UNIVERSIDADE FEDERAL DE ALAGOAS
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TIPO E MOMENTO DO CONSUMO DE ALIMENTOS ULTRAPROCESSADOS E SUA ASSOCIAÇÃO COM A INGESTÃO DIETÉTICA E A ATIVIDADE FÍSICA EM MULHERES COM OBESIDADE QUE VIVEM NA POBREZA

GUILHERME CÉSAR OLIVEIRA DE CARVALHO

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Trabalho de Conclusão de Curso apresentado à Faculdade de Nutrição da Universidade Federal de Alagoas como requisito parcial à obtenção do grau de Bacharel em Nutrição.

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FOLHA DE APROVAÇÃO

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RESUMO

CARVALHO, G.C.O. **Tipo e momento do consumo de alimentos ultraprocessados e sua associação com a ingestão dietética e a atividade física em mulheres com obesidade que vivem na pobreza.** Trabalho de conclusão de curso (Curso de Graduação em Nutrição) - Faculdade de Nutrição, Universidade Federal de Alagoas, Maceió, 2024.

Ao longo dos últimos 50 anos, globalmente, a obesidade quase triplicou, e o sexo feminino tende a ser mais afetado. Além disso, nos países em desenvolvimento, a maior disponibilidade e consumo de alimentos ultraprocessados (AUP) e o nível inadequado de atividade física (AF) têm sido associados a uma maior prevalência de sobrepeso e obesidade em mulheres de baixa renda. Evidências científicas recentes mostram que o momento em que alimentos são consumidos, podem levar a uma ingestão energética excessiva e, consequentemente, ao ganho de peso e à obesidade. Entretanto, estudos que investigam a relação entre essas variáveis, especialmente considerando os tipos e o momento do consumo de AUP, permanecem escassos na literatura científica. Com isso, o objetivo deste estudo foi investigar o tipo e o momento do consumo de AUP e sua associação com a ingestão dietética (ID) e a AF em mulheres com obesidade que vivem na pobreza. Trata-se de um estudo transversal. A obesidade foi definida por pelo menos dois critérios (IMC, circunferência da cintura ou % de massa gorda). A pobreza foi definida como as três classes mais baixas do Critério de Classificação Econômica Brasileira. A AF foi medida com acelerômetros triaxiais e a ID foi avaliada com três recordatórios alimentares de 24 horas. Os alimentos foram categorizados de acordo com a classificação NOVA, com os AUP classificados em cinco subgrupos e o momento de consumo em seis refeições. Foram incluídas 56 mulheres adultas. A ingestão energética total foi de 1.653,21 (503,22) kcal/d. A ingestão de AUP foi de 21,62 (11,94) %kcal/d, sendo maior no café da manhã (4,91%kcal/d), no lanche da tarde (5,39%kcal/d) e no jantar (5,01%kcal/d). Somente o subgrupo 4 de AUP (biscoitos recheados, doces ou guloseimas) apresentou associações positivas com a ingestão de energia (β = 54,40 [27,6, 81,10]kcal/d) e associação negativa com a ingestão de proteína (β = -0,31 [-0,48, -0,14]%kcal/d). O consumo de AUP nos lanches da manhã (β = -0,41 [-0,79, -0,02]%kcal/d) e da tarde (β = -0,18 [-0,33, -0,04]%kcal/d) foi associado à menor ingestão de proteínas. Além disso, o consumo de AUP na hora do almoço foi positivamente associado ao tempo de caminhada (β = 0,16 [0,02;

0,30]%) e passos/hora (β = 8,72 [1,50; 15,94]passos/h). Portanto, as mulheres com obesidade que vivem na pobreza parecem consumir mais AUP durante o café da manhã, o lanche da tarde e o jantar. A AF está positivamente associada ao consumo de AUP no almoço. Os AUP, como biscoitos recheados, doces ou guloseimas, contribuíram para aumentar a ingestão de energia e reduzir a ingestão de proteínas.

Palavras-chave: obesidade; alimentos ultraprocessados; atividade física; baixa renda.

ABSTRACT

Over the last 50 years, globally, obesity has almost tripled, and women tend to be more affected. Furthermore, in developing countries, the greater availability and consumption of ultra-processed foods (UPF) and inadequate levels of physical activity (PA) have been associated with a higher prevalence of overweight and obesity in low-income women. Recent scientific evidence shows that the timing of food consumption can lead to excessive energy intake and, consequently, weight gain and obesity. However, studies investigating the relationship between these variables, especially considering the types and timing of UPF consumption, remain scarce in the scientific literature. Therefore, the aim of this study was to investigate the type and timing of UPF consumption and its association with dietary intake (DI) and PA in women with obesity living in poverty. This is a Cross-sectional study. Obesity was defined by at least two criteria (BMI, waist circumference or % fat mass). Poverty was defined as the three lowest classes of the Brazilian Economic Classification Criterion. PA was measured with triaxial accelerometers and DI was assessed with three 24-hour dietary recalls. Foods were categorized according to the NOVA classification, with UPF into five subgroups, and timing of consumption into six meals. 56 adult women were included. Overall energy intake was 1653.21 (503.22) kcal/d. UPF intake was 21.62 (11.94) %kcal/d, being higher at breakfast (4.91%kcal/d), afternoon snack (5.39%kcal/d) and dinner (5.01%kcal/d). Only UPF subgroup 4 (sandwich biscuits, sweets, or treats) showed positive associations with energy intake (β = 54.40 [27.6, 81.10]kcal/d) and negative association with protein intake (β = -0.31 [-0.48, -0.14]%kcal/d)**.** UPF consumption in morning (β = -0.41 [-0.79, -0.02]%kcal/d) and afternoon (β = -0.18 [-0.33, -0.04]%kcal/d) snacks were associated with lower protein intake. Furthermore, lunchtime UPF consumption was positively associated with walking time (β = 0.16 [0.02; 0.30]%) and steps/hour (β = 8.72 [1.50; 15.94]steps/h). Therefore, in this study, women with obesity living in poverty consume more UPF during breakfast, afternoon snack and dinner. PA is positively associated with UPF consumption at lunch. UPF, such as sandwich biscuits, sweets or treats, contributed to increasing energy intake and reducing protein intake.

Keywords: obesity; ultra-processed foods; physical activity; low income.

SUMÁRIO

1. APRESENTAÇÃO

A população brasileira, ao longo dos últimos anos, vem apresentando um aumento na proporção de adultos com obesidade (SILVA et al., 2021). Entretanto, a complexa dinâmica que envolve esse crescimento apresenta diferenças entre os gêneros e níveis socioeconômicos da população, onde o sexo feminino apresenta uma maior prevalência de obesidade, tendendo a aumentar conforme o declínio do poder aquisitivo (FERREIRA; BENÍCIO, 2015; FERREIRA; SZWARCWALD; DAMACENA, 2019). Esse crescimento tem sido acompanhado por mudanças nos padrões de estilo de vida da população brasileira, onde a adoção de um padrão alimentar nutricionalmente insuficiente e a baixa capacidade de adesão à práticas de AF, são fatores que exercem papel fundamental nessa problemática (FERREIRA; MAGALHÃES, 2011)

Com relação ao padrão de consumo alimentar, tem sido observado o aumento da participação de AUP na dieta da população adulta brasileira, que tem acarretado numa deterioração no perfil nutricional da alimentação e contribuído para uma maior ingestão energética, devido às características intrínsecas desses alimentos (LOUZADA et al., 2015; COSTA et al., 2021). Além disso, têm-se visto uma prevalência de 46% relativo à inatividade física nos indivíduos adultos brasileiros, sendo significativamente maior no sexo feminino (MALTA et al., 2015). Um fato preocupante, visto que a AF é um componente fundamental do gasto energético e está associada à prevenção e tratamento da obesidade (MELO; TIRAPEGUI; RIBEIRO, 2008).

Diante do aumento da participação de AUP no consumo alimentar diário, pode-se destacar tipos de AUP que são consumidos com maior frequência como bebidas açucaradas, biscoitos salgados e doces, guloseimas, pães de forma, embutidos e pratos prontos ou semi-prontos (LOUZADA et al., 2015; COSTA et al., 2021). Entretanto o tipo de AUP parece ter uma distribuição diferente ao longo das refeições que são realizadas durante o dia, onde biscoitos e guloseimas são comuns nos lanches, enquanto AUP como pratos prontos, queijos e macarrão instantâneo, podem estar presentes nas refeições principais, como jantar e almoço, substituindo totalmente ou parcialmente uma refeição (PRADO et al., 2022).

