UNIVERSIDADE ESTADUAL DE CAMPINAS
Faculdade de Ciências Aplicadas

MARIANA PITON HAKIM

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Tese apresentada à Faculdade de Ciências Aplicadas da Universidade Estadual de Campinas como parte dos requisitos exigidos para obtenção do título de Doutora em Ciências da Nutrição e do Esporte e Metabolismo na área de Ciências Nutricionais e Metabolismo.

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Orientador: Prof. Dr. Diogo Thimoteo da Cunha

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EPÍGRAFE

“Safety and security don't just happen, they are the result of collective consensus and public investment.”

Nelson Mandela

RESUMO

O crescimento de refeições fora de casa somado ao aumento expressivo do uso de aplicativos em serviços de *delivery* deu espaço a uma nova modalidade de restaurantes, as chamadas *dark kitchens* (DK), que são estabelecimentos que não possuem atendimento local ao público, prestando unicamente serviços de entrega e retirada de refeições. A fim de promover tanto a segurança dos alimentos, direito do consumidor, quanto a solidificação dos novos empreendedores nessa inovadora forma de negócio, esse estudo objetiva mapear as DK em Campinas – SP, Limeira – SP e São Paulo – SP (etapa 1); e compreender o conhecimento e percepção do consumidor sobre esse novo modelo de negócio, tanto no Brasil (etapa 2), como em diferentes culturas (etapa 3). Para a etapa 1, foi feito um estudo exploratório para identificar DK presentes em um aplicativo de delivery de alimentos por meio de mineração de dados, uso tecnologias de rastreamento e georeferenciamento. Na etapa 2, foram perguntados à 623 brasileiros sobre o conhecimento do termo DK e foram apresentadas 25 assertivas com respostas em escala Likert de cinco pontos adaptada a cada tipo de assertiva, relacionadas aos constructos: disposição de pagar e intenção de compra, confiança nas autoridades de saúde, confiança no aplicativo de entrega de alimentos, segurança dos alimentos percebida, controle de qualidade, experiência do consumidor e solidariedade com o setor de alimentação; e, por fim, na etapa 3, foi aplicado esse mesmo questionário com algumas adaptações para 829 respondentes, sendo 31,5% do Brasil (BR), 34,5% do Reino Unido (UK) e 34,0% da Polônia (PL). Na etapa 1, a identificação e caracterização desses estabelecimentos em três centros urbanos no Brasil revelou que 27,1% dos 22.520 estabelecimentos avaliados são classificados como DK. A análise destacou características distintas, como dispersão geográfica e preços mais acessíveis em comparação com restaurantes tradicionais, além da identificação de seis modelos de DK. A etapa 2 mostrou que 73,4% dos participantes ouviram falar do conceito 'dark kitchen'. Apesar de muitos não conseguirem definir precisamente o conceito, houve uma disposição positiva para pagar e comprar refeições nesse modelo. O fator solidariedade com o setor de alimentação (β=0,440; $p<0,001$) teve maior influência positiva na disposição a pagar e na intenção de compra, seguido pela percepção de segurança dos alimentos (β=0,273; $p<0,001$); controle de qualidade (β=0,125; p=0,003); experiência do consumidor (β=0,110; p=0,002) e confiança nas autoridades de saúde (β=0,059; p=0,047). Por fim, na etapa 3, destacou-se uma variação cultural na compreensão de DK. Apesar das diferentes interpretações do conceito, houve uma disposição favorável dos consumidores para adquirir alimentos nesse modelo, impulsionada por fatores como segurança dos alimentos (β_{BR}=0.106; β_{UK}=0.173; β_{PL}=0.160), experiência do usuário (β_{BR}=0.167; β_{UK}=0.235; β_{PL}=0.231) e responsabilidade social (β_{BR}=0.497; β_{UK}=0.381; β_{PL}=0.378). Em conjunto, os resultados oferecem uma visão abrangente das DK, desde sua caracterização e modelos até o conhecimento do consumidor e fatores determinantes de sua aceitação, contribuindo para o entendimento e desenvolvimento desse setor em constante evolução na indústria alimentícia.

Palavras-chave: alimentação coletiva, segurança dos alimentos, *delivery, dark kitchens*, comportamento do consumidor.

ABSTRACT

The growth of dining out combined with the significant increase in the use of delivery service apps has paved the way for a new type of restaurants, known as dark kitchens (DK). These establishments operate without local customer service, exclusively providing delivery or take-out services. In order to promote both food safety for consumer protection and the consolidation of new entrepreneurs in this innovative business model, this study aims to map DKs in Campinas – SP, Limeira – SP, and São Paulo – SP (stage 1); and understand consumer knowledge and perception of this new business model, both in Brazil (stage 2) and across different cultures (stage 3). For stage 1, an exploratory study was conducted to identify DKs present in a food delivery app through data mining, tracking technologies, and georeferencing. In stage 2, 623 Brazilians were surveyed about their knowledge of the term DK, and 25 statements with five-point Likert scale responses were presented, ranging from 1 to 5. These statements were related to constructs such as willingness to pay and purchase intention, trust in health authorities, trust in food delivery app, perceived food safety, quality control, consumer experience, and solidarity with the foodservice sector. Finally, in stage 3, the same questionnaire, with some adaptations, was administered to 829 respondents, comprising 31.5% from Brazil (BR), 34.5% from the United Kingdom (UK), and 34.0% from Poland (PL). In stage 1, the identification and characterization of these establishments in three urban centers in Brazil revealed that 27.1% of the 22,520 establishments evaluated are classified as DKs. The analysis highlighted distinct characteristics, such as geographical dispersion and more affordable prices compared to traditional restaurants, as well as the identification of six DK models. Stage 2 showed that 73.4% of participants had heard of the term. Although many could not precisely define the concept, there was a positive willingness to pay and purchase meals in this model. The factor of solidarity with the food sector ($\beta=0.440$; $p<0.001$) had the greatest positive influence on willingness to pay and purchase intention, followed by the perception of food safety ($\beta=0.273$; $p<0.001$); quality control ($\beta=0.125$; $p=0.003$); consumer experience ($\beta=0.110$; $p=0.002$); and trust in health authorities ($\beta=0.059$; $p=0.047$). Finally, in stage 3, there was a cultural variation in the understanding of DK. Despite different interpretations of the concept, consumers showed a favorable disposition to acquire food in this model, driven by factors such as food safety ($\beta_{BR}=0.106$; $\beta_{UK}=0.173$; $\beta_{PL}=0.160$), user experience ($\beta_{BR}=0.167$; $\beta_{UK}=0.235$; $\beta_{PL}=0.231$), and social responsibility ($\beta_{BR}=0.497$; $\beta_{UK}=0.381$; $\beta_{PL}=0.378$). Overall, the results provide a comprehensive view of DKs, from their characterization and models to consumer knowledge and determining factors of their acceptance, contributing to the understanding and development of this constantly evolving DK in the food industry.

Keywords: collective feeding; food safety; delivery, dark kitchens; consumer behavior.

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LISTA DE ABREVIATURAS E SIGLAS

ABRASEL: Associação Brasileira de Bares e Restaurantes
ANOVA: Análise de Variância
AVE: *Average of Variance Extracted*
BR: Brasil
CAPES: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
CEP: Comitê de Ética em Pesquisa
CFA: *Confirmatory Factor Analysis*
CFI: *Comparative Fit Index*
CNPq: Conselho Nacional de Desenvolvimento Científico e Tecnológico
COVID-19: Coronavírus-19
CR: Composite Reliability
DTA: Doenças Transmitida por Alimentos
DK: *Dark kitchen*
ENADE: Exame Nacional de Desenvolvimento dos Estudantes
FAFH: *Food Away From Home*
FBI: *Foodborne Illness*
FDA: *Food Delivery Apps*
GFI: *Goodness of Fit Index*
HTMT: *Heterotrait-Monotrait*
ISO: *International Organisation for Standardisation*
IRaMuTeQ: *Interface de R pour les Multidimensionnelles de Textes et de Questionnaires*
JSON: *JavaScript Object Notation*
MICOM: *Measurement Invariance of Composite Models*
MGA: *Multigroup analysis*
OFD: *Online Food Delivery*
PL: Polônia
PLS-SEM: *Partial Least Squares Structural Equation Modeling*
RMSEA: *Root Mean Square Error of Approximation*
SPSS: *Statistical Package for Social Sciences*
TCLE: Termo de Consentimento Livre e Esclarecido
TLI: *Tucker-Lewis Index*
TS: *Text segment*
UK: Reino Unido
URL: *Uniform Resource Locator*
UTAUT: *Unified Theory of Acceptance and Use of Technology*
VIF: *Variance Inflation Factor*

SUMÁRIO

APRESENTAÇÃO

O presente trabalho é apresentado como pré-requisito para o exame de defesa como etapa para obtenção do título de Doutora em Ciências da Nutrição e do Esporte e Metabolismo, na Faculdade de Ciências Aplicadas da UNICAMP.

Esse documento foi elaborado com o intuito de desvendar, por diferentes óticas, o modelo de negócio denominado *dark kitchen.* A proposta é compreender melhor as características e observar, sob o olhar da percepção do consumidor, as *dark kitchens* de modo a trazer reflexões que auxiliem a viabilizar esse modelo de negócio. Visando oferecer reflexões que possam contribuir com tais objetivos, esse documento de defesa de tese foi organizado em 6 partes: introdução, objetivos e métodos; capítulo I; capítulo II; capítulo III, discussões gerais e repercussão do estudo.

A introdução foi desenvolvida com o propósito de apresentar o contexto dos temas aqui abordados e conta com referencial teórico para aprofundamento de tais temas, além de conter os objetivos e metodologia desse trabalho. Os resultados foram organizados na forma de artigos científicos. No capítulo I apresento o artigo "*Exploring dark kitchens in Brazilian urban centres: A study of delivery-only restaurants with food delivery apps*". No capítulo II, compartilho o artigo *"What is a dark kitchen? A study of consumer's perceptions of deliver-only restaurants using food delivery apps in Brazil"*. O capítulo III aborda o artigo *"How dark kitchens are perceived by different cultures? A cross-cultural study in Brazil, Poland and the United Kingdom"*. Os artigos referentes aos capítulos I e II foram publicados da revista *Food Research International,* enquanto o do capítulo III será submetido à mesma revista. Com os resultados individuais de cada artigo apresentados, serão propostas as considerações finais sobre o trabalho como um todo.

Por fim, na última parte desse documento, destaco as repercussões dos resultados já publicados. Os impactos de um trabalho se iniciam pela divulgação científica. Considerando isso, destaco as repercussões nos mais de 50 espaços onde os resultados desse trabalho foram apresentados para a população, englobando reportagens, exposição em programas TV e até mesmo

a integração na formulação de questão para o ENADE (Exame Nacional de Desempenho dos Estudantes).

Acredito que, para o desenvolvimento de uma sociedade, seja importante a adequação dos setores frente às constantes mudanças provenientes das novas possibilidades que a tecnologia nos permite. Para criar um modelo de negócio de maneira responsável e segura é necessário estudá-lo, compreendendo seu perfil e suas dores, seus obstáculos e suas conveniências. Espero com esse trabalho, trazer informações que possam ser usadas como ferramentas mercadológicas para criar solução para os envolvidos nas *dark kitchens*, tendo sempre como norte o bem do consumidor.

Com isso, apresento minha tese de doutorado.

1 INTRODUÇÃO

O mundo está em constante mudança. A globalização, o acelerado ritmo do dia a dia das pessoas, a pandemia da COVID-19 e os constantes avanços da tecnologia exigem que os setores de negócios também se transformem para que possam sobreviver (CUESTA-VALIÑO; GUTIÉRREZ-RODRÍGUEZ; GARCÍA-HENCHE, 2022; FONTES et al., 2017; MORA et al., 2021; WEI; TORRES; HUA, 2016). Focar em trazer soluções para os consumidores é um caminho assertivo para o sucesso de um estabelecimento.

Para a indústria de alimentos, isso não é exceção. Atualmente, os consumidores buscam a melhor maneira de utilizar seu tempo e, no contexto da alimentação, isso se traduz em uma redução do tempo dedicado na preparação de alimentos (BARBOSA; CAMPBELL, 2006; SMITH; NG; POPKIN, 2013; WARDE, 2016) concomitante ao aumento da procura por restaurantes. Em 2020, 58% dos consumidores alegaram ser mais propensos do que eram a dois anos atrás a incorporar mais itens preparados por restaurantes em sua rotina do que refeições preparadas em casa. Além disso, 63% das pessoas dizem preferir gastar dinheiro em uma experiência como um restaurante ao invés de comprar um item discricionário em uma loja (NRA - NATIONAL RESTAURANT ASSOCIATION, 2021). O comer fora do lar, do inglês *Food Away From Home* (FAFH), neste novo cenário, culminou no crescimento do setor, com aumento nas vendas de 43 bilhões de dólares em 1970 para 899 bilhões de dólares em 2020 (CLARO et al., 2014; IBGE -INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2019; NRA - NATIONAL RESTAURANT ASSOCIATION, 2021; WARDE, 2016).

Todavia, FAFH não abrange somente os restaurantes tradicionais, onde o consumidor se locomove até o local e consome neste espaço. FAFH engloba toda alimentação produzida fora do ambiente doméstico, podendo ser consumida nele ou não (CFDD - CENTER FOR DEVELOPMENT DATA, 2017). A presença de telefones, celulares, computadores, *internet, smartphones, tablets,* aplicativos móveis, trouxe novas opções de FAFH para a conveniência das pessoas e que, na maioria das vezes, se resumem ao ato de pedir a comida, esperar, receber a comida em casa, no trabalho ou onde solicitado, e comer.

Este modelo é conhecido como *delivery,* ou no serviço chamado *takeout* (CAMBRIDGE, 2022), no qual o consumidor também solicita a comida via aplicativo ou telefone, porém vai buscá-la no restaurante onde a refeição foi encomendada e leva os alimentos para comer onde desejar, não consumindo-as no restaurante de fato.

Tais vicissitudes proporcionaram que a entrega de alimentos seja vista como uma oportunidade estratégica de negócios como forma de aumentar faturamento e lucratividade dentro do setor de restaurantes. Somente em 2020, o setor de aplicativos para *delivery* de alimentos rendeu 136.431 milhões de dólares por meio de 1.213,9 milhões de usuários (STATISTA, 2020a). A perspectiva para os próximos anos é de que esse crescimento continue ocorrendo de forma impactante (STATISTA, 2020a). No Brasil, em 2019, os pedidos de *delivery* cresceram 71% só no setor digital, e podem ainda representar uma grande fatia no faturamento de restaurantes, podendo chegar a 40% desse total (CREST, 2020). Segundo a Associação Brasileira de Bares e Restaurantes (ABRASEL), o mercado de *delivery* por aplicativo faturou 15 milhões de reais em 2019 e já havia a perspectiva de crescimento para 2020 (ABRASEL - ASSOCIAÇÃO BRASILEIRA DE BARES E RESTAURANTES, 2020a). Dada as situação decorrentes da pandemia da COVID-19, diversas medidas de distanciamento social incluindo interrupção momentânea de serviços de restaurantes devido ao alto risco de contaminação desses ambientes foram aplicadas (CHANG et al., 2021a). Além disso, mais recentemente, o aumento do preço de diversas commodities como reflexo da guerra entre a Ucrânia e a Rússia, resultou no aumento do preço dos alimentos (FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS, 2023), assim como nos gastos familiares e preços de gastos e custos de restaurantes. Nesse sentido, os restaurantes tiveram que buscar ativamente estratégias alternativas paras se manterem competitivos (TECHNOMIC, 2020), resultando no crescimento ainda maior do que o esperado do setor, e as refeições via aplicativo de entrega ganharam ainda mais força (LORENÇATO, 2020; STATISTA, 2020b).

Diante desse conjunto de circunstâncias, como uma inovação disruptiva (BUHALIS et al., 2019), um novo modelo de restaurante ganhou força. As chamadas *dark kitchen*, *ghost kitchen* ou cozinha virtual, surgiram para

representar segmentos no ramo alimentício que consistem em cozinhas que funcionam preparando refeições apenas sob encomenda por meio de aplicativos, ou seja, elas não possuem a função e nem a capacidade de receber público em seu interior (FORBES, 2020; SÃO PAULO, 2022; TERRA, 2020). Economicamente é um modelo muito atrativo, uma vez que nos Estados Unidos o custo para abertura de um restaurante padrão (i.e. de serviço completo) é de 475.500 dólares, em média, enquanto os restaurantes que trabalham somente com retirada (*take out)* e *delivery* têm um custo de abertura de 150.500 dólares, em média (RESTAURANT OWNER, 2020). No Brasil a situação é similar, visto que as *dark kitchens* operam com custos fixos reduzidos.

Ainda que as *dark kitchens* possuam grande potecial para investidores e pessoas buscando oportunidades de negócios, assim como qualquer inovação, é necessário cautela e uma análise sistemática para ver potenciais riscos e benefícios para tornar este modelo sustentável, atrativo e seguro, tanto para o consumidor como para o investidor. Nesse sentido, destaca-se a importância de se compreender melhor as *dark kitchen*, assim como as percepções das pessoas sobre esses estabelecimentos.

Por esse motivo, este projeto visa a estudar e mapear as *dark kitchens* no Brasil, buscando entender as percepções e intenções dos consumidores diante desse conceito. Com relação a percepção da população, inicialmente, o foco estará na audiência brasileira e, posteriormente, serão exploradas diferentes culturas e países. O objetivo é compreender as características e localização dessas *dark kitchens*, gerando um diagnóstico inédito no país que seja propositivo e com base nas percepções dos consumidores, direcionando maior atenção para esses estabelecimentos. Dessa forma, este trabalho pretende contribuir não apenas para a proteção do consumidor, mas também para fortalecer os novos empreendedores nesse segmento de negócios alimentícios, que desempenha um papel tão significativo na economia.

2 REFERENCIAL TEÓRICO

2.1. História do f*ood delivery*

O sistema de entrega de alimentos foi documentado pela primeira vez na Itália, em 1889 (GAMILLA, 2021). Nesse mesmo período houve registros semelhantes desse serviço na Índia, ainda que com características específicas. Na Itália um chefe foi convocado pela realeza para entregar uma pizza (GAMILLA, 2021). Já na Índia, os registros contam sobre a entrega de almoço para trabalhadores, em um sistema conhecido como *dabbawala*, referente à palavra *dabba* (MEHNAZ; BASKAR; VENKTESWAR, 2021), usada para descrever uma caixa de metal utilizada para transportar alimentos. Essa prática também tem sua conexão em outros países, como nos Estados Unidos, onde o serviço de entrega teve início por volta de 1950, atendendo clientes de classe média que preferiam jantar em casa enquanto assistiam televisão (GAMILLA, 2021). Além disso, a televisão foi utilizada para anunciar cardápios, impulsionando as vendas de estabelecimentos que aderiram a esse sistema (GAMILLA, 2021), gerando uma relação benéfica para ambos os lados. Essa mudança foi fortalecida pelo surgimento das grandes redes de *fastfood* no país (BALL, 1996).

