efalizumab Study Group. Efalizumab for patients with moderate to severe plaque psoriasis: a randomized controlled trial. JAMA. 2003;290:3073–3080.

Chapter in a book: Dybul M, Connors M, Fauci AS. Immunology of HIV infection. In: Paul WE, ed. Fundamental Immunology. 5th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2003:1285–1318.

Entire book: Gibson GR, Rastall RA. Prebiotics: Developments and Application. Hoboken,

NJ: Wiley; 2006.

Government bulletin: Guidance on Labeling of Foods That Need Refrigeration by Consumers. College Park, MD: Office of Food Labeling, US Food and Drug Administration; 1997. Docket No. 96D-0513.

Internet citation: American College of Surgeons. National Trauma Data Bank Report 2006, Version 6.0. Chicago, USA. Available at: http://www.facs.org/trauma/ntdb/ntdbannualreport2006.pdf. Accessed on October 22, 2007.

Tables and illustrations. Tables and illustrations should be numbered in the sequence in which they appear in the text. They should appear in sequence after the reference list.

Tables. All tables should be included in the text file after the reference list. Each table should be constructed using the table functions of the word-processing program being used. A title should appear at the top of each table. A column heading should appear in the top cell of each column. Within the table, each data set should appear in a single cell; the return key should not be used within any cell. Text should be justified to the left. Numerical data should be justified to the decimal point. Capitalization should be restricted to the first letter of the legend, the first letter in each cell, and applicable abbreviations or acronyms. Abbreviations used in the table should be spelled out in a footnote. When citing prior studies in tables please use the following format: Smith et al. (1998)[21].

Illustrations. All artwork should be submitted in digital format in separate files saved using the following convention: surname of first author_figure number (e.g., Smith_figure 1). Figure legends should be cited in the manuscript after the reference list but should not appear in the figures themselves. Charts and graphs downloaded from the Internet are not acceptable. Line artwork (vector graphics) should be saved in Encapsulated PostScript (EPS) format and bitmap files (halftones or photographic images) in Tagged Image Format (TIFF), with a resolution of at least 300 dpi at final size. Do not send native file formats.

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Procedures

Manuscript processing

Manuscript submission. Manuscripts should be submitted online. There is no charge for submission. Full instructions and support are available on the site and a user ID and password can be obtained on the first visit. Support can be contacted by phone (+1-434-817-2040) by e-mail (ts.mcsupport@thomson.com) or online. If you cannot submit online, please contact the Editorial Office by e-mail (nutritionreviews@ilsi.org).

Use of iThenticate. *Nutrition Reviews* uses iThenticate software to determine the level of similarity between text in submitted articles and in articles published previously. Every manuscript received for consideration is run through this software directly following submission. Results are evaluated by the journal's editors and included in deliberations about the manuscript's suitability for publication.

Review process. Manuscripts are peer-reviewed promptly after submission, and are usually published within 10 months of acceptance. Authors may be asked to revise their manuscript to address any concerns raised during the review process. Authors may check the progress of their manuscript by logging in to the Manuscript Central site.

License to publish. Authors are required to complete an Author License form prior to publication of their work. The form will be provided to the corresponding author by the journal's production editor shortly after manuscript acceptance.

Copyediting and proofs. Manuscripts accepted for publication are edited for clarity of content, consistency, and style prior to publication. Following copyediting and typesetting, formatted proofs are sent to the authors via e-mail for final approval. Authors should check the proofs promptly and carefully to answer any queries posed by the copyeditor and to ensure the text is complete and that all tables and figures are included and properly cited. Complete instructions are sent out with the proofs.

Author Copies and Offprints. Following publication, a free link to the published version of the article is provided to the corresponding author for distribution to coauthors and interested colleagues. This link permits free access with full online functionality without the need for a subscription. Authors may additionally order offprints at a 50% discount. This offer only applies to offprints, created at the time of initial print publication. It does not apply to reprints, ordered post publication.

Ethics and misconduct

Nutrition Reviews is a member of the Committee on Publication Ethics and consults the guidelines of that organization as well as the International Committee of Medical Journal Editors, and the World Association of Medical Editors when handling allegations of misconduct.

All authors are obliged to ensure their manuscripts reflect the highest standards of scientific and ethical integrity. Evidence of possible scientific or ethical misconduct related to manuscripts submitted for review or published in *Nutrition Reviews* will be investigated for the purpose of determining the appropriate editorial course of action.

Post-production Corrections

No correction to a paper already published will be carried out without an erratum or corrigendum (as applicable), this applies to papers on Advance Access and published within an issue. This means that any change carried out to a paper already published online will have a corresponding erratum or corrigendum published with its own separate DOI. Whether on Advance Access or in an issue, if an erratum or corrigendum is published, the online version of the original paper will also be corrected online and the correction notice will mention this. Corrections will only be made if the publication record is seriously affected by the academic accuracy of published information.

Authors' corrections to Supplementary Data are made only in exceptional circumstances (for example major errors that compromise the conclusion of the study). Because the Supplementary Data is part of the original paper and hence the published record, the

information cannot be updated if new data have become available or interpretations have changed.