Além disso, o peso e composição corporal sofrem complexas regulações, onde não só quanto e quais alimentos são ingeridos tem papel importante, mas

também quando esses alimentos são ingeridos, onde o horário das refeições em relação ao horário do ciclo circadiano individual, são preditores das variáveis de peso, composição corporal e ingestão alimentar (ALBRECHT, 2017; BOEGE et al., 2021; TEIXEIRA et al., 2023)

Por isso, esse trabalho de conclusão de curso apresenta uma revisão da literatura e um artigo original acerca do tipo e momento do consumo de AUP e sua associação com a ID e a AF em mulheres com obesidade que vivem na pobreza.

2. REVISÃO DA LITERATURA

2.1 OBESIDADE

2.1.1 Epidemiologia e etiologia

A obesidade é uma doença crônica, de etiologia complexa e multifatorial definida pelo acúmulo anormal ou excessivo de gordura que levam a impactos negativos à saúde dos indivíduos (WHO, 2021). Além do mais, a obesidade está associada ao desenvolvimento de diversas outras doenças, comorbidades e desfechos negativos de saúde, tendo impacto significativo para a morbidade e mortalidade dos seres humanos (JUNG, 1997; UPADHYAY, et al. 2018).

Estima-se que ao longo das últimas décadas, a quantidade de indivíduos portadores de obesidade praticamente triplicou no cenário mundial, se tornando um dos principais problemas de saúde pública que ameaçam o mundo atualmente (WHO, 2021; HAIDAR; COSMAN, 2011; ARROYO-JOHNSON; MINCEY, 2016). Do mesmo modo, a população brasileira tem passado pelo processo de transição nutricional, onde a prevalência de desnutrição apresenta um rápido declínio, enquanto a prevalência de sobrepeso/obesidade aumenta em um ritmo acelerado (BATISTA FILHO; RISSIN, 2003). Segundo dados do Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico (Vigitel) de 2023, a frequência de adultos brasileiros portadores de obesidade foi de 24,3%, sendo mais prevalente no sexo feminino (BRASIL, 2023).

O processo de transição nutricional tem levado a mudanças significativas nos padrões de alimentação e AF da população, onde fatores como o ambiente alimentar, o marketing de alimentos e bebidas não saudáveis, a urbanização e a redução da AF tem levado a uma ingestão energética que excede o gasto de energia, ocorrendo assim um estado de equilíbrio energético positivo onde a consequência é um aumento na massa corporal, geralmente, através do acúmulo de gordura corporal (POPKIN, 2001; HILL, et al. 2012; ROMIEU, et al. 2017). Portanto, apesar do peso e composição corporal dos indivíduos ser regulado por um complexo conjunto de mecanismos endócrinos, metabólicos e neurais, o modelo do balanço energético é um modelo baseado em evidências que aumenta nossa compreensão sobre a patogênese da obesidade (HALL, et al. 2022).

2.2 BALANÇO ENERGÉTICO

2.2.1 Definição

O modelo do balanço energético é baseado na primeira lei da termodinâmica e propõe uma relação matemática simples entre duas variáveis, que quando estão em desequilíbrio, são responsáveis pelas variações no peso e composição corporal, sendo essas variáveis a ingestão energética (IE) e o gasto energético total (GET) (WESTERTERP et al., 1995). Portanto, essa relação pode ser definida através da seguinte equação: BE = IE - GET

A IE é proveniente da ingestão alimentar diária e pode ser estimada através de alguns métodos como recordatórios alimentares ou diários alimentares (WESTERTERP et al., 1995) Já o GET é composto por outras 3 variáveis determinadas pelo tamanho e composição corporal, pelo ambiente e pelo comportamento dos indivíduos, são elas a taxa metabólica basal (TMB), o efeito térmico do alimento (TEF) e a atividade física (AF) (DELANY; LOVEJOY, 1996; WESTERTERP, 2017).

Apesar deste modelo apresentar uma explicação simples para as variações de peso e composição corporal, ele também se baseia em mecanismos fisiológicos complexos, tendo o cérebro como órgão principal, onde sinais internos e externos influenciam a regulação neural do balanço energético, levando a modificações inconsciente dos indivíduos nas variáveis de IE e GET (HALL et al., 2022).

2.2.2 Atividade física

A AF é um componente do gasto energético total, definida através do conceito de qualquer movimento corporal produzido pela musculatura esquelética e que resultará em gasto de energia, além do gasto em repouso, onde diariamente a maioria dos seres humanos realizam atividades físicas sejam elas ocupacionais, domésticas e/ou esportivas para manter a vida (CASPERSEN et al., 1985; GRIERA et al., 2007).

O peso e gordura corporal podem ser reduzidos exclusivamente através do aumento da AF, além disso, a AF é um importante contribuinte para diminuição de desfechos de saúde desfavoráveis, prevenção e tratamento de doenças crônicas (WESTERTERP et al., 1992; JAKICIC; OTTO, 2005; WARBURTON; BREDIN, 2017). Entretanto, a AF é um comportamento complexo e altamente variável entre os

indivíduos onde esses benefícios são mais significativos quando combinados com um controle da ingestão alimentar. (CASPERSEN et al., 1985; THOMPSOM et al., 2012; GRIERA et al., 2007).

Ao longo dos últimos anos, o estilo de vida sedentário tem se tornado predominante no cenário mundial, principalmente em indivíduos com obesidade (AROCHA RODULFO, 2019; SILVEIRA et al., 2022). Fatores como a ausência de locais adequados para práticas de atividades físicas, uso indiscriminado de aparelhos tecnológicos (ex. celular, computador, televisão) tanto no trabalho quanto no tempo de lazer, tem levado ao aumento exponencial desse estilo de vida (PARK et al., 2020; BLÜHER, 2019). E associado a esse aumento do sedentarismo, a população mundial apresenta também um aumento do risco para desenvolvimento de doenças crônicas e maior mortalidade (KATZMARZYK et al., 2020)

Existem várias formas de se avaliar o nível de AF dos indivíduos. As ferramentas de avaliação de AF, vão desde questionários de autorrelato até equipamentos tecnológicos portáteis, entretanto, a escolha da ferramenta ideal dependerá de fatores como características da população estudada, tipo de AF a ser avaliada, objetivo do estudo, entre outros (AINSWORTH et al., 2014). A utilização de acelerômetros triaxiais tem sido de extrema importância pela capacidade de coletar grandes quantidades de dados através da monitoração por vários dias consecutivos, além de avaliar de maneira precisa a frequência, duração e intensidade das atividades físicas realizadas e também o comportamento sedentário dos indivíduos (WESTERTERP, 1999; McCLUNG et al., 2018; AINSWORTH et al., 2014).

2.2.3 Ingestão dietética

A ID pode ser entendida através do simples conceito de fornecimento de energia e nutrientes através da ingestão oral de alimentos ou substâncias (KHALID et al., 2014; HOPKINS et al., 2015). E desde 1997, o planejamento e avaliação da ID de indivíduos e populações é baseado em um conjunto de valores de referência para adequada ingestão de nutrientes e energia, chamados de “Ingestão Dietética de Referência” (PADOVANI et al., 2006; TRUMBO et al., 2013).

A ingestão energética, como um componente da ID, é uma importante variável do balanço energético e em conjunto com a AF, irá determinar o ganho e perda de peso dos indivíduos (SCHUTZ, 1995). Os valores de Ingestão Dietética de

Referência, garantem uma recomendação para assegurar uma boa qualidade alimentar e uma ingestão energética adequada para manutenção do balanço energético neutro (ROMIEU et al., 2017). Quando a ID dos indivíduos ultrapassa as recomendações de necessidade energética, o balanço energético positivo irá ocorrer resultando assim em ganho de peso e/ou obesidade (SASAKI, 2008; DRIEMEYER CORREIA HORVATH et al., 2014; HILL et al., 2012)

Ao longo dos últimos anos, o avanço mundial das vendas e consumo de alimentos industrializados e prontos para consumo tem tido impactos significativos na ID dos indivíduos (TRAILL et al., 2014). O aumento da participação desses alimentos tem contribuído para pior ID e uma baixa qualidade alimentar, sendo associados positivamente com a ingestão energética, logo, um dos principais fatores para o desenvolvimento da epidemia da obesidade mundial (SHIM et al., 2022; BIELEMANN et al., 2015; TRAILL et al., 2014)

A avaliação da ID dos indivíduos é realizada comumente através de ferramentas de autorrelato, onde a escolha da ferramenta mais adequada irá variar de acordo com o interesse do que será analisado, população estudada e também recursos econômicos e humanos (McCLUNG et al., 2018). Os métodos variam entre ferramentas de registro, onde os indivíduos realizam o registro dos alimentos consumidos ao longo do dia à medida que a ingestão ocorre (ex. diário alimentar, registro estimado, registro de pesagem), e as ferramentas de recordação onde os indivíduos relatam a ingestão de alimentos após ela ter acontecido (ex. recordatório 24 horas, questionário de frequência alimentar, dia alimentar habitual) (RUTISHAUSER, 2005;McCLUNG et al., 2018). O recordatório 24 horas é um método de baixo custo amplamente utilizado, que consiste em uma entrevista conduzida por um profissional treinado, onde o entrevistado é questionado sobre todos os alimentos e bebidas ingeridos nas 24 horas precedentes à entrevista de forma quantitativa e o mais detalhadamente possível (FISBERG; MARCHIONI; COLUCCI, 2009; RUTISHAUSER, 2005). Uma das principais limitações dessa ferramenta é a influência da memória do entrevistado que pode afetar as especificações do relato e consequentemente na qualidade da informação coletada (FISBERG; MARCHIONI; COLUCCI, 2009; RUTISHAUSER, 2005). Entretanto, o Departamento de Agricultura dos EUA desenvolveu o método de múltiplos passos que consiste em uma abordagem em 5 etapas para avaliação do recordatório 24 horas responsável por aumentar a eficiência dos dados coletados, diminuindo os

relatos incorretos devido ao viés de memória (CONWAY et al., 2003; CONWAY et al., 2004; MOSHFEGH et al., 2008).