No Reino Unido, a venda de alimentos para consumo fora do estabelecimento é conhecida desde a Revolução Industrial. Naquela época, diversos produtos eram oferecidos, incluindo batatas fritas, que mais tarde foram combinadas com peixe, sendo uma combinação tradicionalmente preparada para consumo fora do local de venda (BALL, 1996). Além disso, o aumento da presença feminina no mercado de trabalho durante esse período resultou em maiores rendas e menos tempo disponível para preparar refeições em casa. Esse movimento no mercado de trabalho gerou um crescimento ainda maior no consumo de alimentos fora de casa. Em 1970, esse serviço de alimentação consistia principalmente em pequenos estabelecimentos comerciais com cardápios limitados (BALL, 1996). Com o avanço dos sistemas, esse perfil evoluiu, resultando em cardápios mais diversificados nas grandes redes de *fatsfood* (Ball, 1996) e nos serviços de entrega de alimentos (LORD et al., 2023). Assim, os serviços registrados na Índia na década de 80, perduram até hoje, ainda que esse serviço ainda exista e atenda múltiplos trabalhadores, agora se

apoia em sistemas automatizados por meio de plataformas *online* (MEHNAZ; BASKAR; VENKTESWAR, 2021).

Essas plataformas experimentaram um crescimento exponencial na última década (NAVARRETE; APARICIO; ROSADO, 2022) devido aos avanços tecnológicos e inovações nesse setor (LEE et al., 2017). Esse crescimento foi impulsionado pela pandemia da COVID-19, que aumentou a demanda por entregas de alimentos (GAMILLA, 2021; ZANETTA et al., 2021b). Em resposta às restritivas medidas sanitárias impostas pelo contexto pandêmico (ZANETTA et al., 2021b) e embora haja uma lacuna sobre o tema, muitos indivíduos que perderam seus empregos durante esse período encontraram no setor alimentício uma oportunidade, tornando o conceito de restaurante virtual especialmente relevante em tempos de crise econômica (PEREIRA et al., 2021)

Consequentemente, diversos estabelecimentos comerciais ajustaram suas estratégias, destacando o serviço de entrega como uma prioridade essencial, enquanto outros surgiram no mercado já adotando exclusivamente essa modalidade de venda desde sua concepção (NAVARRETE; APARICIO; ROSADO, 2022). Essa adaptação estratégica não apenas atendeu à demanda crescente por conveniência durante a pandemia, mas também evidenciou uma mudança estrutural no panorama dos serviços alimentícios, com o surgimento de modelos de negócios mais voltados para o ambiente virtual e o consumo remoto. Esse cenário reflete não apenas uma resposta pragmática às condições adversas, mas também sinaliza uma transformação duradoura na dinâmica do setor, reforçando a importância contínua dessas plataformas na oferta de soluções inovadoras e adaptáveis às necessidades dos consumidores.

2.2. Mercado de *food delivery*

A entrega de comida *online* representa uma transformação notável na dinâmica do setor alimentício, em que os consumidores utilizam canais online para efetuar pedidos em restaurantes e varejistas de *fast-food* (ELVANDARI; SUKARTIKO; NUGRAHINI, 2018). Nesse contexto, a oferta diversificada de escolhas de restaurantes e uma ampla gama de alimentos disponíveis são proporcionadas aos consumidores por meio desse sistema (PIGATTO et al., 2017). Os aplicativos de entrega de alimentos têm conquistado ampla aceitação

e popularidade, principalmente pela sua habilidade em facilitar a entrega rápida e conveniente de refeições diretamente na porta dos clientes (XU, 2017).

À medida que a paisagem tecnológica avança, os restaurantes têm se adaptado de forma proativa, migrando de plataformas *offline* para *online*, investindo no desenvolvimento de seus próprios *websites* e aplicativos móveis para aprimorar a experiência do cliente (Yeo et al., 2017; Ray et al., 2019). Contudo, é válido ressaltar que nem todos os estabelecimentos optam por gerir internamente seus canais de entrega, muitos preferem recorrer a plataformas de terceiros renomadas, tais como Foodpanda, Swiggy, Zomato, Uber Eats, Ifood (CHEVALIER, 2023a; LO; YU; CHEN, 2020), devido ao maior alcance desses canais, ainda que exista um custo para a venda por meio destas plataformas.

Embora essas plataformas tenham inicialmente concentrado suas operações em áreas metropolitanas, seu impacto tem sido um catalisador significativo para o crescimento exponencial do setor *online food delivery* (OFD). Projetado para aumentar de US$ 1,03 trilhões em 2023 para expressivos US$ 1,79 trilhões em 2028, com uma taxa de crescimento anual de 10,06%, o mercado global de OFD revela notável potencial, refletindo a crescente preferência dos consumidores por serviços de entrega *online* (STATISTA, 2023a). No Brasil, o crescimento do valor de mercado nesse setor também demonstra consistência. No ano de 2022, o segmento atingiu faturamento no valor de U$ 7,89 bilhões e espera-se que atinja U$ 10,96 bilhões (CHEVALIER, 2023b).

A indústria OFD não apenas testemunhou avanços tecnológicos notáveis, que abrangem desde o desenvolvimento de *websites* até a implementação de aplicativos móveis, a integração de drones e o uso de inteligência artificial (IA), mas também desencadeou uma constante adaptação por parte dos restaurantes. Essas inovações não só aprimoram a eficiência do setor OFD, mas também impulsionam a competitividade, promovendo uma experiência gastronômica mais ágil, personalizada e alinhada às exigências modernas dos consumidores. A busca incessante por integração tecnológica reflete o comprometimento contínuo em oferecer soluções inovadoras e garantir a excelência na entrega de alimentos, consolidando o OFD como uma força vital no cenário atual da indústria alimentícia global.

2.3. *Dark kitchens* e seu destaque no mercado de *food delivery*

No contexto de crescimento do *food delivery*, observou-se uma expansão de um modelo de negócio nomeado *dark kitchen*. Embora o surgimento desse modelo anteceda a pandemia da COVID-19, foi durante esse período que sua popularidade cresceu exponencialmente (NAVARRETE; APARICIO; ROSADO, 2022; SHAPIRO, 2023), especialmente em países em desenvolvimento (GAMILLA, 2021; JOHN, 2021). Além disso, avanços na tecnologia da informação e maior acesso a dispositivos móveis e à internet (SETIANI; PRATIWI; KUSUMAWATI, 2023) têm acompanhado estilos de vida mais agitados ou a necessidade de conveniência (SUREEYATANAPAS; DAMAPONG, 2024).

As *dark kitchens* ganharam destaque, principalmente devido à necessidade de redução de custos operacionais enfrentada por muitos restaurantes durante a pandemia (SUREEYATANAPAS; DAMAPONG, 2024). Nos Estados Unidos, esse aumento foi marcado pela abertura da grande cadeia de supermercados Whole Foods, que optou por adotar esse novo modelo de estabelecimento sem atendimento direto ao cliente, mesmo após o fechamento temporário de várias lojas físicas (SHAPIRO, 2023). Embora a Whole Foods seja considerada uma loja física, o princípio das *dark kitchens* é semelhante, ou seja, esse tipo de serviço não oferece atendimento direto ao cliente e aceita apenas pedidos *online* (SHAPIRO, 2023).

Assim, pode-se concluir que a evolução das *dark kitchens* está intrinsecamente ligada à necessidade de adaptação do setor a novas tecnologias, emergências de saúde, demandas econômicas e mudanças nas preferências dos consumidores. Além de terem ganhado mais espaço e relevância após a pandemia da COVID-19, prevê-se que esse modelo de negócio seja duradouro e continue em destaque nos próximos anos (KULSHRESHTHA; SHARMA, 2022; NAVARRETE; APARICIO; ROSADO, 2022; SHAPIRO, 2023).

Até o ano de 2030, estima-se que aproximadamente 50% de todos os serviços de alimentação em escala global adotarão o modelo de *dark kitchen* (STATISTA, 2023b), evidenciando uma mudança significativa nas práticas convencionais do setor. Este movimento é respaldado pela projeção do tamanho

do mercado global de *dark kitchens*, que atingiu a estimativa de U$ 56,71 bilhões em 2021 e apresenta uma previsão de crescimento substancial, alcançando a marca de U$ 112,53 bilhões até o ano de 2027 (STATISTA, 2024). O crescente reconhecimento e implementação das *dark kitchens* destacam a ascensão e a consolidação desse modelo inovador como uma força significativa no cenário global.

2.4. Definições de *dark kitchen*

As *dark kitchens* têm sido abordadas por diferentes nomenclaturas, como *cloud kitchen,* cozinha virtual, *ghost kitchen,* cozinha invisível, cozinhas compartilhadas (CHATTERJEE; SINGH; SINGH, 2022; DIAN et al., 2021; JOHN, 2021; UPADHYE; SATHE, 2020) e, ainda que já desempenhem um papel significativo nos serviços de alimentação, a literatura acadêmica ainda carece de uma clara conceitualização e definição para este fenômeno emergente. Entretanto, mesmo diante dessa diversidade de termos, a expressão *dark kitchen* tem ganhado destaque em relatórios, literatura acadêmica, reportagens e outras formas de divulgação na mídia (KER, 2022). Da Cunha et al. (2024) organizou as definições encontradas na literatura (Tabela 1).

Tabela 1 – Definições e fontes de diferentes nomes para *dark kitchens*. Reimpressa e traduzida de “Dark kitchens: Origin, definition, and perspectives of an emerging food sector”, por Da Cunha et al., 2024, International Journal of Gastronomy and Food Science.

Source	Name	Definition
Asri et al., 2022	*Ghost kitchen*	Um tipo de restaurante que oferece entrega online e retirada.
Olopade, 2021	*Ghost kitchen* (*virtual* ou *cloud kitchens*)	Instalações projetadas exclusivamente para pedidos de *delivery*.
IWA 40, 2022	*Virtual kitchen*	Espaço de cozinha comercial sem opção de refeição no local ou varejo que fornece um serviço de *catering* centralizado, padronizado e digitalizado com instalações de suporte de *hardware e software* ou recursos do local para várias restaurantes virtuais compartilharem recursos para operações de *catering*.
Idris et al., 2023	*Cloud kitchen*	Uma ideia de uma área de cozinha comercial que permite retirada sem refeições no local, muitas vezes por meio de chamadas e plataformas *online*.
Syafiq et al., 2022	*Cloud kitchens (ghost kitchens, virtual kitchens, dark kitchens, or invisible kitchens)*	Restaurantes que não oferecem serviço de refeição no local e, em vez disso, dependem de pedidos *online* via agregadores de comida *online* e *site* ou aplicativo móvel do restaurante.
Hakim et al., 2022	*Dark kitchens*	Restaurantes sem fachadas, sem interação direta com o cliente e cozinhas comerciais apenas para *delivery* que alugam espaços de cozinha compartilhados ou privados para negócios de alimentação.
Kaavya & Andal, 2023	*Cloud kitchen* (*virtual* ou *ghost kitchens*)	Uma forma de serviço de entrega de alimentos em que os consumidores têm suas refeições produzidas em uma cozinha de restaurante tradicional e depois as enviam para suas casas ou locais de trabalho. Um modelo de negócio de serviço de alimentação em que as refeições são preparadas em uma cozinha comercial e depois entregues diretamente aos clientes.
Bradshaw, 2019	*Dark kitchen*	Uma instalação separada (às vezes temporária) de restaurante que produz alimentos para serviços de *delivery*.
Kania-Baran, 2020	*Dark kitchen*	Um espaço compartilhado que é normalmente usado por vários ou mais restaurantes/estabelecimentos de refeições para preparar e distribuir pedidos online.

A origem do termo *dark kitchen* está associada ao conceito de "*dark stores*", locais utilizados para armazenar e despachar produtos vendidos *online*, exemplificados pela empresa Amazon (SHAPIRO, 2023). Nesse contexto, as *dark kitchens* assemelham-se a esses espaços por não possuírem uma presença física destinada ao atendimento ao cliente. A metáfora presente na expressão *ghost kitchen* reflete tanto a invisibilidade dessas instalações quanto o esvaziamento simbólico, sugerindo que se trata de um restaurante desprovido de mesas, cadeiras, clientes ou garçons (TOZI, 2021). Já o termo *cloud kitchens* estabelece um paralelo com o conceito da área da computação de "armazenamento em nuvem", representando um ambiente desconhecido, mas

que proporciona acesso ao conteúdo de interesse (MISHRA, 2014). Essa analogia destaca a limitação do acesso dos clientes a plataformas de pedidos online, enquanto as infraestruturas físicas permanecem ocultas.

A diversidade terminológica atual também pode impactar a percepção do consumidor, uma vez que o termo "*dark*", traduzido para o português como escuro, possui conotações simbólicas negativas, associadas a elementos como "ruim", "triste", "dor", "medo" e "perigo" (SÃO PAULO, 2021). Dada a falta de familiaridade do público em geral com as *dark kitchens*, o primeiro contato por meio desse termo, acaba por contribuir para a influência significativa do aspecto simbólico da linguagem cotidiana sobre a imaginação coletiva. O mesmo pode ocorrer com aqueles que têm conhecimento sobre o modelo de negócios, pelo fato de a maior parte das pessoas possuir informações fragmentadas e não uma clareza fidedigna sobre estes restaurantes.

Khan (2020) definiu *dark kitchens* como espaços que não estão localizados em restaurantes, mas sim em estabelecimentos alugados ou compartilhados, sem sala de jantar ou área de atendimento. No entanto, diferenças fundamentais entre as descrições de vários autores persistem, refletindo muito mais do que apenas uma divergência terminológica e acabam por trazer à luz as diferentes formas operacionais entre as instalações de *dark kitchens*. Alguns estudos definem *dark kitchens* como espaços de *coworking*, grandes locais com *design* atrativo onde tarefas são realizadas conjuntamente ou colaborações ocorrem. Essa classificação, no entanto, deve ser usada com cautela, por possivelmente não abranger todas as possibilidades do modelo de *dark kitchens*.

Para elucidar essa terminologia, a *International Organization for Standardization* (ISO) publicou diretrizes em 2022, diferenciando algumas nomenclaturas. Nessa perspectiva, *virtual kitchen* consolidou-se como uma instalação comercial de preparação de alimentos sem serviço local ao público, fornecendo um serviço de *catering* centralizado, padronizado e digitalizado, com suporte de *hardware* e *software* ou recursos compartilhados no local para cozinhas virtuais. Em contrapartida, *virtual restaurant* refere-se a empresas principais que conduzem atividades de *catering* por meio de uma cozinha virtual (IWA 40, 2022).

Alguns autores buscam classificar os diferentes modelos de gestão de *dark kitchens* sob as diferentes denominações apontadas anteriormente. No entanto, a literatura carece de clareza, deixando a decisão de como classificar os modelos a critério de cada autor. Essa falta de precisão na conceitualização não contempla a diversidade terminológica, organizacional e técnica desses serviços. Ademais, poucos artigos documentam as origens, especificidades e contexto em que cada nomenclatura é empregada, complicando a análise e a construção de uma compreensão coletiva sobre *dark kitchens*.

Da Cunha et al. (2024), com base nas definições existentes na literatura propôs uma definição mais abrangente, incluindo as características do modelo, localização, e dinâmica de gestão das *dark kitchens:*

> *"Dark kitchens são modelos de food service que oferecem refeições prontas para entrega ou retirada, solicitadas por telefone, aplicativos de entrega de comida, sites ou redes sociais. Esses locais podem ou não ter fachada, mas não possuem ou oferecem espaço para a realização das refeições no local. As dark kitchens podem estar em locais independentes, franquias, espaços compartilhados, dentro de outros restaurantes ou até mesmo em domicílios. As dark kitchens também podem ser conhecidas como cloud kitchens, cozinhas fantasmas, invisíveis, compartilhadas, satélites, virtuais ou cibernéticas"*

2.5. Escolha dos consumidores frente às *dark kitchens*

Compreender os sentimentos do consumidor é essencial, pois vários fatores estão envolvidos nas escolhas alimentares, incluindo fatores econômicos e práticos (FURST et al., 1996; MARSOLA et al., 2020). A qualidade do alimento servido é um importante motivador de escolha para consumidores, salientando que estes são aspectos de extrema importância para que haja preferência pelo estabelecimento, e assim contribuindo para que ele se mantenha em funcionamento (HAN; HYUN, 2017). Durante o pico da pandemia da COVID-19, o consumidor se sentiu mais motivado a frequentar restaurantes onde ele se sentia seguro (HAKIM; ZANETTA; DA CUNHA, 2021b). Mas as questões de qualidade vão além da importância econômica e têm relação direta com a segurança e minimização de riscos do consumidor. A ausência de qualidade em

serviços de alimentação pode ser observada pela presença de alimentos contaminados que podem transmitir doenças, conhecidas como Doenças Transmitidas por Alimentos (DTA).

As DTA são marcadas por um quadro clínico de vômitos e diarreias, podendo apresentar também dores abominais, dores de cabeça, febre, alteração na visão, olhos inchados, diarreia sanguinolenta, insuficiência renal aguda e morte (BRASIL, 2010). Além das DTA serem consideradas um problema mundial (OMS - ORGANIZAÇÃO MUNDIAL DE SAÚDE, 2002), no Brasil, mesmo havendo subnotificação dessas doenças, entre 2000 e 2017 houve 236.403 doentes e 2.340.201 de expostos considerando os surtos notificados (NOTIFICAÇÃO, 2018). As ações que contribuem para minimizar a probabilidade de ocorrência de uma DTA são chamadas boas práticas de manipulação de alimentos. Para a regulamentação das boas práticas, existem legislações específicas. No Brasil, a legislação que exige e orienta essas práticas, no âmbito federal, é a resolução RDC 216 de 2004 (BRASIL, 2004), e no estado de São Paulo a legislação vigente é a portaria CVS-5 de 2013 (SÃO PAULO, 2013). A adequação do serviço de alimentação referente à legislação sanitária é um indicador direto de segurança dos alimentos.

Apesar da *dark kitchen* se tratar de uma alternativa mais rápida e com menor custo de operação em comparação às cozinhas tradicionais devido à minimização dos gastos com mão de obra, aluguéis de pontos comerciais mais baratos e a não necessidade de estrutura de salão, esse tipo de empreendimento pode oferecer riscos sanitários devido a falhas na infraestrutura e modo de operação dos funcionários (ABRASEL - ASSOCIAÇÃO BRASILEIRA DE BARES E RESTAURANTES, 2020b). Ainda que exista uma legislação que exija o licenciamento dos estabelecimentos popularmente conhecidos como *dark kitchens* na cidade de São Paulo – decreto nº 61.376, de 31 de maio de 2022 (SÃO PAULO, 2022), o fato de serem negócios fáceis de serem iniciados, somados a ausência de fachada do estabelecimento, cria uma lacuna no sistema de vigilância sanitária, dificultando a fiscalização correta pelos órgãos sanitários e pelos aplicativos de entrega, possivelmente possibilitando a existência de cozinhas sem padrão de qualidade, deixando o consumidor mais exposto a riscos de contaminação causada por alimentos (ABRASEL - ASSOCIAÇÃO BRASILEIRA DE BARES E RESTAURANTES, 2020b). Além disso, uma vez que

a pressão social encoraja boas práticas (CLAYTON; GRIFFITH; PRICE, 2003), a falta de fachada e do atendimento direto ao consumidor pode minimizar a pressão social dos clientes, podendo mitigar ações, estrutura e práticas em prol da segurança dos alimentos.