A growing number of funding agencies stipulate that research articles they have funded must be published, licensed, and archived in compliance with specific requirements.

Note to NIH Grantees. Pursuant to NIH mandate, the accepted version of contributions authored by NIH grant-holders will be posted to PubMedCentral on the author's behalf upon acceptance. This accepted version will be made publicly available 12 months after publication in an issue.

ANEXO III- Instrumento New Castle Otawa original[27]

NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
CASE CONTROL STUDIES

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability.

Selection

1) Is the case definition adequate?
   a) yes, with independent validation *
   b) yes, eg record linkage or based on self reports
   c) no description

2) Representativeness of the cases
   a) consecutive or obviously representative series of cases *
   b) potential for selection biases or not stated

3) Selection of Controls
   a) community controls *
   b) hospital controls
   c) no description

4) Definition of Controls
   a) no history of disease (endpoint) *
   b) no description of source

Comparability

1) Comparability of cases and controls on the basis of the design or analysis
   a) study controls for _____ (Select the most important factor.) *
   b) study controls for any additional factor * (This criteria could be modified to indicate specific control for a second important factor.)

Exposure

1) Ascertainment of exposure
   a) secure record (eg surgical records) *
   b) structured interview where blind to case/control status *
   c) interview not blinded to case/control status
   d) written self report or medical record only
   e) no description

2) Same method of ascertainment for cases and controls
   a) yes *
   b) no

3) Non-Response rate
   a) same rate for both groups *
   b) non respondents described
   c) rate different and no designation

NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
COHORT STUDIES

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

1) Representativeness of the exposed cohort
   a) truly representative of the average _____ (describe) in the community *
   b) somewhat representative of the average _____ in the community *
   c) selected group of users eg nurses, volunteers
   d) no description of the derivation of the cohort

2) Selection of the non exposed cohort
   a) drawn from the same community as the exposed cohort *
   b) drawn from a different source
   c) no description of the derivation of the non exposed cohort

3) Ascertainment of exposure
   a) secure record (eg surgical records) *
   b) structured interview *
   c) written self report
   d) no description

4) Demonstration that outcome of interest was not present at start of study
   a) yes *
   b) no

Comparability

1) Comparability of cohorts on the basis of the design or analysis
   a) study controls for _____ (select the most important factor) *
   b) study controls for any additional factor * (This criteria could be modified to indicate specific control for a second important factor.)

Outcome

1) Assessment of outcome
   a) independent blind assessment *
   b) record linkage *
   c) self report
   d) no description

2) Was follow-up long enough for outcomes to occur
   a) yes (select an adequate follow up period for outcome of interest) *
   b) no

3) Adequacy of follow up of cohorts
   a) complete follow up - all subjects accounted for *
   b) subjects lost to follow up unlikely to introduce bias - small number lost - > ____ % (select an adequate %) follow up, or description provided of those lost) *
   c) follow up rate < ____% (select an adequate %) and no description of those lost
   d) no statement

ANEXO IV- Instrumento New Castle Ottawa Adaptado

Newcastle-Ottawa Scale adapted for cross-sectional studies[28]

Selection:(Maximum 5 stars)

1) Representativeness of the sample:
- a) Truly representative of the average in the target population. * (all subjects or random sampling)
- b) Somewhat representative of the average in the target population. * (non-random sampling)
- c) Selected group of users.
- d) No description of the sampling strategy.

2) Sample size:
- a) Justified and satisfactory. *
- b) Not justified.

3) Non-respondents:
- a) Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory. *
- b) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory.
- c) No description of the response rate or the characteristics of the responders and the non-responders.

4) Ascertainment of the exposure (risk factor):
- a) Validated measurement tool. **
- b) Non-validated measurement tool, but the tool is available or described.*
- c) No description of the measurement tool.

Comparability: (Maximum 2 stars)

1) The subjects in different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled.
- a) The study controls for the most important factor (select one). *
- b) The study control for any additional factor. *

Outcome:(Maximum 3 stars)

1) Assessment of the outcome:
- a) Independent blind assessment. **
- b) Record linkage. **
- c) Self report. *
- d) No description.

2) Statistical test:
- a) The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including confidence intervals and the probability level (p value). *
- b) The statistical test is not appropriate, not described or incomplete.

This scale has been adapted from the Newcastle-Ottawa Quality Assessment Scale for cohort studies to perform a quality assessment of cross-sectional studies for the systematic review, "Are Healthcare Workers' Intentions to Vaccinate Related to their Knowledge, Beliefs and Attitudes? A Systematic Review".

We have not selected one factor that is the most important for comparability, because the variables are not the same in each study. Thus, the principal factor should be identified for each study.

In our scale, we have specifically assigned one star for self-reported outcomes, because our study measures the intention to vaccinate. Two stars are given to the studies that assess the outcome with independent blind observers or with vaccination records, because these methods measure the practice of vaccination, which is the result of true intention.