2.3 MOMENTO DE CONSUMO

2.3.1 Associação com ingestão energética e obesidade

Na literatura científica atual, já está bem estabelecido o impacto da qualidade e quantidade de ingestão alimentar sobre o ganho de peso e desenvolvimento da obesidade. Entretanto, uma nova linha de pesquisa têm mostrado que o momento em que os indivíduos ingerem alimentos também podem contribuir para ganho de peso corporal através da desorganização do ciclo circadiano que tem um papel fundamental na regulação no metabolismo energético e em hormônios reguladores de apetite (BOEGE et al., 2021)

O ciclo circadiano é uma complexa rede de interações fisiológicas, que tem como órgão central o núcleo supraquiasmático (SCN) do hipotálamo, capaz de regular os sistemas endócrinos e metabólicos através de estímulos ambientais, comportamentais e genéticos (BOEGE et al., 2021; TEXEIRA et al., 2024; MONTARULI et al., 2021)

A ingestão alimentar dos indivíduos segue um padrão, mas que estão cada vez mais diversos. Evidências científicas recentes têm demonstrado que desregulações no padrão alimentar como a não realizar refeições (ex. café da manhã), comer com maior frequência ao longo do dia, além do momento em que as refeições são realizadas (ex. tarde da noite), tem sido positivamente associado com uma maior ingestão energética, ganho de peso e desenvolvimento de obesidade (ST-ONGE et al., 2017; REID; BARON; ZEE, 2014; TEIXEIRA et al., 2023)

2.4 CLASSIFICAÇÃO NOVA

2.4.1 História e definição

A história do desenvolvimento humano é acompanhada pelo desenvolvimento do processamento de alimentos, que foram fundamentais para garantir a segurança alimentar e nutricional, aumentar o prazo de validade, além de melhorar a palatabilidade dos alimentos (AUGUSTIN et al., 2016). Ao longo dos últimos 100

anos, o processamento dos alimentos tem mudado de maneira significativa, onde os tipos de processamentos primários como secagem, moagem, congelamentos, fermentação e conservas têm sido substituídos por processamentos mais complexos e tecnológicos (AUGUSTIN et al., 2016. KNORR; AUGUSTIN; TIWARI, 2020).

Com o avanço dos tipos, propósitos, níveis de processamento e, consequentemente, modificação da qualidade nutricional dos alimentos, surge a proposta de um sistema de classificação alimentar que leva em consideração os processos físicos, biológicos e químicos aos quais os alimentos são submetidos ao serem separados da natureza e antes de serem consumidos ou usados na preparação de pratos e refeições (MONTEIRO et al., 2016).

O sistema de classificação NOVA, reúne os alimentos em 4 grupos de acordo com a proporção e o objetivo do processamento aos quais os alimentos são submetidos, sem levar em consideração a composição nutricional (MONTEIRO et al., 2016). Esse sistema de classificação já está sendo vastamente utilizado em nível mundial em estudos epidemiológicos e em menor proporção em estudos experimentais a fim de avaliar mudanças no padrão e qualidade alimentar, além da associação com marcadores de saúde (MONTEIRO et al., 2018; MARINO et al., 2021). Para mais, tem sido também bastante utilizado em diretrizes alimentares voltadas para melhorar a nutrição e saúde de populações (MOUBARAC et al., 2014; AMORIM; SILVA; SOBRAL, 2023).

2.5 ALIMENTOS ULTRAPROCESSADOS

2.5.1 Definição e influência na obesidade

Segundo o sistema de classificação NOVA, os AUP fazem parte do último grupo de classificação, caracterizados por serem formulações fabricadas por indústrias de grande porte, que passam por diversos graus e setores de processamento (MONTEIRO et al., 2019). Ao longo desse extenso processamento, essas formulações sofrem adições de diversos ingredientes como sal, açúcar, óleos, gorduras e, especialmente, aditivos alimentares de uso exclusivamente industrial, onde, quando prontos, os AUP apresentam poucas ou quase nenhumas substâncias intactas dos alimentos in natura ou minimamente processados pertencentes ao primeiro grupo do sistema de classificação (BRASIL, 2014; MONTEIRO et al., 2019).

As características intrínsecas dos AUP, são de produtos energeticamente densos devido à combinação de xarope de milho com alto teor de frutose, óleos

hidrogenados ou interesterificados e isolados de proteína (MONTEIRO et al., 2019). Além de hiper palatáveis, atraentes e com longo tempo de prateleira devido à combinação de aditivos alimentares como aromatizantes, realçadores de sabor, corantes, emulsificantes, entre outros (MONTEIRO et al., 2019).

Para mais, esses alimentos são, em sua maioria, difundidos no mercado por empresas transnacionais que apelam através de um marketing agressivo, embalagens e campanhas publicitárias atrativas, propagadas através de diversos meios de comunicação, além do baixo custo e praticidade, que tem levado a uma contínua expansão da aquisição e consumo dos AUP a nível mundial (MONTEIRO et al., 2019; BAKER et al., 2020) Esse crescimento tem acarretado sérios prejuízos para a saúde das populações, onde dietas ricas em AUP tem levado a ingestão energética excessiva, estando positivamente associadas ao ganho de peso excessivo e ao desenvolvimento da pandemia global de sobrepeso e obesidade (HALL et al., 2019; ASKARI et al., 2020; SWINBURN et al., 2011)

2.5.2 Tipos de alimentos ultraprocessados

Diante do avanço da comercialização e consumo de AUP, é perceptível a diversidade de produtos existentes no mercado mundial com vários tipos de AUP disponíveis para aquisição. Entretanto, ao avaliar a literatura científica é possível perceber a falta de padronização para avaliar o consumo de AUP das populações, onde, de acordo com a nacionalidade das populações avaliadas, os subgrupos de tipos de AUP podem variar desde 4 subgrupos até 19 subgrupos (JUUL et al., 2022; VANDEVIJVERE et al., 2019; COSTA et al., 2018).

No Brasil, a partir do ano de 2015, o formulário de marcadores de consumo alimentar do Sistema de Vigilância Alimentar e Nutricional (SISVAN) sofreu uma atualização com a adição de perguntas que estivessem de acordo com o sistema de classificação NOVA, além das as recomendações propostas pelo Guia alimentar para população brasileira (LOUZADA et al., 2023; LOURENÇO; GUEDES; SANTOS, 2023). A partir dessa atualização começaram a fazer parte perguntas que abordam sobre o consumo de AUP, que foram fragmentados em 4 subgrupos conforme os tipos de AUP, sendo esses o subgrupo de hambúrguer e/ou embutidos, o de bebidas adoçadas, o de macarrão instantâneo, salgadinhos de pacote ou biscoito salgados e por último o subgrupo de biscoito recheado, doces e guloseimas (BRASIL, 2015) Esses marcadores de consumo de AUP são interpretados como fatores que refletem

um perfil de alimentação não saudável e possuem uma ótima performance para avaliação do perfil qualitativo da alimentação de crianças, adolescentes e adultos brasileiros (LOUZADA et al., 2023; LOURENÇO; GUEDES; SANTOS, 2023).