Ademais ao risco que possa existir nas *dark kitchens,* é importante entender como os consumidores percebem esse risco e se isso afeta a aceitação e percepção dessas pessoas em relação a esse modelo de negócio. Ainda que existam poucos estudos que buscam compreender as *dark kitchens*, alguns autores mostraram que os consumidores parecem valorizar positivamente a qualidade dos alimentos, sem comprometer a segurança dos alimentos, a sustentabilidade e a conveniência (CAI; LEUNG; CHI, 2022; CHATTERJEE; SINGH; SINGH, 2022; KULSHRESHTHA; SHARMA, 2022; ONGKASUWAN et al., 2022). Pelo fato do consumidor não poder ver as refeições e o estabelecimento propriamente dito previamente à sua escolha, uma vez que o primeiro olhar de julgamento é para um ambiente virtual, o processo de decisão de compra e aceitação do restaurante é construído de uma forma diferente dos restaurantes que independem do uso de tecnologia para a venda (VENKATESH et al., 2003; VENKATESH; THONG; XU, 2012). Nesse sentido, aspectos como o controle de qualidade e conveniências oferecido pelo aplicativo e a experiência do consumidor (RAY et al., 2019) são medidas importantes a serem consideradas na compreensão das percepções de consumidores, além de fatores já conhecidos como relevantes quando trata-se de restaurantes tradicionais, segurança no restaurante e sua marca, percepção de ajuda ao comércio e confiança nas instituições governamentais (HAKIM et al., 2020; HAKIM; ZANETTA; DA CUNHA, 2021b).

Ainda, o fato das *dark kitchens* serem um produto gerado em meio às rupturas que levam a mudanças de modelo de mercado, pode haver uma tendência de um desempenho inferior aos já estabelecidos convencionalmente ou podem se aprimorar rapidamente para conquistar seu espaço no comércio (GANS, 2016). A inovação de serviços motivados por avanços tecnológicos tem efeitos significativos na experiência do cliente e sua intenção comportamental futura (SU, 2011). Portanto é importante a compreensão dos fenômenos de consumo com olhar atento para os aspectos observados em produtos que envolvem tecnologia em sua venda (VENKATESH; THONG; XU, 2012), uma vez

que o consumidor que possuir um conjunto favorável de condições é mais propenso ao uso dessa tecnologia.

Além disso, a inovação de serviços motivados por avanços tecnológicos tem efeitos significativos na experiência do cliente e sua intenção comportamental futura (SU, 2011), portanto, deve-se atentar para uma prestação de serviços eficiente. Em plataformas online, a confiança e confiabilidade dos clientes é revertida em *feedback*, e a satisfação desse cliente impulsiona novas recomendações dos estabelecimentos e aumenta a intenção do consumidor de voltar a ter interesse pelo serviço e até mesmo recomendá-lo (SHARMA; KUMAR, 2019).

3 OBJETIVOS

3.1. Objetivos gerais

- Identificar e avaliar a localidade das *dark kitchens*;
- Avaliar os fatores que influenciam a disposição em pagar por refeições produzidas em *dark kitchens;*
- Avaliar o conhecimento dos consumidores no Brasil, Polônia e Reino Unido sobre *dark kitchens*.

3.2. Objetivos específicos

- Localizar estabelecimentos que possuem o perfil de *dark kitchen* nas cidades de Campinas – SP, Limeira – SP e São Paulo – SP;
- Identificar o pacote de serviço dos restaurantes reconhecidos como *dark kitchens*;
- Averiguar a localização geográfica das *dark kitchens* e sua distância das áreas centrais da cidade onde o estabelecimento é localizado;
- Avaliar potenciais modelos de *dark kitchens;*
- Identificar variáveis associadas ao conhecimento e percepção dos consumidores em relação às *dark kitchens* no Brasil; Polônia e Reino Unido;
- Identificar o perfil do consumidor de refeições por *delivery* de restaurantes tradicionais e de *dark kitchens*;
- Avaliar a percepção de *dark kitchens* em diferentes culturas.

4 MÉTODOS

4.1. Tipo de estudo

Foi realizado um estudo exploratório dividido em três grandes etapas: 1) georeferenciamento de *dark kitchens* nas cidades de Limeira – SP, Campinas – SP, e São Paulo – SP; 2) conhecimento e intenções de consumidores; identificação no Brasil; e 3) conhecimento e intenções de consumidores na Polônia, Reino Unido e Brasil. A pesquisa tem abordagem quanti-qualitativa.

4.1.1. Etapa 1 - Identificação das dark kitchens

4.1.1.1. Métodos

A coleta de dados foi realizada em duas etapas: i. etapa automatizada e ii. etapa manual. Na etapa automatizada, os dados foram coletados por meio do site da plataforma Ifood® (https://www.ifood.com.br/), aplicativo de *delivery* de comida e operadora de *delivery* de comida mais utilizado no Brasil (CHEVALIER, 2022b). O Ifood® possui mais de trezentos mil serviços de alimentação com mais de sessenta milhões de pedidos por mês em mais de 1.700 cidades do Brasil (IFOOD, 2021) e é o aplicativo de entrega de comida mais utilizado no Brasil (CHEVALIER, 2022a).

4.1.1.2. Etapa Automatizada

A etapa automatizada foi realizada por meio de mineração de dados para extrair informações de páginas públicas da internet. Foram utilizados dois scripts em Python para acessar o conteúdo desejado, utilizando o padrão de representação JSON (JavaScript Object Notation) (Apêndice A).

A coleta de dados foi feita considerando os restaurantes listados no site Ifood® das cidades de Limeira, Campinas e São Paulo <www.ifood.com.br>. As cidades são todas do estado de São Paulo, o maior e mais desenvolvido estado do Brasil. As cidades foram selecionadas com base nas classificações estabelecidas pela REGIC (Regiões de Influência das Cidades). Limeira é Centro Sub-regional B (308.482 habitantes), categoria destinada às cidades que exercem influência nos municípios circunvizinhos. Campinas é uma metrópole (1.223.237 habitantes), classificação para centros urbanos de grande centralidade que abrangem diversos territórios e possuem um contingente

populacional relevante - mais de 2 milhões de habitantes - e é a única capital não estatal com esta classificação no Brasil. Por fim, São Paulo é uma Grande Metrópole Nacional (12,3 milhões de habitantes), única cidade brasileira com essa classificação, com a maior hierarquia urbana do país (IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2018).

Dos scripts foram extraídas as seguintes informações: URL (*Uniform Resource Locator*) do restaurante, nome do restaurante, distância linear do restaurante ao centro da cidade (como endereço inicial da busca), tempo estimado de entrega, avaliação do restaurante fornecido pelos usuários (escala de 5 pontos onde '1' é 'ruim' e '5', 'excelente'), número de usuários que avaliaram o restaurante, classificação de preço (escala de 5 pontos onde '1' é 'mais barato' e '5' é 'mais caro' – essa classificação é feita automaticamente pela plataforma), categoria do restaurante (ou seja, tipo de comida oferecida), informações de endereço, número do CNPJ (Cadastro Nacional de Empresas) do restaurante, se o restaurante aceita agendamento de entregas e retiradas de pedidos, e se o restaurante permite o rastreamento da localização do pedido até sua entrega utilizando a logística disponibilizada pelo próprio iFood®. Todo restaurante cadastrado no iFood® deve ter CNPJ, ou seja, deve estar cadastrado como restaurante em órgãos públicos. Os pontos geograficamente centrais das cidades designadas para a busca foram: Limeira, Rua Boa Morte 500–576 – Centro, Limeira – SP (CEP 13480–181); em Campinas, Avenida Francisco Glicério 1000 – Centro, Campinas – SP (CEP 13012–100); e em São Paulo, Praça Cel. Fernando Prestes – Bom Retiro, São Paulo – SP (CEP 01124–060). Esses endereços foram escolhidos por estarem geograficamente localizados no centro das respectivas cidades.

4.1.1.3. Etapa manual

A segunda etapa foi realizada manualmente para avaliar se os restaurantes poderiam ser *dark kitchens*. Essa etapa foi realizada com os primeiros 1.000 restaurantes de cada uma das cidades de Limeira (85,4% do total de restaurantes disponíveis no alicativo de *delivery* de comida), Campinas (47,8% do total) e São Paulo (6% do total). As *dark kitchens* foram classificadas de acordo com os pressupostos de KHAN (2020), ou seja, serviços de alimentação sem atendimento local ao público, que oferecem refeições

transportadas por *delivery* e onde não há contato direto com o consumidor. Foram incluídos neste contexto imóveis domiciliários, alugados ou partilhados, comuns a este tipo de negócio. Foram excluídos os estabelecimentos que não eram exclusivamente de alimentação (farmácias, supermercados, floriculturas, lojas de conveniência etc.).

Esta etapa foi conduzida de forma investigativa e exaustiva. Primeiramente foi utilizado o Google® Street View para visualizar a vitrine do estabelecimento, e foi feita uma avaliação da informação disponível sobre os estabelecimentos nas redes sociais e nas buscas no Google. Nos casos em que os dados recolhidos foram insuficientes, foi realizado um processo de verificação em três etapas para contactar diretamente os estabelecimentos, ou seja, através de (i) telefone, (ii) e-mail e (iii) redes sociais disponíveis. Essa abordagem foi importante para buscar informações além da visualização virtual da vitrine do estabelecimento, pois alguns dados do Google Street View podem estar desatualizados devido à abertura de novos estabelecimentos que não foram incluídos na última atualização do Google Maps. Com base nessas informações e na definição de *dark kitchens* de KHAN (2020), os restaurantes foram classificados de acordo com os critérios da abaixo:

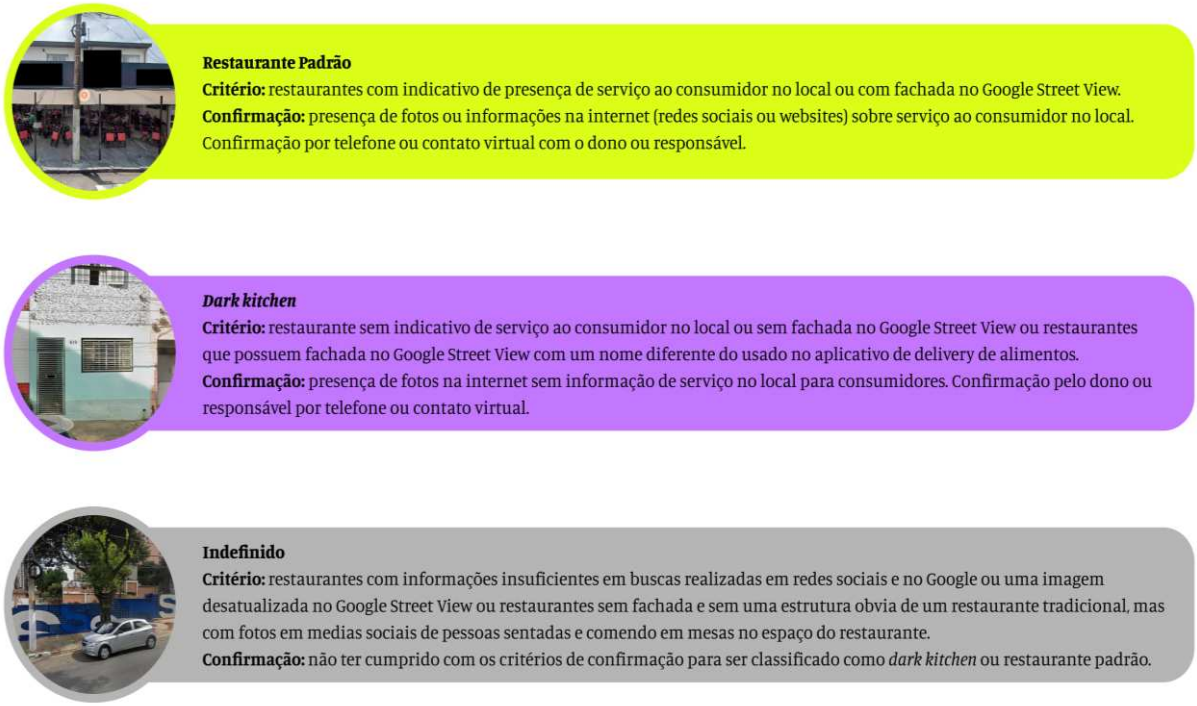

Figura 1 - Critérios de classificação de restaurantes padrão, *dark kitchen* e indefinido.

A coleta de dados foi realizada entre dezembro de 2020 e janeiro de 2023. Para testar a adequação da metodologia, a coleta automática de dados foi realizada pela primeira vez em 20 de dezembro de 2020 referente à cidade de Limeira e uma avaliação manual foi realizada em 2021. Concluída esta etapa e confirmada a metodologia proposta, pesquisas automatizadas foram realizadas nas cidades de Campinas e São Paulo em 11 de janeiro de 2022. Os dados encontrados foram analisados manualmente até 3 de janeiro de 2023.

No Ifood®, os restaurantes são divididos de acordo com as categorias de alimentos à venda. Essas categorias são utilizadas para ajudar o consumidor a entender melhor o que o restaurante tem a oferecer, ou mesmo para filtrar suas buscas de acordo com seus interesses. Devido à grande variedade e superespecificação dos tipos de alimentos, foram criadas seis categorias: i. Comida Brasileira (Brasileira, Carnes, Congelados, Frango, Marmita, Peixes, Comida Saudável, Sopas e Caldos, Variada, Congelados, Frutos do Mar, Pratos Típicos de diversos estados brasileiros, Panquecas, Categorias Vegana e Vegetariana), ii. Comida Étnica (categorias Árabe, Chinesa, Contemporânea, Francesa, Italiana, Mexicana, Africana, Alemã, Argentina, Asiática, Colombiana, Coreana, Espanhola, Grega, Indiana, Mediterrânea, Peruana, Portuguesa, Tailandesa e Yakisoba); iii. Lanche (categorias Hambúrguer, Lanche, Pastel, Salgado, Tapioca [alimento composto por farinha granulada e branca, parecidos com o arroz, proveniente da mandioca] e Crepe); iv. Pizza (incluindo apenas pizzarias); v. Sobremesas (categorias Açaí, Doces e Bolos e Sorvetes); e vi. Padaria e cafeteria (categorias Padarias, Lanchonete e Sucos). As categorias foram agrupadas de forma independente por dois pesquisadores e posteriormente discutidas até chegar a um consenso.

4.1.1.4. Georreferenciamento

Após a coleta de dados, todos os restaurantes foram representados graficamente por meio do software Power BI (Microsoft - EUA). Os restaurantes classificados como '*dark kithen*', 'restaurante padrão' e 'indefinido' foram claramente identificados, assim como o ponto central de cada cidade. Todos os restaurantes foram plotados usando coordenadas de longitude e latitude usando graus decimais variando de -90 a 90 para latitude e -180 a 180 para longitude.

A densidade no centro foi calculada considerando todas as *dark kitchens* e restaurantes padrão num raio de 5 km² do centro. O número total de restaurantes foi dividido por 5 para padronizar a medida em quilômetros quadrados (km²).

Uma zona tampão foi criada em torno dos limites de cada centro da cidade. Como as cidades diferiam significativamente em tamanho e população, foram criados buffers diferentes: 2,5 km² para Limeira, 3,4 km² para Campinas e 5,8 km² para São Paulo. Esses valores foram a distância mediana do ponto central da cidade. Correspondem também a aproximadamente 1% do tamanho da área urbana de cada cidade. Buffers variando de 800 m a 5 km foram utilizados em estudos anteriores que avaliaram a densidade e proximidade de lojas de alimentos (MAGUIRE et al., 2017; THORNTON et al., 2012; TURRELL; GISKES, 2008).

4.1.1.5. Classificando modelos de dark kitchens

Os modelos de *dark kitchens* foram ainda classificados com base em dados coletados nos sites, plataforma Ifood®, Google Street View e mídias sociais. Os dados coletados dos restaurantes citados nos métodos de etapas automatizadas foram inseridos em uma planilha. Foi adicionada uma coluna para observações sobre *dark kitchens* e suas características (por exemplo, o tipo de fachada e informações públicas sobre o restaurante). A análise dos dados seguiu os princípios da análise de conteúdo temática, método qualitativo que compreende técnicas de agrupamento e categorização com base em significados semelhantes ou intersecções de características (BARDIN, 2016).

Na análise qualitativa, as *dark kitchens* foram classificadas com base na presença ou ausência de vitrine, endereço, características de infraestrutura, informações do cardápio, número do CNPJ, informações públicas na internet e contato direto com o estabelecimento (por telefone, e-mail ou através das redes sociais).

4.1.1.6. Análise de dados

As distribuições teóricas das variáveis quantitativas foram analisadas por meio de médias, variâncias, assimetria, curtose e histograma. O teste de Kolmogorov-Smirnov (com correção de Lillefors) foi utilizado para verificar a

normalidade dos dados. Para comparar dois grupos independentes (restaurantes padrão e *dark kithcens*), foi utilizado o teste t-Student. As correlações foram feitas pelo coeficiente de correlação de Pearson. Foram construídos três modelos de regressão logística, um para cada cidade, sendo Limeira, Campinas e São Paulo. A variável dependente foi a presença de *dark kitchens* na zona tampão. As variáveis independentes foram incluídas no modelo múltiplo após apresentarem valores significativos no modelo único. O valor exponencial do beta foi utilizado para estimar o odds ratio (OR). A qualidade do ajuste foi medida usando o teste de Hosmer e Lemeshow. O procedimento *bootstrap* com 1.000 amostras foi utilizado quando apropriado para normalizar os dados. A qualidade do bootstrap foi medida analisando os intervalos de confiança de 95%.

As análises estatísticas foram realizadas utilizando o software Statistical Package for Social Sciences (SPSS) v.20. Para todas as análises foram considerados significativos valores de $p < 0,05$.

4.1.2. Etapa 2 - Conhecimento e intenções do consumidor no Brasil

4.1.2.1. Amostra e coleta de dados

A coleta de dados foi feita virtualmente por meio da Plataforma Google Forms (Alphabeth Inc. Mountain View - U.S.). Primeiramente, realizou-se um teste piloto com dez consumidores para determinar a compreensibilidade do questionário e o tempo médio de resposta dos participantes (≅ 10 minutos). Redes sociais foram utilizadas para convidar os participantes. Também foram enviados convites por *e-mail.* Amostra de referência não probabilística foi usada. Utilizando o método da raiz quadrada inversa (KOCK; HADAYA, 2018) com uma significância de 5% e coeficiente de caminho de 0.10, foi necessária uma amostra de 619 indivíduos. Foram coletados 629 questionários no período de 10 de fevereiro a 21 de março de 2022. Todos os participantes deveriam ser brasileiros e maiores de 18 anos. A variância entre as variáveis indicadoras foi verificada para cada participante. Seis casos de variância=0 foram excluídos (MAT RONI; DJAJADIKERTA, 2021). Todos os participantes assinaram eletronicamente um Termo de Consentimento Livre e Esclarecido (TCLE) (Apêndice B) aprovado pelo Comitê de Ética em Pesquisa da UNICAMP (CAAE: 42944221.4.0000.5404) (Apêndice C).

4.1.2.2. Medidas

A primeira parte do questionário avaliou o conhecimento e a percepção dos consumidores sobre *dark kitchens*. Os participantes foram questionados: "Você conhece ou já ouviu falar dos termos '*dark kitchen*', *'cloud kitchen'*, 'cozinha fantasma' ou 'cozinha virtual'?" Os participantes poderiam responder 'sim, eu sei', 'sim, eu ouvi' ou 'não'. Aqueles que responderam 'sim, eu sei' foram então questionados: "A que esse termo se refere?". Eles foram instruídos a descrever o que achavam mais apropriado, dando uma resposta aberta. Em seguida, foi apresentada aos participantes a definição da expressão *dark kitchen* utilizada neste estudo (Figura 2) (FORBES, 2020; ORACLE, 2022; RINALDI; D'AGUILAR; EGAN, 2022).

Figura 2 – Definição de dark kithchen apresentada aos participantes na etapa 2.

Na segunda fase do estudo, foi aplicado um questionário (Apêndice D) para testar hipóteses sobre a disposição de pagar por refeições preparadas em *dark kitchens*. Como este é o primeiro estudo a abordar a percepção do consumidor sobre *dark kitchens*, o questionário foi composto por 26 itens adaptados de diferentes estudos. Os itens correspondem a sete constructos: disposição de pagar e intenção de compra, confiança nas autoridades de saúde,

confiança no aplicativo de entrega de alimentos, segurança dos alimentos percebida, controle de qualidade, experiência do consumidor e solidariedade com o setor de alimentação. Os indicadores foram medidos por meio da escala Likert de cinco pontos adaptada a cada tipo de afirmação, variando de 1 (totalmente disposto/totalmente desconfiado/totalmente discordo) a 5 (totalmente disposto/totalmente confia/totalmente concordo). Por fim, na terceira e última fase do questionário, foram feitas oito perguntas sobre as características sociodemográficas dos participantes.

4.1.2.3. Análise de dados

A análise dos dados do texto (respostas abertas) foi realizada por meio do software *Interface de R pour les Multidimensionnelles de Textes et de Questionnaires* (IRaMuTeQ). The IRaMuTeQ software permite a quantificação de variáveis essencialmente qualitativas derivadas de dados não estruturados (i.e., textos) para descrever o material que vem de uma determinada pessoa ou grupo (CAMARGO; JUSTO, 2013). No geral, foram utilizadas duas análises textuais: (1) análise lexicográfica clássica para revisar estatísticas sobre o número de segmentos de texto, ocorrências, formas e hápax; (2) Classificação hierárquica descendente para detectar o dendrograma com as classes emergidas, onde quanto maior o valor do qui-quadrado ($\chi 2$), mais a palavra está associada à classe. Palavras com valor de $\chi 2 < 3,80$ não foram consideradas ($p < 0,05$).

Para testar o modelo de hipóteses, os indicadores foram primeiramente avaliados por análise fatorial confirmatória (CFA) usando mínimos quadrados com pesos diagonais. O qui-quadrado ($\chi 2$; $p < 0,05$), erro quadrático médio de aproximação (RMSEA <0,05), índice de ajuste comparativo (CFI > 0,90), resíduo quadrático médio padronizado (SRMR <0,08), índice Tucker-Lewis (TLI > 0,90), e índice de adequação (GFI >0.90) foram usados para testar o ajuste do modelo (KLINE, 2016).

A modelagem de equações estruturais de mínimos quadrados parciais (PLS-SEM) foi escolhida para testar as hipóteses. A técnica PLS-SEM é justificada onde a teoria é insuficientemente fundamentada (Henseler et al., 2009). Além disso, o PLS-SEM tem suposições menos rigorosas sobre a

normalidade das variáveis. O modelo de mensuração (a parte do modelo que descreve as relações entre as variáveis latentes e seus indicadores) foi avaliado por meio de cargas fatoriais (>0,40), confiabilidade composta (CR>0,80) e média de variância extraída (AVE>0,40). A correlação das razões heterotraço-monotraço (HTMT) foi usada para avaliar a validade discriminante (<0,85) (HAIR et al., 2016; HENSELER; RINGLE; SINKOVICS, 2009). A multicolinearidade foi avaliada usando o valor do fator de inflação da variância (VIF) (<5,0). O modelo estrutural (parte do modelo que descreve as relações entre as variáveis latentes) foi avaliado por meio da explicação da variância dos construtos endógenos, tamanho do efeito (f^2>0,15), e relevância preditiva (Stone-Geisser's Q^2 >0,15). Os tamanhos de efeito (f^2) foram classificados como pequeno (f^2≥0,02), médio (f^2≥0,15), ou grande (f^2 ≥0,35) (COHEN, 1988). Uma análise de *bootstrapping* com 5.000 amostras foi usada para estimar as estatísticas t e os valores de p (p<0,05) das cargas estimadas.

Não houve problemas com dados ausentes. O voluntário tinha que preencher todo o formulário antes do envio. As análises estatísticas foram realizadas usando Statistical Package for Social Sciences (SPSS) v.20 (IBM Corp. Armonk – U.S.), JASP 0.16.1 (University of Amsterdam), e SmartPLS v3.2.8 (SmartPLS GmbH. Bönningstedt - Germany) (RINGLE; WENDE; BECKER, 2015).

4.1.3. Etapa 3 - Conhecimento e intenções do consumidor em diferentes culturas

4.1.3.1. Amostra e coleta de dados

Os dados foram coletados virtualmente por meio da plataforma online Survey Monkey (SurveyMonkey Inc., San Mateo – EUA). Os dados foram coletados no Brasil, Reino Unido e Polônia. A amostra foi calculada pelo método da raiz quadrada inversa (KOCK; HADAYA, 2018) com nível de significância de 5% e coeficiente de caminho de pelo menos 0,15. Foi necessária uma amostra de 274 pessoas por país para estimar os coeficientes de trajetória.

Os convites aos participantes da pesquisa tiveram início em agosto de 2023 e foram enviados por meio de redes sociais e listas de e-mail. Um total de 926 questionários (Brasil = 310; Reino Unido = 306; Polônia = 310) foram

coletados até outubro de 2023. Todos os participantes deveriam ter mais de 18 anos e residir no Brasil, no Reino Unido e na Polônia. A amostra foi selecionada tendo em conta cotas para gênero (aproximadamente 60% mulheres), idade (aproximadamente 50% têm mais de 30 anos) e aproximadamente 50% usam *Food Delivery App* (FDA) pelo menos uma vez por semana. Para garantir a qualidade dos dados, foram excluídos os participantes com respostas monótonas (ou seja, desvio padrão igual a zero) em todos os indicadores (n = 6). Foram excluídos os participantes com dados incompletos no questionário principal (sobre *dark kitchens*). Respostas incompletas para dados demográficos foram consideradas ausentes.

Todos os participantes brasileiros e poloneses assinaram um termo de consentimento eletronicamente. O Comitê de Ética da Universidade Estadual de Campinas aprovou o estudo (10 de janeiro de 2022; número do protocolo: CAAE42944221.4.0000.5404) (Apêndice C) para realização no Brasil. Para a pesquisa na Polônia, os participantes assinaram o termo aprovado no Comitê de Ética da Universidade de Gdansk (Apêndice E). Os participantes britânicos não necessitaram assinatura, uma vez que, para o Reino Unido, esse tipo de pesquisa não necessita aprovação em comitê.

4.1.3.2. Medidas

O questionário foi aplicado anteriormente no estudo de Hakim et al. (2022). Primeiro, uma versão original em inglês do questionário foi revisada por todos os pesquisadores. Algumas pequenas adaptações foram feitas no questionário original e sua versão adaptada em português pode ser observada no apêndice F. Então, esta nova versão foi adaptada para português e polonês por falantes nativos com boa formação em inglês. Uma retrotradução foi feita para o inglês para garantir consistência, clareza e significado.

O questionário é composto por 36 perguntas. São 12 questões para determinar características sociodemográficas, comportamento habitual de compra em aplicativos de entrega de comida e conhecimento sobre *dark kitchens*. Existem duas questões de conhecimento, uma para autorrelato de conhecer ou não conhecer uma *dark kitchen* (conhecimento subjetivo), e outra

sobre a definição relatada de *dark kitchen* (conhecimento objetivo). No questionário original (HAKIM et al., 2022), o conhecimento foi questionado por meio de uma pergunta aberta. Devido a algumas limitações na comparação de diferentes linguagens e significados para o presente estudo, foi utilizada uma questão com possibilidade de múltipla escolha. Após as respostas a esta primeira etapa, foi apresentada a definição de *dark kitchen* (Figura 3). Em seguida, são apresentadas aos consumidores 24 afirmações relacionadas a sete construtos. Os construtos são confiança na vigilância sanitária, confiança em aplicativo de entrega de alimentos, segurança dos alimentos, controle de qualidade, experiência do usuário, responsabilidade social e disposição para comprar em *dark kitchens*. As afirmações foram medidas por meio de uma escala Likert de cinco pontos adaptada a cada tipo de afirmativa, variando de 1 (totalmente indisposto/desconfio totalmente/discordo totalmente) a 5 (totalmente disposto/confio totalmente/concordo totalmente).

Figura 3 – Definição de *dark kithchen* apresentada aos participantes na etapa 3.

4.1.3.3. Análise de dados

A modelagem de equações estruturais de mínimos quadrados parciais (PLS-SEM) foi escolhida para testar as hipóteses apresentadas anteriormente em (HAKIM et al., 2022) estudo.

O PLS -SEM tem suposições menos rigorosas sobre a normalidade, o que é diferente dos métodos baseados em covariância. Além disso, este

estudo testa um novo referencial teórico a partir de uma perspectiva preditiva, outra indicação de modelos PLS, diferente de teorias bem estabelecidas (HAIR et al., 2019a).

O modelo de mensuração (parte do modelo que descreve as relações entre as variáveis latentes e seus indicadores) foi avaliado por meio das cargas fatoriais (> 0,40), da confiabilidade composta (CR > 0,80) e da média da variância extraída (AVE > 0,50). Esta etapa foi realizada para toda a amostra e para cada país para garantir a qualidade dos dados. A razão das correlações heterotraço-monotraço (HTMT) foi utilizada para avaliar a validade discriminante (<0,85) (HAIR et al., 2016; HENSELER; RINGLE; SINKOVICS, 2009). A multicolinearidade foi avaliada pelo valor do fator de inflação da variância (VIF) (< 5,0). A análise multigrupo (MGA) utilizando mínimos quadrados parciais (PLS) foi realizada para testar se os dados dos países apresentam diferenças significativas nas estimativas dos parâmetros específicos do grupo. Neste caso específico gostaríamos de observar se o modelo completo difere entre os grupos. Primeiro, a invariância de medição foi testada usando MICOM (invariância de medição de modelos compostos). Para reduzir o erro familiar para esta análise específica foi considerado p = 0,05 / 3 (grupos) = 0,016.

O modelo estrutural (parte do modelo que descreve as relações entre as variáveis latentes) foi avaliado com base na explicação da variância dos construtos endógenos, tamanho do efeito (f2 > 0,15) e relevância preditiva (Q^2 de Stone-Geisser > 0,15). O tamanho do efeito foi classificado em pequeno ($f^2 \geq 0,02$), médio ($f^2 \geq 0,15$) ou grande ($f^2 \geq 0,35$) (COHEN, 1988). Um procedimento de *bootstrapping* com 5.000 amostras foi utilizado para estimar as estatísticas t e os valores de p das cargas estimadas. Todos os valores de p inferiores a 0,05 foram considerados significativos.

O teste qui-quadrado foi utilizado para testar associações e proporções entre diferentes países. As análises estatísticas foram realizadas utilizando JASP 0.16.1 (Universidade de Amsterdã) e SmartPLS v3.2.8 (SmartPLS GmbH. Bönningstedt - Alemanha) (RINGLE; WENDE; BECKER, 2015).

3.2. Aspectos éticos

O projeto foi aprovado pelo Comitê de Ética da Universidade de Gdanski para condução da pesquisa na Polônia e pelo Comitê de Ética em Pesquisa da UNICAMP (CAAE 42944221.4.0000.5404), após o cadastro da pesquisa no sistema Plataforma Brasil, segundo roteiro apropriado e em conformidade com a Resolução n° 466/2012, do Conselho Nacional de Saúde. No Reino Unido não foi exigido aprovação para o tipo de pesquisa abordada.

Importante ressaltar que o pesquisador principal possui licenças originais e vigentes dos softwares utilizados para a análise dos dados SPSS e MaxQDA oriundas de projetos de pesquisa vigentes ou encerrados.

5 RESULTADOS

Os resultados de cada etapa serão apresentados na forma de capítulos, sendo cada um dos capítulos referente a uma etapa desse trabalho.

CAPÍTULO 1

EXPLORING *DARK KITCHENS* IN BRAZILIAN URBAN CENTRES: A STUDY OF DELIVERY-ONLY RESTAURANTS WITH FOOD DELIVERY APPS

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Exploring *dark kitchens* in Brazilian urban centres: A study of delivery-only restaurants with food delivery apps

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Abstract

Dark kitchen is a delivery-only restaurant that operates without direct contact with the consumer, has no premises for local consumption and sells exclusively through online platforms. The main objective of this work is to identify and characterise *dark kitchens* in three urban centres featured in the most used food delivery app in Brazil. To this end, data collection was conducted in two phases. In the first phase, through data mining, we collected information from restaurants in three cities (Limeira, Campinas and São Paulo - Brazil) that were provided in the food delivery app. A total of 22,520 establishments were searched from the central point of each of the cities. In the second phase, the first 1,000 restaurants in each city were classified as *dark kitchens*, standard, or undefined restaurants. A thematic content analysis was conducted to further distinguish the *dark kitchen* models. Of the restaurants evaluated, 1,749 (65.2%) were classified as standard restaurants, 727 (27.1%) as *dark kitchens*, and 206 (7.7%) as undefined. In terms of the characteristics of *dark kitchens*, they were more dispersed and located further away from the central points compared to standard restaurants. Meals in *dark kitchens* were cheaper than in standard restaurants, and had a lower number of user reviews. Most of the *dark kitchens* in São Paulo served Brazilian dishes, while in the smaller cities, Limeira and Campinas, it was mainly snacks and desserts. Six different models of *dark kitchen* were identified: Independent *dark kitchen*; shell-type (hub); franchise; virtual kitchen in a standard restaurant (different menu); virtual kitchen in a standard restaurant (similar menu but different name); and home-based *dark kitchen*. The modelling approach and methodology used to classify and identify *dark kitchens* is considered a contribution to science as it allows a better understanding of this fast growing sector of the food industry. This in turn can help to develop management strategies and policies for the sector. Our study is also of value to regulators to determine their proliferation through urban planning and to promote appropriate guidelines for *dark kitchens* as they differ from standard restaurants.

Keywords: food service; cloud kitchen; virtual kitchen; ghost kitchen; food delivery.

1. Introduction

The use of food delivery apps is becoming more commonplace in people's everyday lives. As a result, the market for food delivery has grown exponentially in Brazil and worldwide in recent years (CREST; GRUPO, 2020; STATISTA, 2022b). This scenario has contributed to the emergence of a new trend in the food industry: *dark kitchens*. There are many names for *dark kitchens* such as: cloud or ghost kitchens, invisible, shared, commissary, satellite, virtual, or even cyber kitchens (CHATTERJEE; SINGH; SINGH, 2022; DIAN et al., 2021; JOHN, 2021; UPADHYE; SATHE, 2020). These food businesses are characterised by having no spaces for local consumption, no direct contact with the public and selling exclusively through online platforms (KHAN, 2020).

It is estimated that *dark kitchens* are not just a temporary solution. Sales are forecasted to reach USD 0.91 trillion in 2023 worldwide, with annual growth of 12.33% by 2027 (STATISTA, 2022b). According to Euromonitor projections, the global *dark kitchens* will potentially unlock USD 1.5 trillion opportunities by 2050 (EUROMONITOR, 2019). Although all *dark kitchens* showed high growth through increased sales, however, many experienced low market share averaging low to medium profits (SUSILOWATI; YUWONO; LEONNARD, 2021). So, food entrepreneurs who open a restaurant to sell food online may struggle to develop efficient strategies to make a profit. Based on the increased sales, *dark kitchens* still seem to be a promising business model. However, few studies look at how *dark kitchens* work, organize themselves and their management strategies. Previous studies were focused on determining consumers' preference or acceptance of *dark kitchens* (KHAN et al., 2022; KULSHRESHTHA; SHARMA, 2022) willingness to pay (HAKIM et al., 2022) and types of food and drinks sold (Rinaldi et al., 2022). However, despite the clear development of the phenomenon described, researchers emphasise that there is still a gap in studies on *dark kitchens*, especially in countries where *dark kitchens* are profilerating (CAI; LEUNG; CHI, 2022; KULSHRESHTHA; SHARMA, 2022). Several studies (quantitative, qualitative and mixed-method approaches) have been conducted on the markets in India, Indonesia, the US and the UK (KHAN et al., 2022) or in Italy and Poland (VARESE et al., 2023) on the prospects of *dark kitchens* and meal delivery apps, but few in the Brazilian market (HAKIM et al.,

2022). The role of consumers in understanding, buying and patronising *dark kitchens* is also unclear. Although recent studies have shown a positive willingness to buy food produced in *dark kitchens*, including in Brazil (CAI; LEUNG; CHI, 2022; HAKIM et al., 2022), there are some barriers to understanding consumers' intentions towards this restaurant model. The first issue is that consumers still do not really know what *dark kitchens* are (HAKIM et al., 2022).

The second issue is that the food delivery apps in Brazil are an obstacle in identifying these venues, as there is nothing on the user interface of these apps that distinguishes a standard restaurant from a *dark kitchen*. Therefore, even if a person knows about the existence of these food services, they cannot quickly identify them to make their choice. It is currently unknown what percentage of *dark kitchens* offer services in the various food delivery apps and countries. However, given the growing trend, it is essential to characterise this new food service sector and understand the role of *dark kitchens* in the food-consumer relationship.

Despite some classifications, we believe that *dark kitchens* in Brazil can have different features. With this in mind, we posed the following research questions: Q1: Where are these *dark kitchens* located in Brazilian urban centres? Q2: What features of *dark kitchens* differ from standard restaurants? Q3: What kind of food, cuisines and menus are offered in *dark kitchens* in Brazil? Q4: How is this kind of model organised in Brazil? Hence, the main objective of this work is to identify and characterise the *dark kitchens* in three urban centres that are featured in the most commonly used food delivery app in Brazil. Our research has implications for the body of scientific knowledge and practice. Achieving this goal and answering the questions will enable a better understanding of this rapidly growing sector and the role of *dark kitchens* in the relationship between food and consumers. Thus, data on the characteristics of *dark kitchens* could support further, more in-depth research to find out which model is most efficient and effective in meeting consumer demands. In terms of practical implications, we believe that the results of our research can help the government understand the impact of *dark kitchens* on the economy and public health. Next, the results of the study will provide food authorities with better information to ensure food safety, maintenance of cold chain during delivery, and essential information such

as food allergens are disclosed (SOUTHEY, 2021). The answers will also be used to understand the spatial pattern and agglomeration of the *dark kitchens* (SAFIRA; CHIKARAISHI, 2022). On the other hand, the growth trend of this industry is pushing for knowledge that can serve as a basis for regulating the sector. Currently, only one city in Brazil (São Paulo) regulates *dark kitchens* (BRASIL, 2022), which differs from standard restaurants. This work attempts to explore the *dark kitchens* in Brazil in an innovative way. Currently, there is no clear method to identify *dark kitchens*. Therefore, we combined several technological strategies to explore the *dark kitchens* in the most used food delivery app in Brazil. The proposed method is suited to identify food services that were not advertised or easily identified as *dark kitchens* in food delivery apps or company websites.