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4. ARTIGO ORIGINAL

TYPE AND TIMING OF ULTRA-PROCESSED FOODS CONSUMPTION AND ITS ASSOCIATION WITH DIETARY INTAKE AND PHYSICAL ACTIVITY IN WOMEN WITH OBESITY LIVING IN POVERTY

ABSTRACT

Objective: To investigate the type and timing of ultra-processed foods (UPF) consumption and its association with dietary intake (DI) and physical activity (PA) in women with obesity living in poverty. **Methods:** Cross-sectional study. Obesity was defined by at least two criteria (BMI, waist circumference or % fat mass). Poverty was defined as the three lowest classes of the Brazilian Economic Classification Criterion. PA was measured with triaxial accelerometers and DI was assessed with three 24-hour dietary recalls. Foods were categorized according to the NOVA classification, with UPF into five subgroups, and timing of consumption into six meals. **Results:** 56 adult women were included. Overall energy intake was 1653.21 (503.22) kcal/d. UPF intake was 21.62 (11.94) %kcal/d, being higher at breakfast (4.91%kcal/d), afternoon snack (5.39%kcal/d) and dinner (5.01%kcal/d). Only UPF subgroup 4 (sandwich biscuits, sweets, or treats) showed positive associations with energy intake (β = 54.40 [27.6, 81.10]kcal/d) and negative association with protein intake (β = -0.31 [-0.48, -0.14]%kcal/d)**.** UPF consumption in morning (β = -0.41 [-0.79, -0.02]%kcal/d) and afternoon (β = -0.18 [-0.33, -0.04]%kcal/d) snacks were associated with lower protein intake. Furthermore, lunchtime UPF consumption was positively associated with walking time (β = 0.16 [0.02; 0.30]%) and steps/hour (β = 8.72 [1.50; 15.94]steps/h). **Conclusions:** Women with obesity living in poverty consume more UPF during breakfast, afternoon snack and dinner. PA is positively associated with UPF consumption at lunch. UPF, such as sandwich biscuits, sweets or treats, contributed to increasing energy intake and reducing protein intake.

Keypoints:

- The distribution of UPF consumption throughout the day was evaluated.
- UPF was more consumed during main meals as compared to snacks.

- Only sandwich biscuits, sweets and treats were associated with increased energy intake and reduced protein intake.
- Physical activity measured by triaxial accelerometers was associated with UPF consumption at lunch.

Keywords: obesity; ultra-processed foods; physical activity; low income.

INTRODUCTION

Obesity is a preventable disease that has become one of the most serious public health issues today. Globally, from 1975 to the present day, the prevalence of obesity in the population has nearly tripled, and it has also become a rising problem in urban settings in underdeveloped countries (¹). In developing countries, the progression of obesity is associated with socioeconomic, educational, and sex-related factors, where women tend to be more affected by obesity than men and have greater weight gain and excessive fat accumulation (²). Particularly, the last Brazilian nationwide survey shows that obesity in low-income women is at 28.9%, whereas in higher-income women, it is 20.4% (³).

Studies indicate that the increase in the consumption of Ultra-Processed Foods (UPF), which is positively linked to excess daily energy intake and body weight gain, plays a major role in the increase of obesity levels worldwide (⁴). UPF is a food group derived from the NOVA classification system, which groups foods according to the extent and purpose of their processing (⁵). This group includes ready-to-eat foods such as sweets, sugary drinks, and package snacks, among other products manufactured by large industries, which undergo various degrees of processing to be added with ingredients such as salt, sugar, fat, and food additives for exclusively industrial use such as stabilizers, colorings, preservatives, which aim to mask the quality of the food through more attractive sensory aspects (⁵). Over the last few decades, in developing countries, the greater availability and consumption of UPF has been associated with a higher prevalence of overweight and obesity ([6]). In the Brazilian population, over ten years, the share of energy from UPF in total daily energy consumption increased by 1.02%, with a significant rise in the lower-income strata ([7]). In addition, women had the highest frequency of UPF consumption between 2017 and 2018, with around 20% of UPF in total daily energy consumed ([7]).

Much is already known about the impact of the quantity and quality of food individuals eat on their health. However, the human body and eating behavior are influenced by endogenous biological processes that occur cyclically throughout the day, known as the circadian cycle ([8]). Recent scientific evidence in this area of the study shows that not only composition of food individuals eat but also when they eat it can lead to excessive daily energy consumption and, consequently, weight gain

and obesity ([9, 10]). The timing of UPF consumption is poorly studied in the scientific literature. The studies report types of UPF that show a higher dietary intake, such as carbonated drinks, bakery goods, sweets and chocolate ([11,12]). But the classification of types of UPF varies considerably between studies, making it difficult to compare them ([13]). In addition, studies on the timing of UPF consumption focus on eating episodes outside the home and the time of eating, but not on UPF consumption per meal ([14,15]). It is important to understand when and which UPF are being consumed to identify if different timing of consumption may lead to different impacts on the individuals diet quality and other health markers. Also, identifying the groups of UPF most impactful in such markers can be an important way to delineate educational actions with this population.

Another aspect that may influence the higher prevalence of obesity in low-income women is their inadequate level of physical activity (PA) ([16]). Particularly, low-income women report the lack of a support network, longer working hours, busy lives, and limited spaces for exercise as limiting factors ([17]). Furthermore, it is important to note that previous studies that compared PA according to socioeconomic status mostly used self-report tools to assess PA. This method can introduce significant biases in the results due to challenges such as recall bias, social desirability or expectation, resulting in overestimation of PA and underestimation of sedentary behavior ([18,19]). Therefore, using accelerometry can play a fundamental role in minimizing these biases, providing objective and accurate measures of PA despite the limitations regarding stratification by domain and type of PA ([20]). There is scientific evidence linking PA, measured using accelerometers, with health outcomes in this same population ([21]). However, we found no studies in the literature establishing a link between PA, measured using accelerometers, and the consumption of UPF.

Although it is widely recognized that both UPF consumption and PA play an important role in the development of obesity, studies investigating the relationship between these variables, especially considering the types and timing of UPF consumption, remain scarce in the scientific literature. Recent studies have differed as to the direction of this relationship, with some pointing to positive and others to negative associations between UPF consumption and PA levels ([22, 23]). Research on populations living in poverty is even scarcer. Therefore, this study aims to investigate

the type and timing of ultra-processed foods (UPF) consumption and its association with dietary intake and physical activity (PA) in women with obesity living in poverty.

METHODS

Design and ethical aspects

This study is a secondary cross-sectional analysis of the baseline of an already finished randomized clinical trial, registered in the Brazilian Registry of Clinical Trials (ReBEC) under the number RBR-387v6v, carried out in 2018. The research was approved by the Research Ethics Committee of the Federal University of Alagoas (No. 2.535.991). All participants were informed about the procedures and signed an informed consent form before starting the study, formalizing their participation. The STROBE-nut guidelines were taken into account when writing this study.

Population and sample

The sample was recruited through community advertisements or direct invitations to women who had some connection with the Centre for Recovery and Nutritional Education (CREN-AL), which treats malnourished children, located in the seventh administrative region of the municipality of Maceió, AL, Brazil, and which has the lowest Human Development Index (HDI) in the municipality (0.65). The sample size calculation for the randomized clinical trial is described in the article already published ([24]), which aimed to detect a difference in weight loss between groups.

Women with obesity were included, defined by the presence of two of the following criteria: BMI ≥ 30 kg/m² and < 45 kg/m², waist circumference (WC) ≥ 88cm, body fat percentage ≥ 35%, aged between 19 and 44 years and classified as economic class "C" and "D - E", as determined by the Brazilian Economic Classification Criterion (CCEB) ([25]). The CCEB is an instrument that consists of questions about assets, domestic workers, housing data, education of the head of the household, access to piped water, and paved streets, with different weights and scores for each item. According to the score obtained, individuals are classified into six classes: A (average household income 4725.73 US$), B1 (2102.53 US$), B2 (1085.66 U$), C1 (600.34 US$), C2 (342.39 US$), D-E (143.35 US$).

Women who were taking medication of chronic use (antidiabetics, antihypertensives, antiretrovirals, immunosuppressants, antidepressants), who were menopausal, pregnant or breastfeeding, or who had undergone through any surgical

intervention for weight loss were not included. Furthermore, those who did not have at least two 24-hour dietary recalls (24HR) were excluded from our analyses.

Anthropometric assessment and body composition

The anthropometric assessment involved collecting data on weight, height, and body composition. Participants' weight was measured on a digital scale (Filizola, São Paulo, Brazil), and height was measured using a standardized wall-mounted stadiometer. Body composition was estimated using Sanny BI 1010 tetrapolar bioelectrical impedance (Sanny, São Paulo, Brazil), using the protocol proposed by Kyle et al. ([26]). BMI was calculated and classified according to the World Health Organization .