2. Dark kitchens - literature review and contextual background

In recent years, the food delivery market, which includes services that deliver food ordered through very different channels for direct consumption, has gained popularity worldwide. This phenomenon refers to the restaurant-to-consumer delivery segment, which includes food delivery made directly by restaurants for orders placed through platforms (platform-to-consumer delivery), as well as through restaurants' websites, apps and social media, or by phone/email (NIGRO et al., 2023).

Food delivery systems have a long history, and one of the oldest originated in Korea in the 14th century (TORRES, 2021). Researchers also cite an example from Italy, from 1889, when Italian King Humberto and Queen Margherita asked taverna owner Raffaele Esposito to bring them pizza to the palace (GAMILLA, 2021). Soon after, in 1890, during the British colonial period, another system known as Dabbawala (a lunchbox delivery and return system) was established in India, to provide the British population with non-local food (MAHADEVAN, 2021). Dark kitchen, on the other hand, is a recent phenomenon supported by the evolution of food delivery systems and technological development in the early 2010s. This phenomenon arose in response to increased demand for high-quality meal delivery and rising rents in city center locations (SISODIA; NAIR, 2021). These kitchens have lower opening and maintenance costs than a standard restaurant due to their simpler structure and are therefore attractive from an economic perspective (GIOUSMPASOGLOU; LADKIN; MARINAKOU, 2023; RESTAURANT OWNER, 2020). The possibility of the emergence of this business model arose with the creation of mobile applications as a solution to the population's need for easy shopping (SMITH; NG; POPKIN, 2013). COVID -19 accelerated the growth of *dark kitchens* as a reflection of the economic destabilisation at the time. During the worst of the pandemic, when people stayed at home, restaurants were forced to close their doors, creating the need for alternative outlets (CHANG et al., 2021b; TALWAR et al., 2021). Later, when shops reopened, there was still a barrier for many consumers to avoid restaurants for fear of contracting COVID -19 (HAKIM; ZANETTA; DA CUNHA, 2021c).

Although the sector is recognised by many names, there is neither a clear definition nor an established industry conversation (KHAN, 2020). In this sense, there have been efforts in recent years to improve the sector, including its terminology and definitions. For example, the International Organisation for Standardisation (ISO) has recently published guidelines on the subject described, distinguishing the terms "virtual kitchen" and "virtual restaurant" as follows (IWA 40, 2022): virtual kitchen - commercial cooking space without a dine-in or retail option that provides a centralised, standardised and digitised catering service with hardware and software support facilities or site resources for multiple virtual restaurants to share resources for catering operations; virtual restaurant - main body that carries out catering business activities through a virtual kitchen and that includes individuals, enterprises and other organisations. Several classifications of kitchen models can be found in the literature, taking into account the form of ownership (property, rental) (MUANGMEE et al., 2022), or the type of food served (e.g., dessert, burger, chicken, Chinese, Italian, etc.) (RINALDI; D'AGUILAR; EGAN, 2022). Although there are several terms for a *dark kitchen*, in Brazil this term was mainly used in reports (HAKIM et al., 2022). For this reason, this term was used most frequently in this study. In practice, *dark kitchens* around the world, operate with a variety of business models, both organizational and technically. For example, John (2021) made a categorisation based on the models of *dark kitchens* presented by an Indian restaurant support software company (MAGGO, 2018): independent cloud kitchen model (i.e. tradionally delivery-only restaurant), the brand house model (i.e., multi-brand kitchen for multiple cuisines), the storefront franchise model (i.e., a single brand in a single kitchen, but multiple outlets and a visible storefront), aggregator-owned (shell-type) model (i.e., multi-brand offering owned by an aggregator with rented kitchens) and fully outsourced model (chefs only do final touches and finishing). However, the organisation of services and opportunities for growth vary from culture to culture. This diversity of definitions and the typology presented show the important role that *dark kitchens* and FDA play for consumers.

Researchers here emphasise cognitive, developmental and social relevance due to the need to use information technology (PRABOWO; NUGROHO, 2019) with specific needs and demands. In this context, it is also important to actively participate in the development of innovative solutions and

sometimes in testing them (CHO; BONN; LI, 2019). For example, consumer expectations of food delivery by drone have been recognised (HWANG; KIM; KIM, 2019). From a risk-benefit point of view, this type of solution enables the fulfilment of requirements such as: Hygiene and protection from possible contamination (SHARMA et al., 2021), payment security (CHOWDHURY, 2023), a wide choice of menus (KONG et al., 2023) and time and labour saving (GANI et al., 2023). Extensive research on consumer intentions and benefits associated with food delivery apps has recently been conducted by Hong et al. (2023), among others. It is also interesting to note that delivery platforms are increasingly recognising where *dark kitchens* can meet underserved demand (MAPIC, [s.d.]).

It should also be noted that delivery-only food services are not free of constraints, both from restaurateurs' and consumers' perspectives. This includes challenges of maintaining the right temperature, including the cold chain (NAQUIAH et al., 2021), as well as the hygiene of the containers and couriers delivering the food (PURAM et al., 2022). According to professionals, seating and waiting areas in traditional restaurants offering food delivery services are increasingly underutilised or even empty, putting pressure on restaurant profitability. Secondly, serving customers while preparing food for delivery - at the same peak time of the day would potentially result in deterioration of customer experience due to longer waiting and delivery times (AHUJA, 2017; MAPIC, [s.d.]).

The above considerations confirm that the described phenomenon is very developmental and dynamic, and that its role and importance on the food market will systematically grow.

3. Methods

Data collection was performed in two stages: i. automated step and ii. manual step. In the automated stage, data was collected through the website of the Ifood® platform (https://www.ifood.com.br/), the most commonly used food delivery app and food delivery operator in Brazil (CHEVALIER, 2022b). Ifood® has more than three hundred thousand food services with more than sixty million orders per month in over 1700 cities across Brazil (IFOOD, 2021) and it is the most used food delivery app in Brazil (STATISTA, 2022a).

3.1. Automated step

The automated step was carried out using data mining to extract information from public internet pages. Python scripts were used to access the desired content using the JSON (JavaScript Object Notation) representation standard in the search for the desired web page. The data collection was done considering the restaurants listed on the Ifood® website for Limeira, Campinas and São Paulo cities. The cities are all from the state of São Paulo, the largest and most developed state in Brazil. The cities were selected based on the classifications established by REGIC (Regions of Influences of the Cities). Limeira is Subregional Centre B (308,482 inhabitants), a category for cities that exert influence on surrounding municipalities. Campinas is a metropolis (1,223,237 inhabitants), a classification for urban centres of great centrality that span several territories and have a relevant population contingent - more than 2 million inhabitants - and is the only non-state capital with this classification in Brazil. Finally, São Paulo is a Great National Metropolis (12.3 million inhabitants), the only city with this classification, with the highest urban hierarchy in the country (IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2018).

The following information were extracted from the scripts: URL (Uniform Resource Locator) of the restaurant, name of the restaurant, linear distance of the restaurant from the city centre (as the starting address for the search), estimated delivery time, rating of the restaurant given by users (5-point scale where ‘1-poor’ and ‘5-excellent’), number of users who rated the restaurant, price rating (5-point scale where ‘1-cheapest’ and ‘5-most expensive restaurant’ – This classification is automatically made by the platform based on quantile), category of the restaurant (i.e. type of food offered), address information, CNPJ

number (National Registry of Enterprises number) of the restaurant, whether the restaurant accepts scheduling of deliveries and taking-out of orders, whether the restaurant allows tracking of the location of the order until its delivery by using the logistics provided by iFood® itself. Every restaurant registered on iFood® must have a CNPJ, i.e., it must be registered as a restaurant with public bodies. The geographically central points of the cities designated for the search were: in Limeira 500-576 Boa Morte street – Centro, Limeira – SP (zip code 13480-181); in Campinas 1000 Francisco Glicério avenue – Centro, Campinas – SP (zip code 13012-100); and in São Paulo, Cel. Fernando Prestes square – Bom Retiro, São Paulo – SP (zip code 01124-060). These addresses were chosen because they are geographically located in the centre of the respective cities.

3.2. Manual step

The second step was done manually to assess whether restaurants might be *dark kitchens*. This step was carried out with the first 1,000 restaurants in each of the cities of Limeira (85.4% of the total available restaurants in food delivery app), Campinas (47.8% of the total) and São Paulo (6% of the total). Dark kitchens were classified according to the assumptions of Khan (2020), i.e., food services without local service to the public, offering meals transported by delivery and where there is no direct contact with the consumer. Home-based, rented, or shared premises, common to this type of business were included in this context. Establishments which were not exclusively food services were excluded (i.e., pharmacies, supermarkets, flower shops, convenience stores etc.).

This stage was conducted in an investigative and exhaustive manner. First, Google®Street View was used to visualize the establishment's storefront, and an assessment was made of the information available about the establishments on social networks and Google searches. In cases where the data collected were insufficient, a three step verification process was made to contact the establishments directly, i.e., via (i) telephone, (ii) e-mail, and (iii) available social networks. This approach was important to look for information beyond the virtual visualization of the premises' storefront, as some Google Street View data may be outdated due to the opening of new establishments that were not included

in the latest Google Maps update. Based on this information and definition of *dark kitchens* by Khan (2020), the restaurants were classified according to the criteria in figure 1.

Figure 1 - Criteria for classifying restaurants as standard, dark kitchen or undefined.

The data collection was carried out between December 2020 and January 2023. To test the methodology's appropriateness, automatic data collection was first carried out on 20 December 2020 concerning the city of Limeira and a manual evaluation was carried out in 2021. Once this step was completed and the proposed methodology confirmed, automated surveys were carried out in Campinas and São Paulo cities on 11 January 2022. The data found were analysed manually until 3 January 2023.

In Ifood®, restaurants are divided according to categories of food for sale. These categories are used to help consumers get a better understanding of what the restaurant has to offer, or even to filter their searches according to their interests. Due to the wide variety and over-specification of types of food, six categories were created: i. Brazilian food (Brazilian, Meat, Frozen, Chicken, Lunchbox, Fish, Healthy food, Soups and broths, Varied, Frozen, Seafood, Typical dishes from different Brazilian states, Pancakes, Vegan and Vegetarian categories), ii. Ethnic Food (Arabic, Chinese, Contemporary, French, Italian, Mexican, African, German, Argentinian, Asian, Colombian, Korean, Spanish, Greek, Indian, Mediterranean, Peruvian, Portuguese, Thai, and Yakisoba categories); iii. Snack (Hamburger, Snack, Pastel, Savoury Snack, Tapioca [a

food consisting of white grains, rather like rice, which come from the cassava plant], and Crepe categories); iv. Pizza (including only pizzerias); v. Desserts (*Açaí* [popular ice cream-like Brazilian dessert], Sweets and cakes, and Ice cream categories); and vi. Bakery and café (Bakeries, Cafeteria and Juice shop categories). The categories were grouped independently by two researchers and then discussed to reach a consensus.

3.3. Georeferencing

After data collection, all restaurants were graphed using Power BI software (Microsoft - USA). The restaurants classified as '*dark kitchen*', 'standard restaurant' and 'undefined' were clearly identified, as was the central point of each city. All restaurants were ploted using longitude and latitude coordinates using decimal degrees ranging from -90 to 90 for latitude and -180 to 180 for longitude.

The density in the centre was calculated considering all *dark kitchens* and standard restaurants within 5-km² of the centre. The total number of restaurants was divided by 5 to standardise the measure to square kilometres (km²).

A buffer was created around the boundaries of each city centre. As the cities differed significantly in size and population, different buffers were created: 2.5km² for Limeira, 3.4km² for Campinas, and 5.8km² for São Paulo. These values were the median distance from the central point of the city. They also correspond to approximately 1% of the size of the urban area of each city. Buffers ranging from 800 m to 5 km were used in previous studies that evaluated the density and proximity of food stores (MAGUIRE et al., 2017; THORNTON et al., 2012; TURRELL; GISKES, 2008).

3.4. Classifying *dark kitchens* models

The *dark kitchen* models were further classified based on data collected from the websites, Ifood® platform, Google Street View and social media. The data collected from the restaurants cited in the automated step methods were inserted into a sheet. A column was added for observations about *dark kitchens* and their characteristics (e.g., the type of storefont and public information about the restaurant). The data analysis followed the principles of

thematic content analysis, a qualitative method comprising grouping techniques and categorising them based on similar meanings or intersections of characteristics (BARDIN, 2016).

In the qualitative analysis, the *dark kitchens* were classified based on the presence or absence of a storefront, address, infrastructure features, menu information, CNPJ number, public information on the internet and direct contact with the establishment (by phone, email, or via social media).

3.5. Data analysis

The theoretical distributions of the quantitative variables were analysed using means, variances, skewness, kurtosis and histogram. The Kolmogorov-Smirnov test (with Lillefors correction) was used to check the normality of the data. To compare two independent groups (standard restaurants and *dark kitchens*), the t-Student test was used. Correlations were made by using Pearson's correlation coefficient. Three logistic regression models were constructed, one for each city, namely Limeira, Campinas and São Paulo. The dependent variable was the presence of *dark kitchens* in the buffer zone. The independent variables were included in a multiple model after they showed significant values in the single model. The exponential value of beta was used to estimate the odds ratio (OR). Goodness of fit was measured using the Hosmer and Lemeshow test. The bootstrap procedure with 1,000 samples was used where appropriate to normalise the data. The bootstrap quality was measured by analising the 95% confidence intervals.

Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) v.20 software. For all analyses, values of $p < 0.05$ were considered significant.

4. Results and discussion

4.1. Characterising *dark kitchens*

After the automated step, the sample consisted of 22,520 establishments, 1173 in Limeira, 4780 in Campinas, and 16,567 in São Paulo. This total number corresponds to all the restaurants in the search from the given central point. With this data, we analysed 3,000 establishments (1,000 from each city) in the manual step, classifying 1749 (65.2%) as standard restaurants, 727 (27.1%) as *dark kitchens* and 206 (7.7%) were undefined. Under the Ifood® rules, establishments that are not restaurants (i.e., markets, beverage retailers, florists, gift shops and others) can also make sales in the application. Since this study focused on *dark kitchens*, all establishments that are not exclusively food services were excluded from the sample (n=318).

The city with the highest percentage of food services classified as *dark kitchens* was São Paulo, measuring 35.4% (Table 1). With more than 12 million inhabitants (IBGE, 2023), São Paulo is ranked as the 21st largest economy in the world (CASA CIVIL DO ESTADO DE SÃO PAULO, 2020). Still, it is a city with large socio-economic gaps (RODRIGUES; PAIVA, 2022). This scenario shows the profile of a city attractive to new investment because of its wealth. In addition, *dark kitchens* emerged in large urban centres to meet the demand of discerning customers (SISODIA; NAIR, 2021). Such notes can justify the greater presence of *dark kitchens* in a big city like São Paulo. However, it was found that in smaller cities (e.g., Campinas and Limeira) *dark kitchens* accounted for more than 20% of the total food services. This result suggests that this model has also gained acceptance in smaller cities.

Table 1. Sample classification.

City	Standard restaurant		Dark kitchen		Undefined	
	n	%	n	%	n	%
Limeira	626	65.4	215	22.5	116	12.1
Campinas	625	70.3	217	24.4	47	5.3
São Paulo	498	59.6	295	35.3	43	5.1
Total	**1749**	**65.2**	**727**	**27.1**	**206**	**7.7**

DK: Dark kitchen; SR: Standard restaurant

Answering the first research question (Q1), in all cities, it was found that *dark kitchens* were located further away from the central point than standard restaurants (Table 2). The density of standard restaurants was higher than *dark*

kitchens in the city's central region. Figure 1 shows the map of the three cities and the heatmap for *dark kitchens* and standard restaurants. The maps show the highest density of standard restaurants in the centre (Figures 2B, 2D, and 2F). Although there were several *dark kitchens* in the centre of the cities, it can be seen that *dark kitchens* were scattered in the neighbourhoods and do not follow certain patterns and agglomerations (Figures 2A, 2C, and 2E). There was also a positive correlation between distance from the central point and delivery time for Limeira ($r= 0.37$; $p< 0.001$), Campinas ($r= 0.56$; $p< 0.001$), and São Paulo ($r= 0.27$; $p< 0.001$).

Table 2. Comparison between *dark kitchens* and standard restaurants considering different variables in the cities of Campinas, Limeira, and São Paulo (Brazil).

Variable	Limeira			Campinas			São Paulo		
	SR	**DK**	**p-value**	**SR**	**DK**	**p-value**	**SR**	**DK**	**p-value**
Distance from central point (mean km)	2.46	2.66	**0.037**	3.31	4.08	**<0.001**	4.62	6.21	**0.001**
Density in central point (number of outlets/km²)ǂ	123.0	43.8	-	105.3	30.3	-	61.8	13.9	-
Delivery time (mean minutes)	45.27	45.87	0.968	42.40	45.32	**0.034**	46.67	43.42	**0.007**
User rating (mean 5-point scale)	4.56	4.58	0.708	4.57	4.50	0.252	4.64	4.25	**0.001**
User rating count (mean n)	80.1	25.6	**<0.001**	132.1	68.9	**<0.001**	181.7	109.3	**<0.001**
Price range (mean 5-point scale)	1.71	1.40	**0.001**	1.93	1.44	**0.001**	2.70	2.03	**0.001**
Category – Type of food offered (%)*									
Brazilian Food	29.1	23.4	-	24.5	25.8	-	32.9	30.3	-
Ethnic food	6.6	4.8	-	9.8	12.4	-	15.7	23.9	-
Snacks	29.9	37.7	-	24.6	18.4	-	9.5	8.4	-
Pizza	9.2	5.2	-	6.2	5.1	-	4.7	5.2	-
Desserts	17.7	19.5	-	28.2	31.8	-	12.9	16.7	-
Bakery and cafe	3.9	2.6	-	6.7	6.5	-	7.5	0.6	-

DK: Dark kitchen; SR: Standard restaurant; * percentage of column; ǂ 5km² of range; Bold p-values are significant differences.