Physical activity

PA was measured using a triaxial accelerometer (ActivPAL®, Glasgow, UK) located on the front area of the participants' thigh, at the midpoint between the inguinal line and the upper edge of the patella, with two transparent, hypoallergenic medical dressings (VitaMedical®, Minas Gerais, Brazil) to avoid contact between the device and the participants' skin. The women wore the accelerometers for three consecutive days without removing them for any activity. The data was transferred to ActivPAL3™ software version 7.2.32 to produce the intensity and duration of each activity performed by the individuals. The system estimates PA for the period in which the device was worn, and the calculation is based on the angulation of the device to detect the position of the limbs and the acceleration of three body axes: anteroposterior, lateral, and vertical. From this, the periods spent lying/sitting, standing, and walking are calculated every tenth of a second, as well as the number of total steps taken during the period of use. In this analysis, we present the PA data (i.e., time spent lying/sitting, time spent standing and time spent walking) as a percentage of the total time that the accelerometers were worn by the individual. Details about the use of ActivPAL accelerometers in this population may be seen elsewhere ([27]).

Food intake

Food intake was assessed through a 24HR using the multiple pass method (MPM) ([28]), aiming to minimize underreporting and simultaneously reduce the effort

required from the researcher and the participant. The timing of UPF was collected from step 3 of the MPM (time and occasion). Each participant was asked to complete a 24HR on three different days before the start of the study intervention, including two weekdays and one weekend day. The interviews were carried out in person by the same trained nutritionist.

Food intake was reported using home measurements estimated by a photographic manual ([29]) to minimize errors relating to the quantification of portions. The total energy, the amount of carbohydrates, proteins, and fats in the food was quantified using the brazilian table of food composition (TBCA) ([30]), food composition table ([31]) and the information provided by the manufacturers of the food products, in that order of preference, using the WEBDIET PRO 2.0 software.

The foods were classified according to NOVA into four groups: unprocessed or minimally processed, culinary ingredients, processed, and ultra-processed ([5]). Secondly, the foods classified as "ultra-processed" were stratified according to the food consumption marker categories of the Food and Nutrition Surveillance System (SISVAN): 1. Hamburger or sausages (ham, mortadella, salami, sausage); 2. Sweetened drinks (soft drinks, boxed juice, powdered juice, boxed coconut water, guarana/grass syrups, fruit juice with added sugar); 3. Instant noodles, packaged snacks, or crackers; 4. Sandwich biscuits, sweets, or treats (lollipops, chewing gum, caramel, jelly, condensed milk) ([32]). We added group 5. Savory "bakery" snacks (*coxinha*, pizza, pastry, etc.) to cover the diversity of the UPF found. Other foods (margarine, tomato sauce, etc.) were excluded from the subgroup analysis due to their heterogeneity, making it impossible to group them logically. The entire classification and tabulation process were done by double entry to reduce the likelihood of error ([33]).

Statistical analysis

Continuous variables were described by mean and standard deviation, shown in brackets, and categorical variables were described by absolute and relative frequency. The difference in UPF intake between meals was evaluated using the Repeated Measures ANOVA test. Specifically, to analyze the relationship between total UPF consumption (time and types), dietary intake and PA indicators, univariable linear regressions adjusted for age were carried out, presented in β and 95%

Confidence Interval (CI). An alpha of 5% was adopted. All the analyses were carried out using the JAMOVI V. 2.3 statistical program (Sydney, Australia).

RESULTS

The primary research recruited 80 potentially eligible participants and, after exclusion due to eligibility criteria (n=20) or declining participation (n=2), a sample of 58 women was obtained who completed data collection. Participants who answered only one 24HR questionnaire (n=2) were excluded from the analysis. The final sample (n=56) had a mean age of 31.57 (7.06) years, was mostly made up of the "D-E" economic classes (n = 39; 69.6%), and had a mean BMI of 33.33 (4.14) kg/m^2 (Table 1). In terms of PA, the sample spent 67.07 (6.77) % of their time lying down/sitting, 23.45 (5.06) % of their time standing, 9.11 (3.07) % of their time walking, and an average of 429.02 (160.50) steps per hour. In terms of dietary intake, the sample had an average energy intake of 1790.1 (674.18) kcal/day, of which 19.9 (4.19) %kcal/d was protein, 52.8 (7.04) %kcal/d carbohydrates and 27.4 (6.98) %kcal/d lipids. In addition, 21.62 (11.94) %kcal of the total daily energy intake came from UPF (Table 2).

Furthermore, our analysis showed that the higher the consumption of UPF throughout the day, the higher the total daily energy intake of these women (β= 18.8 kcal/d; 95% CI: 4.15, 33.40), and when the ultra-processed food groups were analyzed, only the group 4 (sandwich biscuits, sweets or treats) was significantly associated with a higher total daily energy intake (β= 54.40 kcal/d; 95% CI: 27.60, 81.10) and with a lower percentage of dietary protein (β= -0.31 %kcal/d; 95% CI: -0.48, -0.14) (Table 3).

When evaluating the UPF consumption pattern per meal, higher consumption of this food group was observed at breakfast with 4.91 (5.08) %kcal/d, afternoon snack with 5.34 (7.41) %kcal/d, and dinner with 5.09 (6.70) %kcal/d (Table 2 and Figure 1). When grouped together, main meals contributed significantly more to UPF consumption compared to snacks, with 13.20 (10.31)%kcal/d and 7.86 (9.17) %kcal/d, respectively (Table 2 and Figure 2). In the regression analysis, a higher percentage of UPF intake at afternoon snack contributed to a higher total daily energy intake (β= 52.50 kcal/d; 95% CI: 31.80; 73.20); however, surprisingly, the percentage of UPF intake at breakfast was negatively associated with total daily energy intake (β= -38.12 kcal/d; 95% CI: -73.10; -3.19) (Table 4). In addition, it was possible to observe a negative relationship between the percentage of UPF in the

morning snack and afternoon snack and the percentage of daily protein intake (β= -0.411 %kcal/d; 95% CI: -0.796; -0.028) and (β= -0.189 %kcal/d; 95% CI: -0.338; -0.040), respectively (Table 4).

About the relationship between UPF consumption and PA pattern, the percentage of UPF at lunch was positively associated with the number of steps per hour (β= 8.72 steps/h; 95% CI: 1.50; 15.94) and with the percentage of time spent walking (β= 0.160%; 95% CI: 0.020; 0.300) (Table 4).

DISCUSSION

In the present study, women with obesity living in poverty had a mean UPF energy intake of 21.62 (11.94) %kcal/d, and the meals richest in these foods throughout the day were breakfast, afternoon snack, and dinner. The percentage of energy consumption of overall UPF and afternoon snack was associated with a higher energy intake and a lower percentage of protein. Among the categories of SISVAN food consumption markers, group 4 (sandwich biscuits, sweets, or treats) was the only one associated with this higher energy intake and lower share of protein in the diet. Finally, the percentage of UPF at lunch was positively associated with the time spent walking and the number of steps per hour.

The percentage of energy intake from UPF found here was similar to other findings in the literature, such as the study carried out by Louzada et al. ([7]), which, using data representative of the Brazilian population aged ten years and over, found an average energy intake from UPF of 19.69% of the total energy consumed. Similarly, in an analysis of data from the Health Survey of the Municipality of Campinas (ISA-Camp) (Brazil) carried out between 2008 and 2009, it was found that among women, the average energy intake from UPF was 25.2% ([34]). It is, therefore, possible to realize that among low-income women, as well as the Brazilian population in general, around one-fifth of the total energy intake during the day comes from UPF, which corroborates previous evidence that the share of UPF in the Brazilian diet is still lower than in some high-income countries in which the percentage of energy intake from UPF exceeds 50% of total energy intake, such as the United States and the United Kingdom ([11]).

In the sample, we observed a different eating pattern to that expected for main meals, as we found a higher intake of UPF at main meals such as breakfast and dinner, as well as the afternoon snack, with lower participation in the morning snack and supper. The Brazilian population's daily food consumption pattern is generally structured around three main meals - breakfast, lunch, and dinner - and food intake episodes between these main meals, called snacks ([35,36]). Generally, the main meals concentrate the greatest energy and nutrient intake of the diet due to the large volume of these meals and being commonly composed of a greater proportion of unprocessed and minimally processed foods. Snacks, on the other hand, are often made up of ready-to-eat, low-priced foods with low nutritional value, and the consumption of UPF is common at these times ([35,36,37]). We did not find any other studies investigating this pattern of UPF consumption according to the meals eaten throughout the day. It is reasonable to assume that this pattern of UPF consumption can be partially justified by the poverty that would lead to food insecurity, thus affecting the dietary quality of these women ([38]). Limited access and limited food choices would lead to a preference for consuming UPF at main meals, given that in recent years, the reduction in the price of these foods and greater diversity of places to buy them has favored their acquisition by low-income individuals. Furthermore, the intrinsic properties of UPF, i.e, practical, ready-to-eat, and hyperpalatable foods, also contribute to an increase in the intake of these foods throughout the day ([7, 34]).

The investigation into the timing of UPF consumption throughout the day raises important discussions about the hypothesis that UPF can cause food addiction (FA), a concept that has gained prominence in recent scientific debate ([39, 40]). In fact, FA has been correlated with an increased intake of UPF, as indicated by the studies by Whatnall et al. ([41]) and Silva-Júnior et al. ([42]). The intake of these foods early in the day is a cause for concern, especially at breakfast, as it would demonstrate an early search for reward and pleasure, just as it is with nicotine addiction ([43, 44]). However, it is important to emphasize that we cannot establish this relationship due to the lack of data on FA in our sample. Therefore, we suggest that future robust research further investigate this potential criterion concerning FA.

Our results regarding the relationship between UPF consumption, energy intake, and diet composition according to macronutrients are consistent in the scientific literature. For example, the clinical trial by Hall et al. ([4]) demonstrated an

increase in the energy intake of individuals submitted to a diet rich in UPF compared to a diet without UPF, both under ad libitum food intake. Other observational studies demonstrated an imbalance in the composition of the diet, in particular a decrease in the percentage of protein intake with an increase in UPF consumption ([45,46]). Furthermore, these findings on the direct relationship between UPF consumption and total energy intake and the negative relationship for protein percentage align with the protein leverage hypothesis. This hypothesis postulates that among macronutrients, protein plays the most substantial role in controlling food intake; therefore, diets with a lower percentage of protein would lead to a compensatory increase in total energy intake in order to meet the needs of this macronutrient ([47,48]).

Although, in general, UPF have an unbalanced nutritional composition, a recent study showed that it is possible to prepare a menu composed mostly of UPF (>80% of total kcal) and still have good quality according to the Healthy Eating Index-2015 (HEI-2015), with an adequate distribution of macronutrients according to the dietary reference intakes (DRIs) ([49]). In this context, among the markers of UPF consumption, our analysis found a significant negative relationship only between group 4 (sandwich biscuits, sweets, or treats) and the percentage of protein in the diet. Both findings raise the discussion that only the classification of UPF according to the NOVA classification is not enough to predict diet quality since there is currently a diversity of UPF available and the NOVA classification is not based on nutrient content ([5], [49]). The finding of subgroups of UPF shows that it is possible to find a pattern of macronutrients among the types of UPF, thus an interface between the NOVA classification and conventional nutritional classification systems ([50]). Finally, it is clear that in women with obesity living in poverty, usually, the UPF consumed has a low percentage of protein and consequently tends to present higher amounts of carbohydrates and lipids together, nutritional characteristics associated with hyper palatability and excessive consumption ([51, 52]).

The evaluation of the relationship between UPF consumption and PA variables indicated a positive relationship between PA level and UPF consumption in this population, particularly the consumption of UPF at lunchtime, which was positively and significantly related to walking time and number of steps per hour. The scientific literature consistently shows that PA in the leisure domain is negatively proportional to schooling, income, and is lower in females ([17, 53]). Therefore, it is reasonable to

assume that the number of steps and the time spent walking reported in this sample mostly express PA related to work and commuting (non-recreational PA). As a result, the time allocated to lunch, a common meal between work shifts, is reduced, leading to the choice of a meal that is prepared and consumed quickly ([54, 55]). These findings suggest that non-recreational PA may mediate the relationship between poverty and higher consumption of UPF and constitute a public health challenge in promoting a less processed and nutritionally balanced diet in this population.

This study has some limitations, as it is a cross-sectional study with a small sample derived from a clinical trial. This can reduce the scope of inferences and the power of statistical tests. Still, we were able to find statistical significance in several associations investigated, which may indicate that power was not an issue, nevertheless, as the present sample was not recruited to test such hypothesis, the present findings must be seen as explorative. Another limitation is the use of 24HR to assess the participants' food consumption, as this method has limitations such as memory bias and under-reporting by the participants due to fear of judgment. However, in another study with the same population, it was not possible to observe underreporting of specific energy intake for any of the groups classified by NOVA ([56]). We can also highlight some of our study's strengths, such as using an accelerometer to assess daily PA, a valuable method with the ability to assess minute-by-minute changes in the intensity of activities carried out throughout the day; avoiding the bias of recall, social desirability or expectation in the answers given by this population when questionnaires are used. In addition, it is a study with an unprecedented evaluation of the distribution of UPF consumption throughout the day, according to meals.

CONCLUSION

Women with obesity living in poverty have a pattern of higher consumption of UPF at main meals, especially breakfast and dinner, compared to snacks. In this mostly sedentary sample, the positive association between the number of steps per hour and the consumption of UPF at lunch is noteworthy; however, the mechanisms that lead to this pattern of consumption and that justify this increase in activity are not yet well established.

In addition, it was observed that the consumption of UPF, especially from the sandwich biscuits, sweets, or treats group, affects dietary intake, leading to a higher energy intake and lower daily protein intake. However, more robust evidence is needed on the intake of different types of UPF according to the nutrient content available to establish new guidelines involving the consumption recommendations for these foods.

AUTHOR CONTRIBUTIONS

Nassib Bezerra Bueno conceptualized and oversaw the current study. Guilherme Carvalho e Micnéias Róberth Pereira interpreted the data and wrote the manuscript. Micnéias Roberth Pereira e Matheus Lima Macena performed statistical analysis and developed figures and tables. Mateus de Lima Macena, André Eduardo Silva Junior, Dafiny Rodrigues Silva Praxedes, Debóra Ferro, Déborah Tenório da Costa Paula, Jennifer Mikaella Ferreira Melo e Maria Clara contributed with collection and organization of the data as well as critically reviewing the manuscript. All authors contributed with critical revisions during data analysis, manuscript writing and approved the final version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

TRANSPARENCY DECLARATION

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE-nut guidelines. The lead author affirms that no important

aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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Table 1. Sociodemographic and anthropometric characteristics of the sample (n = 56).

Characteristics	Mean	Standard deviation
Age (years)	31.57	7.06
Body mass index (kg/m^2)	33.34	4.14
Waist circumference (cm)	100.59	10.25
Body fat (%)	43.86	5.11
	n	**%**
Race/skin color		
White	10	17.9
Non-white	46	82.1
Smoker		
Yes	6	89.3
No	50	10.7
Alcoholic		
Yes	24	42.9
No	32	57.1
Physical exercise		
Yes	13	23.2
No	43	76.8
Economic class		
C1	7	12.5
C2	10	17.9
D-E	39	69.6

Table 2. Food consumption characteristics and physical activity pattern indicators of the sample (n = 56).

	Mean	Standard deviation
Physical activity pattern		
MET/h	1.45	0.06
Sitting/lying time (%)	67.07	6.77
Standing time (%)	23.45	5.06
Walking time (%)	9.11	3.07
Number of steps/h	429.02	160.50
Food consumption characteristics		
Energy intake (kcal/d)	1653.21	503.22
Protein intake (kcal/d)	312.31	50.45
Protein intake (%kcal/d)	19.87	4.18
Fat intake (kcal/d)	872.88	289.19
Fat intake (%kcal/d)	27.36	6.97
Carbohydrate (kcal/d)	1216.06	238.97
Carbohydrate (%kcal/d)	52.76	7.03
UPF (kcal/d)	412.41	352.22
UPF (%kcal/d)	21.62	11.94
UPF at breakfast (%kcal/d)	4.91	5.08
UPF at the morning snack (%kcal/d)	1.08	2.89
UPF at lunch (%kcal/d)	3.21	5.84
UPF at the afternoon snack (%kcal/d)	5.34	7.41
UPF at dinner (%kcal/d)	5.09	6.70
UPF at supper (%kcal/d)	1.43	3.08
UPF group 1 (%kcal/d)	1.60	2.86
UPF group 2 (%kcal/d)	2.19	2.89
UPF group 3 (%kcal/d)	4.32	6.01
UPF group 4 (%kcal/d)	4.34	6.02
UPF group 5 (%kcal/d)	1.02	3.08

MET/h: Metabolic equivalent of task/h; UPF: Ultra-processed food; UPF group 1: Hamburger or sausages (ham, mortadella, salami, sausage); UPF group 2: Sweetened beverages (soft drinks, boxed juice, powdered juice, boxed coconut water, guarana/ginger syrups, fruit juice with added sugar); UPF group 3: Instant noodles, packet snacks or crackers; UPF group 4: Sandwich biscuits , sweets or treats (lollipops, chewing gum, caramel, jelly, condensed milk); UPF group 5: savory "bakery" snacks (coxinha, pizza, pastel, Etc.).