Location is important for a standard restaurant (FISHER, 1997). A restaurant that serves its target audience locally needs to be easily accessible by transport and close to customers and city's commercial conurbations, such as city centres (CHIDAMBARAM; PERVIN, 2018; JUNG; JANG, 2019; PRAYAG; LANDRÉ; RYAN, 2012; WRIGLEY et al., 2016). Dark kitchens, on the other hand, do not need this attribute, and they can be located further away from business centres and benefit from lower rents and fixed costs. This result echoes Talamini et al. (2022) in China and Safira & Chikaraishi (2022) in Jakarta, Indonesia, which showed a greater dispersion of locations for *dark kitchens*. The location of this

business model has already led to discussions about urban development in the state of São Paulo, where *dark kitchens* were indeed more prevalent. There have been many complaints about excessive noise and even the smell of grease near *dark kitchens* in residential neighbourhoods (VIEIRA, 2022a). This problem prompted the creation of the first law regulating *dark kitchens* in Brazil to reduce the urban problem (BRASIL, 2022). In this way, legislation can contribute to the acceptance of this business model among the population, as there are rules that make co-existence more peaceful and less invasive.

In Table 2, many different characteristics of *dark kitchens* compared to standard restaurants are observed. This section answers the second research question (Q2). In terms of price range, there was a difference between standard restaurants and *dark kitchens* in all cities, with the average being higher for standard restaurants. This result was expected, given the lower fixed costs of *dark kitchens* and the brand equity of conventional restaurants (RESTAURANT OWNER, 2020). Price is a major factor in consumers' food delivery app decision-making process, as their purchase intention is positively influenced by the value of price (TAM; SANTOS; OLIVEIRA, 2020; TANDON et al., 2021; VENKATESH; THONG; XU, 2012; ZANETTA et al., 2021a). This positive relationship between price and purchase intention is no different for *dark kitchens*, as price seems to influence purchase intention in this model (HAKIM et al., 2022). Although price is not the only factor considered in a purchase decision, it may increase the tendency to choose a *dark kitchen* compared to a standard restaurant. In terms of the market, this can be a barrier for standard restaurants, which have higher maintenance and fixed costs than *dark kitchens* (RESTAURANT OWNER, 2020) and could hardly compete with *dark kitchens* in the e-market based on food price. On the other hand, standard restaurants are perhaps better known and possibly more established than *dark kitchens* and therefore have a stronger brand. The brand is another critical aspect in the decision-making process. The true power of a brand lies in the minds of consumers, it is a mental construct, based on what consumers experience and learn about the brand over time (KELLER; BREXENDORF, 2019). This mental construct affects how consumers respond to products, prices, communications and other marketing activities, increasing or decreasing brand equity in the process (KELLER; BREXENDORF, 2019). Thus, the brand can contribute to the interpretation, processing and storage of

information about products and services, affect trust (i.e., a customer feels more comfortable with one that they had experienced, is considered of high quality or is familiar) (DIRSEHAN; CANKAT, 2021; HO-DAC; CARSON; MOORE, 2013) and form the perception of value, providing a reason to buy, differentiating the brand and supporting higher prices (AAKER, 1992).

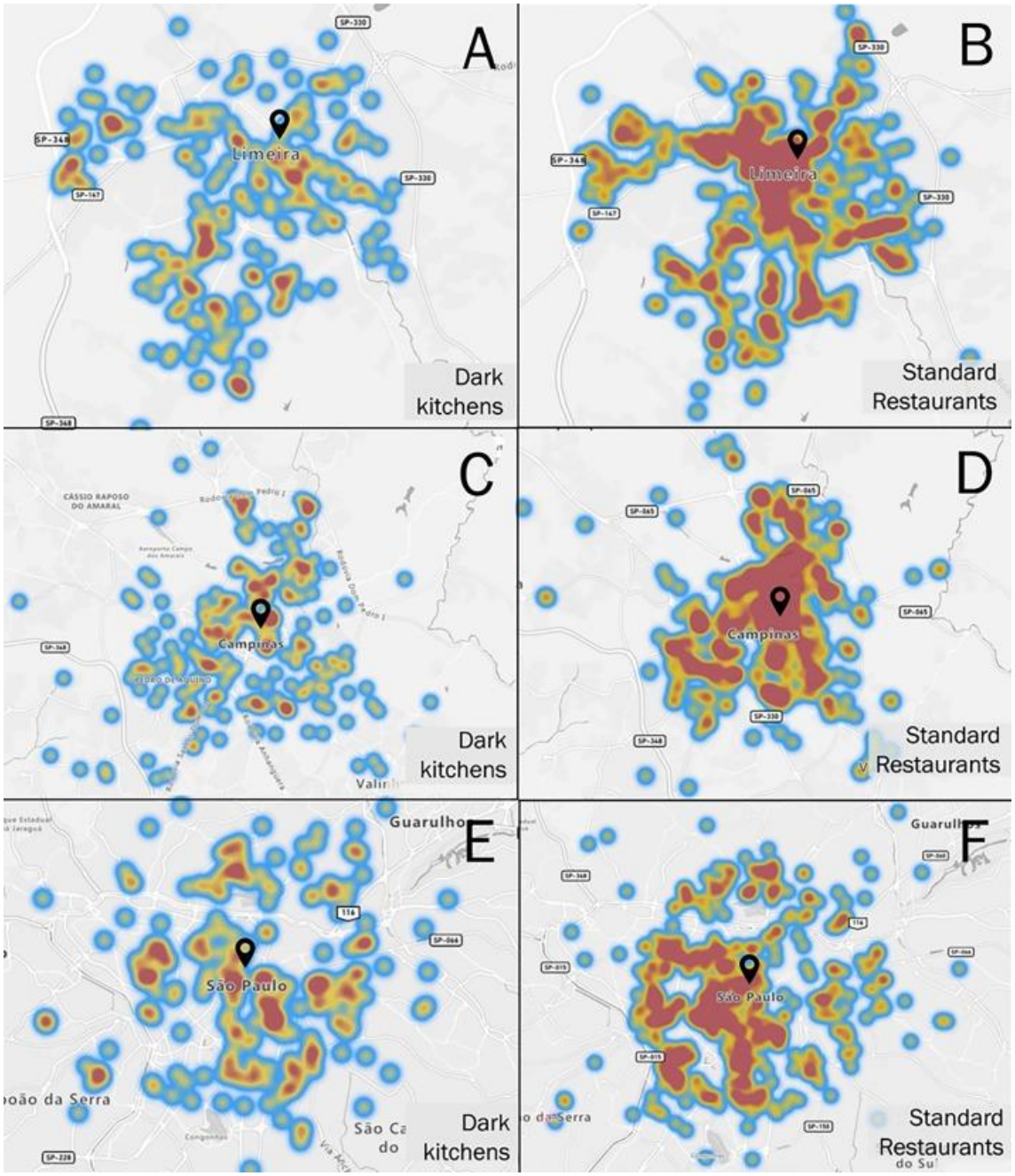


Figure 2. Heatmaps of *dark kitchens* and standard restaurants of Limeira, Campinas and São Paulo.

We also observed that *dark kitchens* received fewer number of user ratings than standard restaurants, although the scores were different only in São

Paulo. With app-based food purchases, there is an expected process from the user during their decision making. This process usually starts with finding a favourite restaurant (PIGATTO et al., 2017). When a restaurant is newly opened, it is less preferred and patronised as there is no prior knowledge about it. Also, as previously mentioned, the brand builds trust with the consumer (KELLER; BREXENDORF, 2019). Despite the growth of *dark kitchens*, standard restaurants are probably better known and recognised than *dark kitchens*. This can lead to a greater number of sales and therefore a greater number of consumers to rate, which explains the result. Some non-food apps also link bonuses to customer reviews (WU et al., 2019). The metrics associated with boosting in the app were unknown, but potentially these reviews could influence how a restaurant is advertised. The volume of online reviews in other industries is positively related to consumer satisfaction, company reputation and profitability (NIETO; HERNÁNDEZ-MAESTRO; MUÑOZ-GALLEGO, 2014). Therefore, this data could be important for survival perspective in terms of marketing. Boosting sales may also naturally result from consumer ratings for app purchases, as this rating serves as a quality control for future consumers' perceptions (RAY et al., 2019) which may increase or decrease purchase intent.

Answering the third research question (Q3), in São Paulo, the Brazilian food category was most prevalent in both *dark kitchens* (30.3%) and standard restaurants (32.9%). It was to be expected that many *dark kitchens* would offer typical Brazilian food, especially in larger centres such as São Paulo and Campinas, where traffic and distance between home and work are greater. Many *dark kitchens* offer utilitarian meals, i.e., they serve consumers who want a quick and cheap lunch or dinner but do not refrain from eating complete meals (e.g., a combination of rice, beans, protein dish, salad, and some dessert). In this case the management is oriented for a cost leadership strategy (LEGIMAI; SALDANHA; GRACIANA, 2022; UYAR et al., 2022; WALLACE; WALLACE, 2022). On the other hand, it is possible to see many *dark kitchens* offering hedonic foods such as snacks and desserts. In Limeira snacks were the most prevalent category, whilst in Campinas it was desserts. In this case, *dark kitchen* tends to be aligned to product differentiation strategy (MURRAY, 1988). It may be easier for small entrepreneurs to open a restaurant selling snacks or sweets, as planning, menu and management are less complex than a restaurant. By

producing fewer units, entrepreneurs can also focus on producing differentiated snacks and desserts that focus on sensory aspects.

The variables such as delivery time and user rating did not seem to show a clear pattern distinguishing between *dark kitchens* and standard restaurants. Delivery time seems to be related to the location of the restaurant, regardless of the type of restaurant. The rating, on the other hand, depends on several factors. The iFood® application itself suggests that when rating, the user provides positive or negative aspects on the characteristics of taste, seasoning, appearance, quantity, packaging, temperature, ingredients, cooking point and wrong items, and also allows a specific rating of the delivery itself, which is not related to the restaurant but to the driver responsible for the delivery. Rating is very important to stimulate user purchase behaviour (SHAH; ABBASI; YAN, 2023) and this can be even more important for small independent restaurants, such as small *dark kitchens*, which are more prone to failure (NIZAM, 2017).

Table 3 shows the probability of occurrence of different characteristics in *dark kitchens* in regions closer to the central points. Delivery time seems to be less likely to be higher (or to increase) in the *dark kitchens* in the central buffer of the three cities studied. In Limeira, snack categories (58%) and desserts (79%) were also characteristics that were less likely to be present in *dark kitchens* in the central region. Dark kitchens in Limeira were more likely to prepare snacks and desserts and, as mentioned earlier, these are items that are easier to produce in small kitchens. It is possible that this type of sale is more common in home-based kitchens, which tend to be more dispersed in central points. In Campinas, increased price seems to have a higher probability (26%) of being present within a 3.4 km² radius of the central point. As mentioned above, rents tend to be more expensive in city centres, which can make goods and services offered in the area more expensive. Also, ethnic foods had a higher probability to be in the centre. Ethnic foods have greater added value and may require greater investment and skilled culinary staff (FARRER, 2020; WESSENDORF; FARRER, 2021). The ethnic heritage food may face some risk factors such as ‘adaptation to customer preference’, ‘costs of ingredients’, and ‘non-native origin of chef’ (ALMANSOURI et al., 2022; ARSIL et al., 2022; MAWROH; DIXIT, 2023). Most of the ethnic restaurants were composed of Japanese restaurants representing 5.5% of all

restaurants. Finally, in São Paulo, the pizza category seems to have a lower chance (84%) of being present in the central space of 5.8km².

Table 3. Multiple logistic regression for *dark kitchens* density in city centre.

Model	Independent	OR	95% CI		R^2
Model 1 - Limeira (2.5 km² buffer)	Delivery time (min)	0.94	0.92	0.96	0.06
	Price range (1-5)	1.58	1.08	2.31	
	Category: Snack (dummy: yes)	0.42	0.21	0.85	
	Category: Desserts (dummy: yes)	0.21	0.08	0.53	
Model 2 - Campinas (3.4 km² buffer)	Delivery time (min)	0.92	0.91	0.93	0.27
	Price range (1-5)	1.26	1.10	1.45	
	Category: Ethnic (dummy: yes)	2.04	1.23	3.40	
Model 3 - São Paulo (5.8 km² buffer)	Delivery time (min)	0.95	0.93	0.97	0.27
	Category: Pizza (dummy: yes)	0.16	0.04	0.62	
	User rating (1-5)	3.11	2.14	4.52	

Dummy: 1= yes; 0= no; OR= Odds Ratio; 95% CI= 95% confidence interval.

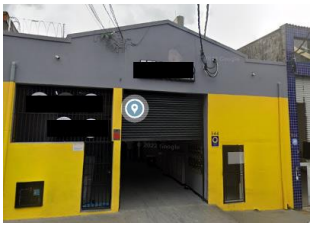
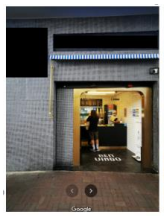
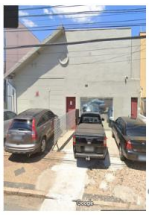
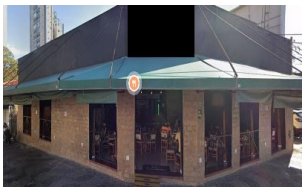
It is important to note that Model 1 has low explanatory power. This does not invalidate the model, but shows an important urban feature. Since Limeira was the smallest city studied, the differences in distance and delivery times between *dark kitchens* and standard restaurants were smaller or not significant. In the models for Campinas and São Paulo, delivery time played an important role in explanatory power.

4.2. Dark kitchen models

In the manual phase of analysing the type of restaurants, several features of *dark kitchens* were extracted and summarised (Table 4). At this stage, the aim was not to classify *dark kitchens* in a quantitative fashion, but to explore the different strategies and models of these food services. Finally, answering the fourth research question (Q4), six *dark kitchen* models emerged from the qualitative analyses: i. independent *dark kitchen*, ii. shell type (hub), iii. franchises, iv. virtual kitchen in a standard restaurant (different menu), v. virtual kitchen in a standard restaurant (similar menu but with different restaurant name) and; vi. home-based *dark kitchen*. Some models are commonly known, such as independent *dark kitchens*, shell-type (hubs) and franchises (JOHN, 2021). The franchise business model has proliferated in recent years (KANG, 2019), and investment in this model underpins the idea that *dark kitchens* are seen as businesses with good economic potential. Franchisors must offer products and

services adapted to their customers (COMBS; KETCHEN, 2003). In this case, franchisors benefit from lower maintenance costs of *dark kitchens* associated with a strong and well-known name/brand.

Table 4. Observed *dark kitchen* models summarized by content analysis.

Model and characteristics	**Example (confirmation)**	**Example (photo)**
i. Independent dark kitchen: Kitchens rented by a brand exclusively for its own use, which may or may not have a storefront.	The lack of a storefront, the lack of information about the place has services in the physical space when searching through Google and social networks.	
ii. Shell-type (Hub): Premises are shared by more than one kitchen/restaurant. A physical space rented by multiple restaurant owners.	The storefront had a larger sign pointing to the name of the hub and other smaller signs with the logos of the restaurants selling in the area. All the restaurants mentioned on the signs had addresses in that location.	
iii. Franchises: Dark kitchens that have more than one outlet, with well-established social networks that can indicate the presence of this restaurant in different cities.	Restaurant has several units some with a storefront, or in *dark kitchen* model. It was also possible to find franchises whose restaurants operate exclusively in the *dark kitchen* model, as shown in the picture on the franchise website (a search bar to check if your address is in the delivery area).	  
iv. Virtual kitchen in a standard restaurant (different menu): Virtual kitchen is set up at the same address as a storefront restaurant but with a different name and service than the standard restaurant.	One could see the storefront of a restaurant selling Brazilian food. In the same place, another restaurant is registered that sells Italian food exclusively online (different menus).	
v. Virtual kitchen in a standard restaurant (similar menu but with different restaurant name): Virtual kitchen is set up at the same address as a storefront restaurant, with similar service (i.e. same type of menu) as the standard restaurant, but with a different name.	Two restaurants are registered at the same address. The menu and the category of food sold are similar, but only one of the restaurants has a frontage, the other does not have its name physically displayed.	
vi. Home-based dark kitchen: Kitchens in residential buildings, which may be in houses, condominiums or flats.	Restaurant located in a residential building.	

Images from Google Street View (2022)

Different models of *dark kitchens* were observed, such as models iv, v, and vi. This result shows that technology can create other models of food

services that serve different market sectors. For example, models iv and v have different marketing stimuli. Those that have the same menus (model v) may use other names for the same restaurant to gain wider application penetration, appear more frequently as an option on the consumer's screen, or even to circumvent a particular application metric. For example, if the application lowers the profile of a restaurant due to low ratings (by not showing it as the first option in the application), adding a "new restaurant" to the application may provide new opportunities to stand out and consequently generate new sales. On the other hand, a virtual kitchen in a standard restaurant (different menu) can potentially create new opportunities for the space itself. An example is self-service restaurants (i.e., the consumer assembles their plate from the buffet on site), which often operate during lunchtime in Brazil. So it is possible to have sales in a standard restaurant at lunchtime but cover the service by using the available kitchen for other sales at other times of the day. Another interesting example is that of a standard restaurant that offers typical Brazilian dishes and has another restaurant at its address with a different name that offers only vegetarian dishes. This strategy can increase sales to an audience with special requirements, such as vegetarians.

Home-based *dark kitchens* (model vi) were also identified during the research. In the case of residential buildings, these restaurants may have similar characteristics to family restaurants and small businesses. Due to their characteristics, family restaurants may have increased risks related to food safety (PEREIRA et al., 2021). Family businesses like these restaurants may be particularly common in developing countries. Model vi evolves under difficult economic and supply-side conditions where the service profile changes, with workers moving into self-employment at times of greater employability difficulties (GINDLING; NEWHOUSE, 2014). Given that the pandemic has led to economic instability and increased unemployment (LEE; YANG, 2022), this migration out of employment and, consequently, into residential kitchens may have been encouraged. This profile shows that attention needs to be paid to this *dark kitchen* model, which can be a potential problem in delivering safe food for the population.

4.3. Theoretical implication

This work reveals a compelling theoretical implication. First, it is not possible to assume only one type of *dark kitchen*. The typology and models of *dark kitchen* developed by this study represents an advancement for future empirical studies on *dark kitchen* services. It is obvious that food business owners are adapting their services in order to reduce costs and increase profits. In this sense, it is possible that new, different models can emerge in opportune scenarios and contexts in different cultures. Future researchers can empirically examine and compare our proposal and typology or extract some constructs to study the *dark kitchen* phenomenon in different countries or between countries.

4.4. Practical and policy implications

Several practical implications can be drawn from the results. First, the number of *dark kitchens* in the most popular food delivery app in Brazil is considerable (27%), and it may be even higher if we take into account the percentage of restaurants that could not be classified (7.7%). These data show the urgency of specific measures for this sector. The typology and models of *dark kitchens* observed in this study also highlight the importance of specific measures and policies taking into account the particularities of each model. In order to improve and support the sector, it is necessary to take into account the perspective of each of the models, which are likely to have different needs and problems that need to be addressed. Stakeholders and policy makers need to be guided by the characteristics of each model when developing regulations.