Table 3. Relationship between dietary intake and physical activity indicators versus overall and types of UPF (%kcal)

	Overall UPF (%kcal/d)		UPF group 1 (%kcal/d)		UPF group 2 (%kcal/d)		UPF group 3 (%kcal/d)		UPF group 4 (%kcal/d)		UPF group 5 (%kcal/d)	
Dietary intake	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**
Energy(Kcal/d)	18.80*	4.15; 33.40	32.60	-31.90; 97.20	11.59	-14.70; 37.90	-5.23	-35.90; 25.40	54.40*	27.60; 81.10	-25.90	-85.10; 33.40
Protein (%kcal/d)	-0.15*	-0.23; -0.06	-0.37	-0.18; 0.13	-0.28	-0.67; 0.11	-0.06	-0.26; 0.12	-0.31*	-0.48; -0.14	-0.06	-0.44; 0.30
Carbohydrate (%kcal/d)	0.05	-0.10; 0.22	-0.22	-0.90; 0.45	0.22	-0.44; 0.89	0.18	-0.13; 0.50	0.20	-0.10; 0.52	0.01	-0.61; 0.63
Fat (%kcal/d)	0.09	-0.06; 0.25	0.59	-0.06; 1.25	0.05	-0.61; 0.72	-0.11	-0.43; 0.19	0.10	-0.21; 0.42	0.05	-0.56; 0.67
Physical activity indicators												
MET/h	0.00	-0,00; 0.00	-0.00	-0.00; 0.00	0.00	-0.00; 0.01	0.00	-0,00; 0.00	-0,00	-0.00; 0.00	0.00	-0.00; 0.00
Sitting/lying time (%)	-0.00	-0.00; 0,00	0.53	-0.10; 1.18	-0.38	-1.02; 0.26	-0.22	-0.52; 0.08	-0.23	-0.53; 0.06	-0.34	-0.94; 0.00
Standing time (%)	0,00	-0,00; 0.00	-0.43	-0.90; 0.03	0.218	-0.25; 0.69	0.19	-0.02; 0.41	0.20	-0.02; 0.42	0.22	-0.21; 0.66
Walking time (%)	0,00	-0,00; 0.00	-0.09	-0.38; 0.20	0.223	-0.06 0.51	0.08	-0.05; 0.22	-0,00	-0.00; 0.00	0.19	-0.07; 0.46
Number of steps/h	2.27	-1.36; 5.89	-3.58	-19.02; 11.86	12.61	-2.22; 27.44	3.16	-4.07; 10.39	-1.92	-9.18; 5.34	7.77	-6.27; 21.81

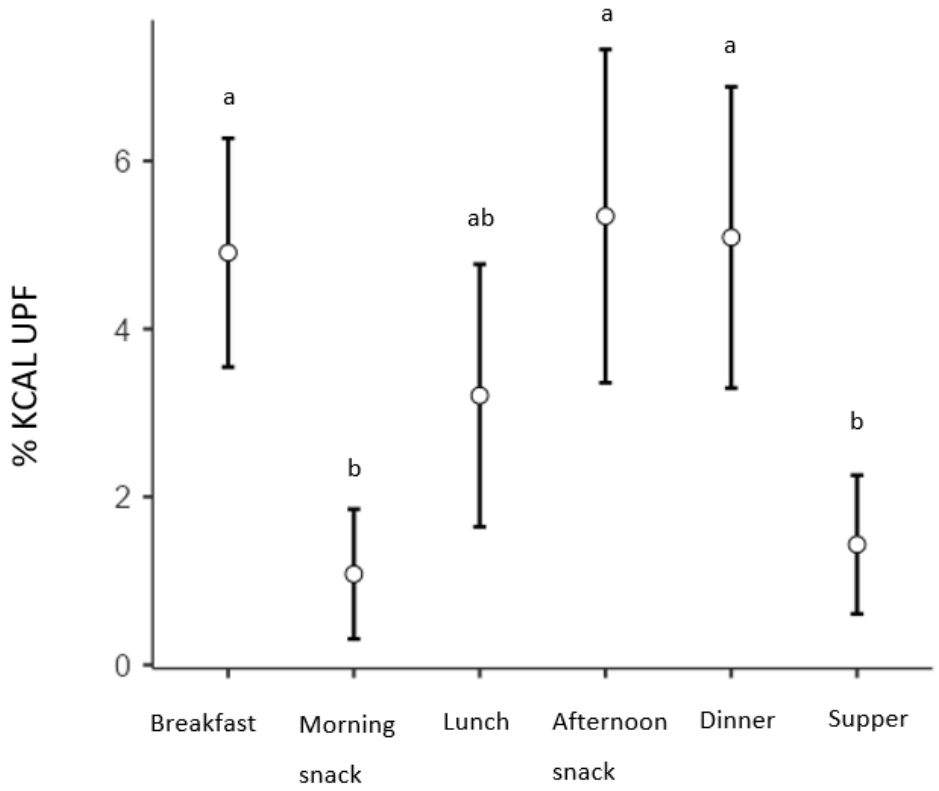
β values adjusted for age; UPF: Ultra-processed foods; UPF group 1: Hamburger or sausages (ham, mortadella, salami, sausage); UPF group 2: Sweetened beverages (soft drinks, boxed juice, powdered juice, boxed coconut water, guarana/ginger syrups, fruit juice with added sugar); UPF group 3: Instant noodles, packet snacks or crackers; UPF group 4: Sandwich biscuits, sweets or treats (lollipops, chewing gum, caramel, jelly, condensed milk); UPF group 5: savory "bakery" snacks (*coxinha*, pizza, pastel, Etc); MET/h: Metabolic equivalent of task/h; * indicate significant relationships between variables.

Table 4. Relationship between dietary intake and physical activity indicators vs. overall UPF and UPF per meal.

	UPF at breakfast (%kcal/d)		UPF at the morning snack (%kcal/d)		UPF at lunch (%kcal/d)		UPF at the afternoon snack (%kcal/d)		UPF at dinner (%kcal/d)		UPF at supper (%kcal/d)	
Dietary intake	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**	**β**	**95%CI**
Energy (Kcal/d)	-38.12*	-73.10; -3.19	60.74	-1.08; 122.60	21.03	-10.50; 52.60	52.50*	31.80; 73.20	-9.58	-37.10; 17.90	29.10	-30.30; 88.50
Protein (%kcal/d)	-0.08	-0.30; 0.14	-0.41*	-0.79; -0.02	-0.06	-0.26; 0.13	-0.18*	-0.33; -0.04	-0.03	-0.21; 0.13	-0.19	-0.56; 0.17
Carbohydrate (%kcal/d)	0.37*	0.00; 0.74	0.08	-0.58; 0.75	-0.08	-0.41; 0.25	-0.01	-0.28; 0.24	0.00	-0.28; 0.29	-0.04	-0.67; 0.58
Fat (%kcal/d)	-0.29	-0.66; 0.07	0.32	-0.33; 0.98	0.14	-0.18; 0.47	0.20	-0.05; 0.46	0.02	-0.25; 0.31	0.22	-0.38; 0.84
Physical activity indicators												
MET/h	-0.00	-0.00; 0.00	-0,00	-0.00; 0.00	0.00	-0,00; 0.00	0.00	-0.00; 0.00	0.00	-0.00; 0.00	0.00	-0.00; 0.00
Sitting/lying time (%)	0.073	-0.29; 0.44	-0.11	-0.76; 0.53	-0.08	-0.41; 0.23	-0.18	-0.43; 0.06	-0.02	-0.30; 0.25	-0.48	-1.07; 0.10
Standing time (%)	0.122	-0.14; 0.39	0.247	-0.22; 0.71	-0.07	-0.31; 0.15	0.10	-0.07; 0.29	0.04	-0.16; 0.24	0.15	-0.28; 0.60
Walking time (%)	-0.07	-0.24; 0.08	-0.044	-0.33; 0.24	0.16*	0.02; 0.30	0.05	-0.05; 0.17	0.02	-0.10; 0.15	0.00	-0.26; 0.28
Number of steps/h	-5.67	-14.19; 2.85	-4.98	-20.12; 10.16	8.72*	1.50; 15.94	2.63	-3.32; 8.58	1.06	-5.49; 7.62	-0.81	-15.04; 13.42

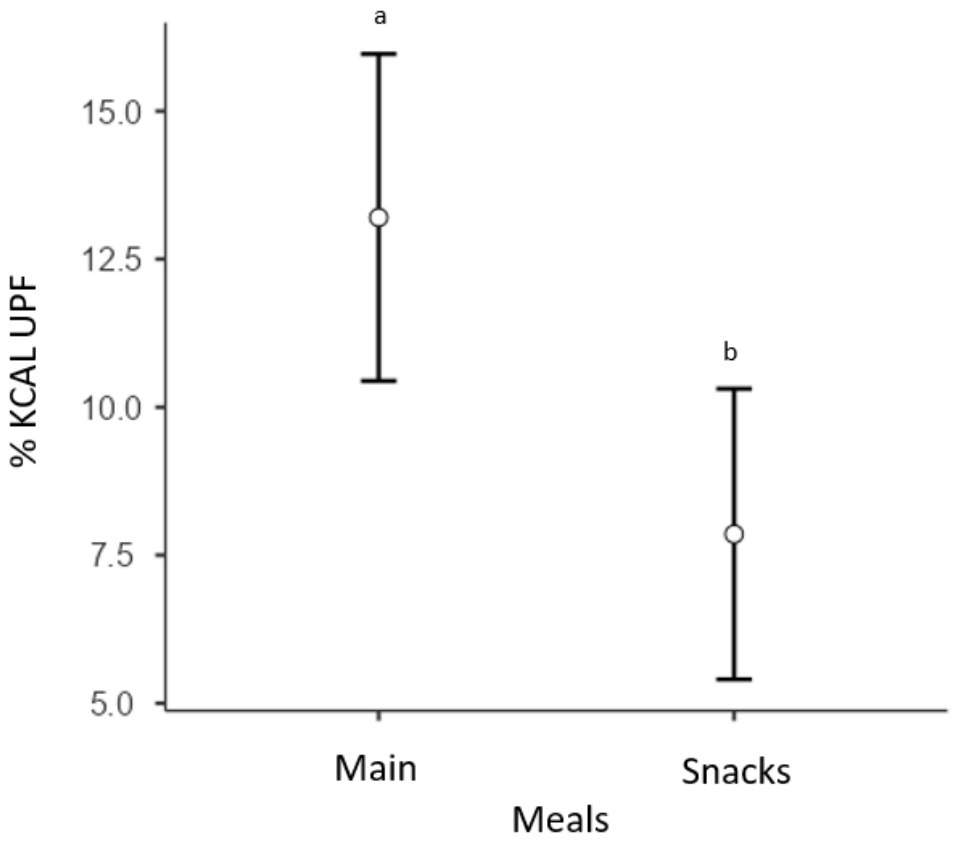
β values adjusted for age; UPF: Ultra-processed foods; MET/h: Metabolic equivalent of task/h; * indicate significant relationships between variables.

Figure 1. Differences in % UPF consumption between meals.



Caption: Different superscript letters indicate significant differences between meals; UPF: Ultra-processed foods

Figure 2. Differences in % UPF consumption between main meals and snacks.



Caption: Different superscript letters indicate significant differences between meals; UPF: Ultra-processed food

5. ANEXOS

ANEXO A - CARTA DE ACEITE (JOURNAL OF HUMAN NUTRITION AND DIETETICS)

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1 mensagem

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11-Mar-2024

Dear Dr Bueno

It is a pleasure to accept your manuscript entitled "TYPE AND TIMING OF ULTRA-PROCESSED FOODS CONSUMPTION AND ITS ASSOCIATION WITH DIETARY INTAKE AND PHYSICAL ACTIVITY IN WOMEN WITH OBESITY LIVING IN POVERTY" in its current form for publication in the Journal of Human Nutrition and Dietetics.

First Look NEW: Please note although the manuscript is accepted the files will now be checked to ensure that everything is ready for publication, and you may be contacted if final versions of files for publication are required.

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Best wishes

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6. MATERIAIS SUPLEMENTARES

6.1 CHECKLIST DO STROBE-NUT

Table 1. STROBE-nut: An extension of the STROBE statement for nutritional epidemiology

Lachat C et al. (2016) STrengthening the Reporting of OBservational studies in Epidemiology – Nutritional Epidemiology (STROBE-nut): an extension of the STROBE statement. Plos Medicine 13(6) http://dx.doi.org/10.1371/journal.pmed.1002036 pdf or online version.

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract. (b) Provide in the abstract an informative and balanced summary of what was done and what was found.	**nut-1** State the dietary/nutritional assessment method(s) used in the title, abstract, or keywords.	1
Introduction				
Background rationale	2	Explain the scientific background and rationale for the investigation being reported.		3
Objectives	3	State specific objectives, including any pre-specified hypotheses.		4
Methods				
Study design	4	Present key elements of study design early in the paper.		5-7
Settings	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	**nut-5** Describe any characteristics of th study settings that might affect the dietary	5

1

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
Settings	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	**nut-5** Describe any characteristics of the study settings that might affect the dietary intake or nutritional status of the participants, if applicable.	5
Participants	6	a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants. (b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed. Case-control study—For matched studies, give matching criteria and the number of controls per case.	**nut-6** Report particular dietary, physiological or nutritional characteristics that were considered when selecting the target population.	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect	**nut-7.1** Clearly define foods, food groups, nutrients, or other food components.	5 - 7

2

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
		modifiers. Give diagnostic criteria, if applicable.	**nut-7.2** When using dietary patterns or indices, describe the methods to obtain them and their nutritional properties.	
Data sources - measurements	8	For each variable of interest, give sources of data and details of methods of assessment (measurement).Describe comparability of assessment methods if there is more than one group.	**nut-8.1** Describe the dietary assessment method(s), e.g., portion size estimation, number of days and items recorded, how it was developed and administered, and how quality was assured. Report if and how supplement intake was assessed. **nut-8.2** Describe and justify food composition data used. Explain the procedure to match food composition with consumption data. Describe the use of conversion factors, if applicable. **nut-8.3** Describe the nutrient requirements, recommendations, or dietary guidelines and the evaluation approach used to compare intake with the dietary reference values, if applicable. **nut-8.4** When using nutritional biomarkers, additionally use the STROBE Extension for Molecular Epidemiology (STROBE-ME).	**5 - 7**

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
			Report the type of biomarkers used and their usefulness as dietary exposure markers. **nut-8.5** Describe the assessment of nondietary data (e.g., nutritional status and influencing factors) and timing of the assessment of these variables in relation to dietary assessment. **nut-8.6** Report on the validity of the dietary or nutritional assessment methods and any internal or external validation used in the study, if applicable.	
Bias	9	Describe any efforts to address potential sources of bias.	**nut-9** Report how bias in dietary or nutritional assessment was addressed, e.g., misreporting, changes in habits as a result of being measured, or data imputation from other sources	**5 - 7**
Study Size	10	Explain how the study size was arrived at.		**5**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why.	**nut-11** Explain categorization of dietary/nutritional data (e.g., use of N-tiles and handling of nonconsumers) and the choice of reference category, if applicable.	**7**

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
Statistical Methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions. (c) Explain how missing data were addressed. (d) Cohort study—If applicable, explain how loss to follow-up was addressed. Case-control study—If applicable, explain how matching of cases and controls was addressed. Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy. (e) Describe any sensitivity analyses.	**nut-12.1** Describe any statistical method used to combine dietary or nutritional data, if applicable. **nut-12.2** Describe and justify the method for energy adjustments, intake modeling, and use of weighting factors, if applicable. **nut-12.3** Report any adjustments for measurement error, i.e,. from a validity or calibration study.	7
Results				
Participants	13	(a) Report the numbers of individuals at each stage of the study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed.	**nut-13** Report the number of individuals excluded based on missing, incomplete or implausible dietary/nutritional data.	8

5

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
		(b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram.		
Descriptive data	14	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) Cohort study—Summarize follow-up time (e.g., average and total amount)	**nut-14** Give the distribution of participant characteristics across the exposure variables if applicable. Specify if food consumption of total population or consumers only were used to obtain results.	8
Outcome data	15	Cohort study—Report numbers of outcome events or summary measures over time. Case-control study—Report numbers in each exposure category, or summary measures of exposure. Cross-sectional study—Report numbers of outcome events or summary measures.		8

6

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.	**nut-16** Specify if nutrient intakes are reported with or without inclusion of dietary supplement intake, if applicable.	**8**
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions and sensitivity analyses.	**nut-17** Report any sensitivity analysis (e.g., exclusion of misreporters or outliers) and data imputation, if applicable.	
Discussion				
Key results	18	Summarize key results with reference to study objectives.		**9**
Limitation	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	**nut-19** Describe the main limitations of the data sources and assessment methods used and implications for the interpretation of the findings.	**11**

Item	Item nr	STROBE recommendations	Extension for Nutritional Epidemiology studies (STROBE-nut)	Reported on page #
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	**nut-20** Report the nutritional relevance of the findings, given the complexity of diet or nutrition as an exposure.	**9 - 12**
Generalizability	21	Discuss the generalizability (external validity) of the study results.		**10-11**
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.		**13**
Ethics			**nut-22.1** Describe the procedure for consent and study approval from ethics committee(s).	**5**
Supplementary material			**nut-22.2** Provide data collection tools and data as online material or explain how they can be accessed.	