Secondly, it could be seen that most *dark kitchens* offer less complex meals (i.e., snacks and desserts). This is an important feature because it can reduce the cost and complexity of operating in this type of food service. With some loss of delivery time, *dark kitchens* can benefit from cheaper rents in "non-central" areas. This allows them to offer more competitive and attractive prices to customers. Nevertheless, the importance of building a strong brand for *dark kitchens* is highlighted, as price, customer reviews and delivery time are not the only factors that consumers consider in their decision-making.

Finally, there is an important political implication. Not only were many *dark kitchens* located in residential areas, many of them were also located within

private homes (i.e., home-based *dark kitchens*). This influences how health surveillance can monitor these places. Current Brazilian law does not allow any authority to enter residential premises without a warrant. In this sense, a theoretical discussion is emerging on how to give legitimacy and legality to these *dark kitchens*. There is a need for health surveillance to set standards and ways to monitor *dark kitchens* in order to be able to protect consumer health.

4.5. Limitations and future research

This study has some limitations. First, the study was conducted in the state of São Paulo. This does not necessarily represent the scenario of a country with a large land area, such as Brazil. To verify whether the results found in this study can be generalised to other regions of Brazil, more comprehensive studies need to be conducted in more locations. As the analyses conducted here only concern a single delivery application, applications with other profiles may yield different characterisation results. An example would be applications that cater to consumers based in small towns.

Finally, this study was also insufficient to assess potential risks to the food delivery app users associated with *dark kitchens*. Despite the hypothesis that it may be more difficult for small establishments to comply with food safety regulations, no study has yet examined food safety in *dark kitchens*. In this case, it is essential to distinguish between the different models of *dark kitchens*. For example, home-based *dark kitchens* are likely to face other difficulties than those operated by shells or franchises.

It is important to emphasise that this work served to understand and explore *dark kitchens* and provide an overview of this food service. The observations and notes taken during data collection allowed for an understanding of what might be found as a *dark kitchen*, but not to classify each *dark kitchen*. The food services were heterogeneous and in several of them it was not possible to classify due to a lack of information. It would be interesting for future research to compare the characteristics of the different *dark kitchen* models described in this study. New studies need to be designed to confirm the various hypotheses put forward here.

5. Conclusion

This study is a first analysis of the presence of *dark kitchens* and the characterisation of this food service model in different urban centres in the State of São Paulo, Brazil. Our results demonstrated a re-distribution of restaurants, as evidenced by the different geographical distribution of *dark kitchens* compared to standard restaurants. In the total number of restaurants studied, 27% *dark kitchens* were observed, with a higher percentage in São Paulo (35.4%), a city with a greater expanse of land, economic development and population. It is estimated that the percentage of *dark kitchens* might be higher due to the number of restaurants that could not be classified. In several analyses of this study, *dark kitchens* were found to be more dispersed and distant from central points than standard restaurants, which were more concentrated in city centres. Nevertheless, it was found that there are differences in the profile of *dark kitchens* and standard restaurants. Dark kitchens had a lower price range and fewer reviews than standard restaurants. In addition to these characteristics, *dark kitchens* selling snacks and desserts were found to be more common in smaller cities such as Campinas and Limeira. These results differed from São Paulo, where Brazilian food were commonly sold in both *dark kitchens* and standard restaurants.

Furthermore, this study brings to light numerous characteristics observed in *dark kitchens* in a standardised manner, leading to various models of *dark kitchens*. It was possible to identify six different models of *dark kitchens*: independent *dark kitchen*, shell type (hub), franchises, virtual kitchen in a standard restaurant (different menu), virtual kitchen in a standard restaurant (similar menu but different name), and home-based *dark kitchen*.

The results of this study are important for entrepreneurs in this sector to understand the characteristics of this type of service. Moreover, the data can be used to formulate specific guidelines and regulations for *dark kitchens*, as they are different from standard restaurants.

Credit authorship contribution statement

Mariana Piton Hakim: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – original draft. **Victor Methner Dela Libera:** Methodology, Formal analysis, Investigation**; Luis D'Avolgio Zanetta:** Methodology, Formal analysis, Investigation**,** Writing – original draft. **Elke Stedefeldt:** Methodology ,Writing – review & editing and Visualization.;**Laís Mariano Zanin:** Methodology ,Writing – review & editing and Visualization; **Jan Mei Soon-Sinclair:** Methodology ,Writing – review & editing and Visualization; **Małgorzata Zdzisława Wiśniewska**: Methodology, Collection and analysis of literature, Writing – original draft; **Diogo Thimoteo da Cunha:** Conceptualization, Formal analysis, Software, Methodology, Investigation, Funding acquisition, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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CAPÍTULO 2

WHAT IS A *DARK KITCHEN*? A STUDY OF CONSUMER'S PERCEPTIONS OF DELIVER-ONLY RESTAURANTS USING FOOD DELIVERY APPS IN BRAZIL

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What is a *dark kitchen*? A study of consumer's perceptions of deliver-only restaurants using food delivery apps in Brazil

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Abstract

Dark kitchens are restaurants with no storefronts, no direct customer interaction and delivery-only commercial kitchens that rent out shared or private kitchen spaces to food businesses. The objective of this study is to determine consumers' knowledge about *dark kitchens* and the factors that influence willingness to pay and intention to purchase meals in this restaurant model. It were surveyed 623 Brazilian consumers. First, consumers' knowledge of the term *dark kitchen* was determined using specific questions. Then, consumers were presented with the actual meaning of *dark kitchens* and were asked about their intention to use this restaurant model. To this end, participants were presented with 25 indicators to assess the following constructs: willingness to pay and purchase intention, trust in health authorities, trust in food delivery app, perceived food safety, quality control, consumer experience, and solidarity with the foodservice sector. Overall, 73.4% of participants reported having heard of the term *dark kitchen*. Using a descending hierarchical classification, four classes of definitions were found. The factor solidarity with the foodservice sector ($\beta=0.440$; $p<0.001$) had the greatest positive influence on willingness to pay and purchase intention, followed by perceived food safety ($\beta=0.273$; $p<0.001$); quality control ($\beta=0.125$; $p=0.003$); consumer experience ($\beta=0.110$; $p=0.002$) and trust in health authorities ($\beta=0.059$; $p=0.047$). Even if consumers cannot accurately describe what a *dark kitchen* is, there is a positive intention to purchase food produced in this kitchen model. It is important to develop strategies to promote and improve *dark kitchen* models. Finally, it is suggested that health authorities and app operators pay more attention to improving food safety in these establishments, as consumers have low risk perception about them.

Keywords: cloud kitchen; ghost kitchen; virtual kitchen; foodservice; restaurant; food safety; consumer behavior; structural equation modeling; food delivery; food app.

1. Introduction

Some challenges and new conditions in modern society are driving disruptive innovation (BUHALIS et al., 2019). This is evident, for example, in the rapid increase in the use of smartphones, application technologies, and Internet access (GSMA, 2022), which are changing the use of time for everyday activities, such as time to prepare food (BARBOSA; CAMPBELL, 2006; SMITH; NG; POPKIN, 2013; WARDE, 2016). More recently, the COVID -19 pandemic challenges encouraged the growth of the shopping sector in a virtual environment as the pandemic negatively impacted physical stores during restrictions, lockdowns, and stay-at-home orders (CHANG et al., 2021b; TALWAR et al., 2021). In addition, many consumers avoided visiting restaurants for fear of COVID -19 infection (HAKIM; ZANETTA; DA CUNHA, 2021). These conditions favored the search for ready-to-eat foods sold online and, in parallel, the development of mobile apps that provide solutions and convenience. As a result, an increase in cost-effective business models, and the transition from physical stores to online services that can serve consumers in different circumstances have been observed (RESTAURANT OWNER, 2020).

The online food delivery (OFD) industry is one of the fastest growing among mobile apps. This industry generated $107.4 billion in global revenue in 2019 and is expected to reach $182.3 billion by 2024 (STATISTA, 2021). In Brazil, OFD orders grew 71% in 2019 and could still represent a large part of restaurant sales, accounting for 40% of the total (CREST, 2020). In a previous study, we found that Brazilian consumers are willing to continue using food delivery apps (FDA) after the pandemic (ZANETTA et al., 2021). This result shows that the growth of the OFD market in the last years will permanently occupy a share of the food market. This expansion of the OFD market and the aftermath of the pandemic have also created space for the emergence of a new business model known as *dark kitchens*. Food establishments that focus solely on meal delivery and do not have physical storefronts or areas for local consumption are often referred to as *dark kitchens* (VOLPE, 2020) or cloud kitchens (ORACLE, 2022). This includes shared space kitchens, where multiple restaurants rent and share space, also called “hubs” (ROAMING HUNGER, 2020). The *dark kitchen* model lends itself as an alternative for companies that want to expand at a much

lower cost (e.g., increase the number of stores in other cities). By centralizing orders with suppliers, deliveries, and a smaller workforce, this model can provide meals at lower prices and faster delivery, especially in large urban centers (RUBINSTEIN, 2019). Some *dark kitchens* may be home-based businesses, i.e., a business undertaking most of its operation in the home environment (REUSCHKE; MASON, 2022). Economically, this is a very attractive model, as the cost of opening a standard (e.g., full-service) restaurant averages $475,500, while takeout-and-delivery-only restaurants average $150,500 (RESTAURANT OWNER, 2020). Although *dark kitchens* are becoming more common and attractive primarily because of the low cost of the business model, few studies address consumer perceptions and the safety of such restaurants.

Although *dark kitchens* are a fast-casual business alternative, with lower operating costs than traditional kitchens, this type of business is new to consumers. Few studies show how people know or perceive this restaurant model. First, it is essential to verify if the consumers know what a *dark kitchen* is, and what this terminology reminds them of. It is also imperative to understand the factors that influence the consumer decision-making process regarding *dark kitchens* as they become more prevalent and demanded. The presence of this business model in the OFD industry builds consumer confidence, endorsed by FDA operators. If consumers are willing to buy meals from *dark kitchens*, how can health authorities and FDA operators help business owners produce safe food, especially small and mid-size enterprises? This study is the first step in Brazil to better explore this scenario, seeking to include *dark kitchens* in the economic and health agenda.

The current study makes a significant contribution to theory and practice in the foodservice industry in several ways. First, we shed light on several factors that determine the intention to purchase meals produced in *dark kitchens* and the willingness to pay for these meals in Brazil. Second, we found that the term "*dark kitchen*" can be confusing. Discussion with consumers, health authorities, and researchers about *dark kitchens* is important to raise awareness of this sector, stimulate appropriate regulation, and modulate consumer perceptions of risk. Third, we found many willingness-to-pay factors that can serve as the basis for future studies. Therefore, this study investigates

consumers' knowledge, perception, and willingness to pay for meals produced in *dark kitchens*.

2. Literature review

2.1. Dark kitchens

In the US, an initial study by Cai et al. (2022) sought to understand how the perceived benefits and risks of *dark kitchens* -referred to in the study as ghost kitchens- can influence consumer trust and intentions. This study found that personal (e.g., taste, quality, value for money) and social benefits (e.g., local economy, worker well-being, public health) positively influence trust. On the other hand, social risks (e.g., worries about *dark kitchen* cleanliness, hygiene, and food sources) undermine trust. Trust, in turn, positively affects consumers' behavioral intentions. This study also discussed the effects of subjective knowledge (e.g., how much one thinks one knows) and objective knowledge (e.g., how much one knows). Subjective knowledge positively impacts personal and social benefits, and objective knowledge reduces consumers' perceived risks of a *dark kitchen* (CAI; LEUNG; CHI, 2022). This finding underscores the importance of educating the public about a *dark kitchen* and creating a positive image among consumers.

Another study by Kulshreshtha & Sharma (2022) sought to understand consumer acceptance of *dark kitchens*, in the study defined as cloud kitchens. Food aspects (e.g., quality and food options), marketing aspects, behavioral aspects (e.g., staff attention during sales, feedback), experimental food (e.g., product or experience personalization), price aspects, health and hygiene aspects, technological aspects, delivery effectiveness, environmental responsibility aspects, and appearance and esthetics were found to influence consumer purchase decisions.

It can be noted that some studies try to explain consumer behavior regarding *dark kitchens*. However, the prevalence and knowledge of this business model vary from culture to culture, especially in the post-pandemic period. Based on several studies in the literature, we developed a model with seven hypotheses that attempt to explain the intention to pay for and consume meals produced in *dark kitchens*. This model is based on grounded hypothesis, but not on an already established theory/model.

2.2. Perceived restaurant safety and trust in health authorities

Consumers are more motivated to go to restaurants where they feel safe (HAKIM; ZANETTA; DA CUNHA, 2021). In addition, food safety concerns have increased with the COVID -19 pandemic (MARAGONI-SANTOS et al., 2021). When consumers decide to purchase a product or service, they weigh the risks and benefits they perceive. The perceived lack of safety in the *dark kitchen* business model may reduce consumers' willingness to pay. When foodborne disease (FBD) is recognized as harmful to the consumer's performance, physical health, and time, the consumer becomes more concerned about food safety (Zanetta et al., 2022). Although people are generally overly optimistic about their risks when eating away from home (DE ANDRADE et al., 2019a), risk perception and food safety concerns are major drivers of food choices (Zanetta et al., 2022b). This leads to the following hypothesis:

H1. Perceived food safety positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

Poor food safety practices and measures in the foodservice industry can manifest themselves through contaminated food that can cause FBD. Most FBD outbreaks in food establishments are due to predictable errors in the food chain (DA CUNHA, 2021). Ready-to-eat meals are frequently implicated in FBD incidents (SOON; BRAZIER; WALLACE, 2020). A sequence of defensive layers, such as food safety education, proper structure, and good practices, can be employed to reduce the risk of FBD (DA CUNHA et al., 2022). However, the status of food safety in *dark kitchens* is unknown by both consumers and researchers. Consumers are often unaware of the risk (or safety) of eating out (Zanetta et al., 2022). To date, there are not enough studies in this area to identify the main errors in the food production chain. Although there is a brand-new law requiring a license to legally operate *dark kitchens* in a Brazilian city (São Paulo, 2022), the ease with which the existence of establishments is omitted reduce inspections and the presence of regulated establishments. Although food safety regulations are flexible, managers of these restaurants may have difficulty complying with food safety regulations due to feelings of informality and

transformation of the work space into a domestic space (*vice* and *versa*) (PEREIRA et al., 2021).

Responsible for inspecting food services are the regulatory agencies, which are independent government bodies established by law to set food safety standards for food services. Certifications issued by government institutions can increase the credibility of establishments (BAI et al., 2019). In this sense, it is important to trust these institutions and health authorities so that certifications and the monitoring system can be trusted. Social trust comes from a willingness to rely on those responsible for making safety and health decisions (SIEGRIST; EARLE; GUTSCHER, 2003). In contrast to informal food trading, such as some street food vendors, the *dark kitchen* gains a degree of formality by offering its services in an FDA. Therefore, the following hypothesis is proposed:

H2. Trust in the health authorities positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

2.3. Trust in food delivery app

Social trust (SIEGRIST; EARLE; GUTSCHER, 2003) can be applied to the responsibilities of government institutions. Still, it can also be exercised by another institution responsible for the safety of a service or product, such as FDA operators. Several well-known companies are operating FDA in different countries, such as Zomato, UberEats, Deliveroo, Foodpanda, Metuan Waimai, Ele.me, and many others. These companies promote dialog between restaurants and consumers and are a reliable link in this negotiation. Perceived trust is a key predictor of consumers' intention to continue using FDA (ZHAO; BACAO, 2020). Moreover, trustworthiness increases the perceived value of an FDA, increasing the intention to continue using it (CHO; BONN; LI, 2019). In this sense, we believe that if consumers trust the FDA operator to guarantee food safety, they will reduce their perception of risk and thus increase their intention to purchase food from *dark kitchens*. This leads us to the following hypothesis:

H3. Trust in food delivery app positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

2.4. Quality control and consumer experience

Because *dark kitchens* are technology-dependent, their acceptance process differs from technology-independent models. Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) and later supplemented it as UTAUT2 (VENKATESH; THONG; XU, 2012). The theory emphasizes the role of hedonic motivation, price value, and users' habits in using a particular technology. Such service-oriented quality attributes are even more important as new products and services may perform worse than those already established in a traditional way or improve rapidly to take their place in commerce (GANS, 2016). Given the differences in the availability of consumer experiences in face-to-face and virtual services, food service quality control is measured in different ways in technology-dependent and technology-independent models. The term quality control is defined as a part of quality management focused on fulfilling quality requirements (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2000). In this study, quality control measure was defined following Ray et al. (2019). According to the authors, customers expect FDA operators to provide various quality indicators, such as photos, reviews, and ratings, which allow customers to pre-select restaurants, select food, and complete the order. These features are strategies FDA operators use to ensure product quality and meet consumer expectations. Than, we hypothesize:

H4. Quality control positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

Consumer experience is often understood as "a customer's journey with a form over time during the purchase cycle across multiple touchpoints" (LEMON; VERHOEF, 2016). Considering food experience, food quality (i.e., sensory aspects of food) is the most important factor in consumer satisfaction

when purchasing meals (MATHAYOMCHAN; TAECHARUNGROJ, 2020). However, it is too early to verify consumers' perceptions of foods produced in *dark kitchens* because the FDA does not specify this characteristic of the food supply. Therefore, consumers cannot say whether the food in *dark kitchens* is better than that in regular restaurants. In this sense, elements such as customer experience and convenience in using the app (e.g., the presence of coupons, cashback, discounts, and delivery time) are important aspects that can increase consumers' purchase intention (RAY et al., 2019). Service innovations driven by technological advances significantly impact customers' experiences and future behavioral intentions (SU, 2011). This study considers consumer experience based on FDA convenience aspects. Consumers judge their experiences by the extent to which actual performance confirms or disappoints their expectations (expectancy disconfirmation theory) (JOHNS; PINE, 2002). According to Ray et al. (2019), customers' experience with FDAs depends on customer engagement programs such as loyalty programs and coupons. Thus, when a consumer using an FDA receives the incentives, the restaurant meets or even exceeds the consumer's expectations. On online platforms, customer trust and reliability are converted into feedback, and customer satisfaction leads to new facility referrals and increases consumer intention to return and word of mouth (SHARMA; KUMAR, 2019). Promoting a good experience when using the application can encourage consumers' willingness to pay. Therefore, the following hypothesis is proposed:

H5. Consumer experience positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

2.5. Solidarity with the food sector

Previous studies have shown that a sense of social responsibility influences consumer behavior in the food sector (Hakim et al., 2021; Zanetta et al., 2021). In times of crisis, people respond internally with solidarity to cope with the hostile environment (MISHRA; RATH, 2020). Solidarity is the support given to members of a group (Cambridge Dictionary, n.d.). The food sector was greatly affected by the pandemic of COVID -19, which led to the closure of several food

businesses and a struggle against the debts of those who resisted this negative phase (LÓPEZ, 2020; OPENTABLE, 2020). This highlights the difficulties faced by the sector and can awaken solidarity as a form of action to support a community in crisis.

H6. Solidarity with the food sector positively affects purchase intentions for meals produced in *dark kitchens* and willingness to pay for those meals

2.6. Proposed model

Consistent with previous studies in the literature, we propose a hypothesis model with the constructs that may influence purchase intention and willingness to pay for *dark kitchen* meals (Figure 1).

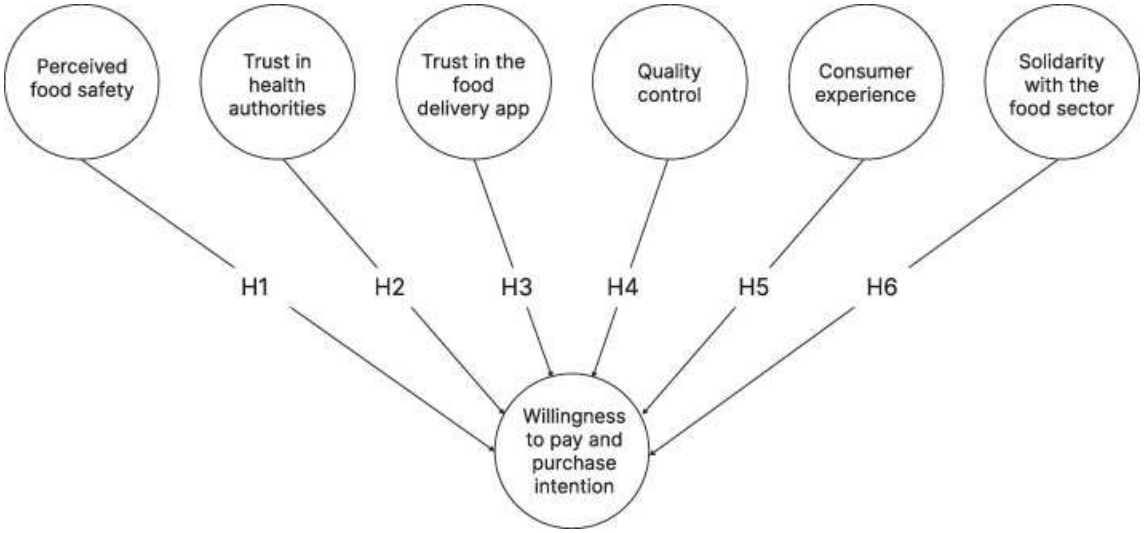

Figure 1. Proposed model.

3. Methods

3.1 Sample and data collection

Data collection was done virtually using the Google Forms platform (Alphabeth Inc. Mountain View - U.S.). First, a pilot test was conducted with ten consumers to determine the comprehensibility of the questionnaire and the average response time of participants (≅ 10 minutes). Social networks were used to invite participants, and invitations were also sent by e-mail. Non-probability referral sampling was used. Using the inverse square root method (KOCK; HADAYA, 2018) with a significance level of 5% and a path coefficient of 0.10, a sample of 619 individuals is required. A total of 629 questionnaires were collected from February 10 to March 21, 2022. All participants had to be Brazilian and over 18 years old. Some questions were included with an inverted answer to avoid monotonous responses. Also, the variance between the indicator variables was checked for each participant. Six cases where variance = 0 were excluded (MAT RONI; DJAJADIKERTA, 2021). All participants electronically signed an informed consent form. The Ethics Committee of the University of Campinas approved the study (January 10, 2022; protocol number: CAAE42944221.4.0000.5404).

3.2 Measures

The first part of the questionnaire assessed consumers' knowledge and perceptions about *dark kitchens*. Participants were asked, "Do you know or have you heard of the terms '*dark kitchen*,' 'cloud kitchen,' 'ghost kitchen,' or 'virtual kitchen'?" Participants could answer 'yes, I know', 'Yes, I have heard' or 'no.' Those who answered 'yes, I know' were then asked, "What does this term refer to?". They were instructed to describe what they thought was most appropriate by giving an open-ended response. Then, participants were presented with the definition of *dark kitchens* used in this study, *"Dark kitchen, cloud kitchen, ghost kitchen, or virtual kitchen are terms used to refer to restaurants that do not have a storefront, without direct customer interaction, and are delivery-only commercial kitchens that rent out shared or private kitchen spaces to food businesses"* (FORBES, 2020; ORACLE, 2022; RINALDI; D'AGUILAR; EGAN, 2022).

In the study's second phase, a questionnaire was used to test hypotheses regarding willingness to pay for meals prepared in *dark kitchens*. Since this is the first study to address consumer perceptions of *dark kitchens*, the questionnaire consisted of 26 items adapted from different studies (HAKIM et al., 2020; HAKIM; ZANETTA; DA CUNHA, 2021; RAY et al., 2019). The items correspond to seven constructs: willingness to pay and purchase intention, trust in health authorities, trust in food delivery app, perceived food safety, quality control, consumer experience, and solidarity with foodservice sector. The indicators were measured using a five-point Likert scale adapted to each type of statement, ranging from 1 (totally unwilling/totally distrust/totally disagree) to 5 (totally willing/totally trust/totally agree). Finally, in the third and last phase of the questionnaire, eight questions were asked about the participants' sociodemographic characteristics.

3.3 Data analysis

The analysis of the text data (open-ended responses) was performed using the software *Interface de R pour les Multidimensionnelles de Textes et de Questionnaires* (IRaMuTeQ). The IRaMuTeQ software allows the quantification of essentially qualitative variables derived from unstructured data (i.e., texts) to describe the material that comes from a particular person or group (CAMARGO; JUSTO, 2013). Overall, two textual analyzes were used: (1) Classical lexicographic analysis to review statistics on the number of text segments, occurrences, forms, and hapax; (2) Descending hierarchical classification to detect the dendrogram with the emerged classes, where the higher the chi-square ($\chi 2$) value, the more the word is associated with the class. Words with a $\chi 2$ value of < 3.80 were not considered ($p < 0.05$).

To test the hypothesis model, indicators were first assessed by confirmatory factor analysis (CFA) using diagonally weighted least squares. $\chi 2$ ($p < 0.05$), root mean square error of approximation (RMSEA < 0.08), comparative fit index (CFI > 0.90), standardized root mean square residual (SRMR < 0.08), Tucker-Lewis index (TLI > 0.90), and goodness of fit index (GFI > 0.90) were used to test model fit (KLINE, 2016)

Partial least squares structural equation modeling (PLS-SEM) was chosen to test the hypotheses. PLS-SEM technique is justified where the theory is insufficiently grounded (HENSELER; RINGLE; SINKOVICS, 2009). Also, PLS-SEM has less stringent assumptions about the normality of the variables. The measurement model (the part of the model that describes the relationships among the latent variables and their indicators) was assessed through factor loadings (>0.40), composite reliability (CR>0.80), and the average of variance extracted (AVE>0.40). Correlations' heterotrait-monotrait ratio (HTMT) was used to assess the discriminant validity (<0.85) (HAIR et al., 2016; HENSELER; RINGLE; SINKOVICS, 2009). Multicollinearity was assessed using the variance inflation factor (VIF) value (<5.0). The structural model (part of the model that describes the relationships among the latent variables) was assessed through variance explanation of the endogenous constructs, effect size (f^2>0.15), and predictive relevance (Stone-Geisser's Q^2 >0.15). Effect size (f^2) was classified as small ($f^2 \geq 0.02$), medium ($f^2 \geq 0.15$), or large ($f^2 \geq 0.35$) (COHEN, 1988). A bootstrapping procedure with 5,000 samples was used to estimate the t-statistics and the *p*-values (significance: p<.05) of the estimated loadings.

There were no problems with missing data. The volunteer had to complete the entire form before submission. Statistical analyzes were performed using Statistical Package for Social Sciences (SPSS) v.20 (IBM Corp. Armonk – U.S.), JASP 0.16.1 (University of Amsterdam), and SmartPLS v3.2.8 (SmartPLS GmbH. Bönningstedt - Germany) (RINGLE; WENDE; BECKER, 2015).

4. Results

4.1 Descriptive and '*dark kitchen*' definitions

The sample consisted of 623 individuals from different regions of Brazil, with most participants from São Paulo (61.7%) and Mato Grosso States (27.1%). The sample is composed of 29.2% young adults (18-29 years old), 62.5% adults (30-59 years old), and 8.3% elderly (≥ 60 years old). The sample is highly educated, with 77.5% completing higher education (Table 1) and predominantly females (66.6%). Despite their high level of education and youth, the sample matched the profile of FDA users (ZANETTA et al., 2021; ZHAO; BACAO, 2020) and is also a sample with similar characteristics to Brazilians who use social media most intensively (DIAS, 2020).

Table 1. Sample characteristics.

Variable	n	%	Variable	n	%
Gender			**Education level**		
Female	415	66.6	Incomplete primary education	2	0.3
Male	202	32.4	Complete primary education	1	0.2
Non-binary	3	0.5	Incomplete high school	5	0.8
I prefer not to say	2	0.3	Complete high school	54	8.7
I prefer to describe myself	1	0.2	Incomplete higher education	78	12.5
Marital status			Complete higher education	202	32.4
Single	263	42.2	Postgraduate	281	45.1
Married	315	50.6	**Monthly family income***		
Divorced	40	6.4	None	10	1.6
Widow	7	1.1	Up to R$1,212.00	12	1.9
Age			R$1,212.01 to R$3,636.00	78	12.5
18-29	182	29.2	R$3,636.01 to R$7,272.00	142	22.8
30-39	168	27.0	R$7,272.01 to R$10,908.00	124	19.9
40-49	132	21.2	R$10,908.01 to R$14,544.00	87	14.0
50-59	89	14.3	R$14,544.01 to R$18,180.00	57	9.1
60 or more	52	8.3	More than R$18,180.00	113	18.1

* $1 = R$4.92 (May, 2022).

Overall, 27.3% reported knowing what a '*dark kitchen*' is, 46,1% reported having heard of the term *dark kitchen*, and 26.6% reported not knowing it. However, only 1% of the respondents fully described the term's meaning. In the classical lexicographic analysis, the textual corpus included 74 text segments (TS), 1880 occurrences, 418 forms, and 243 words that occurred only once (number of hapax). In the descending hierarchical classification, the use of the textual corpus was 62 of the 74 (83.78%) text segments. The analyzed content was categorized into four classes: Class 1 - "Local without a storefront and direct public interaction"; Class 2 - "Delivery-only establishments"; Class 3 - "Restaurant

without on-site consumption selling online"; and Class 4 - "Shared space kitchens working for take-out" (Figure 2).

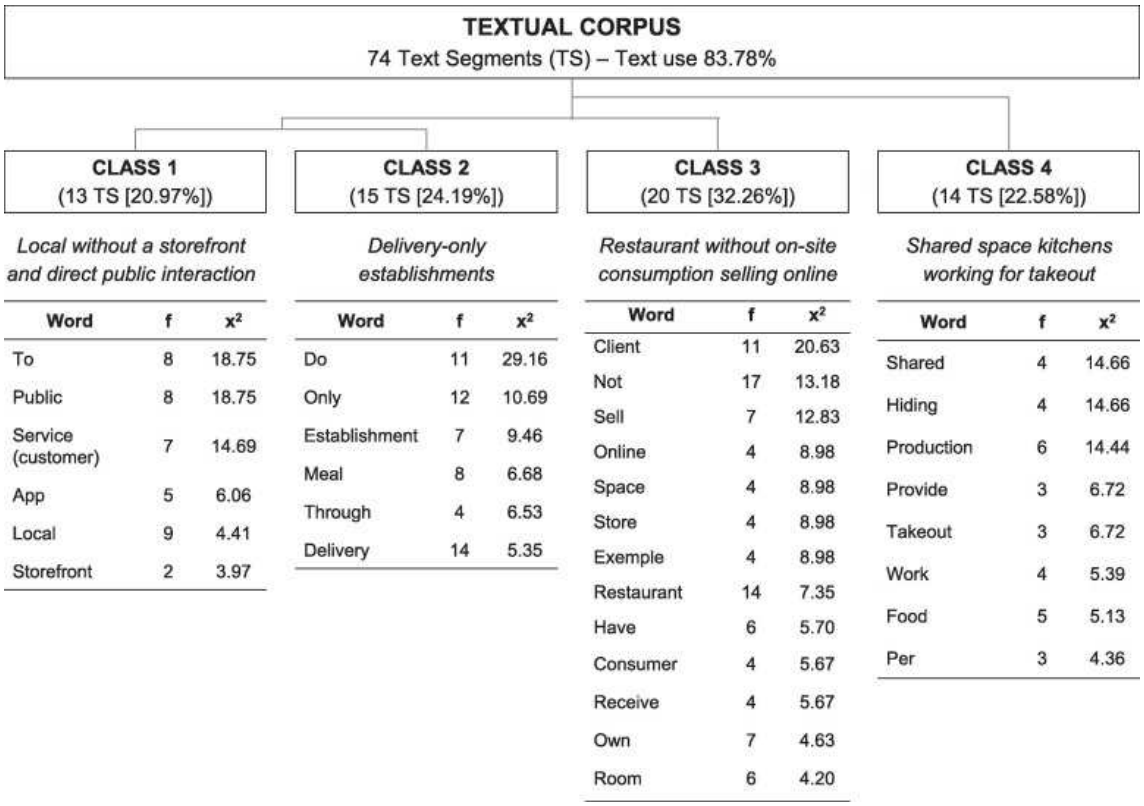

Figure 2. Dendogram of the Descending hierarchical classification of textual corpus.

All classes shared important references for the definition of *dark kitchens*. In the first class, it can be seen that consumers related the term *dark kitchen* to places without storefronts and without direct public service, such as a counter. This is evident in the responses *"restaurants without a storefront"; "(Dark kitchens) are places that produce meals without the public having personal access to them, they operate by delivery.*" The second class focused on the "delivery" characteristic. In this class, *dark kitchens* were defined as services that operate only through delivery. This can be noted in the responses "*These are restaurants and facilities that only offer meal delivery service"; "Places that only make food for delivery".* Classes 1 and 2 shared more similarities between them.

Class 3 focuses on restaurants that do not have on-site consumption and sell online. Interestingly, this category does not encompasses the word delivery, although online sales are included, e.g., "*Restaurant with closed doors, with no place to serve the public"; "(Restaurants with) no customer area, is a new online restaurant marketplace that has no physical store."* Class 4 is the furthest

from the other classes. This class provides some correct guidance on the definition of *dark kitchens*, but does not focus on the core of this model, i.e., restaurants that are deliver-only. Consumers have highlighted that *dark kitchens* operate in shared spaces in this class. They have also included a definition of take-out only, e.g., "*Agglomeration of kitchens that deliver food and the like, with no personal service on-site"; "a place that is exclusively take-out."*

Some consumers misstated the meaning of *dark kitchens*,e.g., *"Small kitchen without windows"*. In addition, some consumers attributed negative characteristics to the term, e.g., *"A dirty kitchen"; "Which has no registered person in charge, that is, clandestine"; "The kitchen where the consumer does not know how the operation works"; "Restaurants set up by delivery services that have no physical space for customers and compete unfairly with traditional restaurants on the platform*". However, it was impossible to observe a class with wrong or misstated definitions due to a $\chi 2 < 3.80$ for such words.

4.2 Measurement model

The CFA showed adequate agreement with the chi-square (χ^2=972.4; $p < 0.001$), indicating good agreement between the hypothesized model and the observed variable data. An acceptable RMSEA=0.072 was also observed, with a reasonable discrepancy between observed and hypothesized covariance matrix. All other fit indices showed a good fit: CFI =0.99, SRMR=0.06, TLI=0.99, and GFI=0.99. One question was removed from the constructs "trust in health authorities" and "willingness to pay and intention to purchase" to improve the reliability and validity of these constructs. All constructs had adequate reliability, with CR >0.80 and indicators with a factor loading >0.65 (Table 2). All VIF scores ranged from 1.32 to 3.99, which is below the threshold of 5.0 (RINGLE; WENDE; BECKER, 2015). Thus, there is no significant problem of collinearity. All AVE were >0.70, and HTMT values ranged from 0.318 to 0.822, which is below the threshold of 0.85 (HENSELER; RINGLE; SARSTEDT, 2015), demonstrating adequate discriminant validity (Table 3).

Table 2. Factor loadings, means, standard deviation, composite reliability, and average variance extracted of constructs and indicators.

Factors/ Indicators	Factor loading	Mean ± SD
Trust in health authorities (*adapted from Hakim et al., 2020)* (CR = 0.881; AVE = 0.716)	-	-
How much do you trust health authorities to actually guarantee the safety of food produced in *dark kitchens*?	0.934	2.56 ± 1.21
How much do you trust health authorities to monitor, regulate, and enforce food hygiene regulations in *dark kitchens*?	0.929	2.39 ± 1.23
How much confidence do you have in the work of the health authority?	0.656	3.22 ± 1.20
There is no difference between the health authority's inspection of regular restaurants and *dark kitchens*.	*	2.63 ± 1.36
Trust in food delivery app *(adapted from Hakim et al., 2020)* (CR = 0.913; AVE = 0.724)	-	-
How much do you trust the app operator to actually guarantee the safety of food produced in *dark kitchens*?	0.867	2.33 ± 1.17
How much do you trust the app operator to verify the restaurants' food safety before adding them to their platform?	0.896	2.23 ± 1.20
If a restaurant is available on the platform, it is certainly safe regarding food hygiene.	0.885	2.19 ± 1.14
How much do you trust the app operator to monitor, regulate, and enforce food hygiene regulations in *dark kitchens*?	0.747	2.03 ± 1.14
Perceived food safety *(adapted from Hakim et al., 2020; Hakim, Zanetta & da Cunha, 2021)* (CR = 0.856; AVE = 0.666)	-	-
I am just as likely to get a stomachache, diarrhea, or vomiting from meals served in *dark kitchens* as I am from meals served in regular restaurants.	0.739	3.29 ± 1.29
I do not care if a restaurant has regular or *dark kitchen* if it was recommended by a friend or family member.	0.854	3.45 ± 1.39
The quality of the food is the same in a regular restaurant as it is in a *dark kitchen*.	0.850	3.13 ± 1.23
Quality Control *(adapted from Ray et al., 2019)* (CR = 0.904; AVE = 0.702)	-	-
If you know the restaurant is a *dark kitchen*, you will feel confident making a purchase if the app shows pictures of food sold in a *dark kitchen*.	0.822	2.99 ± 1.26
If you know the restaurant is a *dark kitchen*, you feel safe buying it if the app shows a good consumer rating of food from *dark kitchens*.	0.868	3.77 ± 1.18
If you know the restaurant is a *dark kitchen*, you feel safe to buy a meal prepared there if the restaurant appears in the top 15 in the app's list of options.	0.855	3.39 ± 1.26
If you know the restaurant is a *dark kitchen*, you feel safe to buy a meal prepared there if the restaurant appears in a banner (featured ad) in the app.	0.805	2.93 ± 1.22
Consumer experience *(adaptado de Ray et al., 2019)* (CR = 0.924; AVE = 0.752)	-	-
Having a discount coupon is a more important factor in choosing a restaurant than whether it is regular or *dark kitchen* type.	0.882	2.61 ± 1.38
The purchase advantage with cashback (money back when you buy this product/service) is a more important factor in choosing a restaurant than whether it is a standard or *dark kitchen*.	0.880	2.57 ± 1.35
The presence of special offers in the restaurant (discount, buy two, pay one, etc.) is a more important factor in choosing a restaurant than if it is a standard or *dark kitchen*.	0.896	2.78 ± 1.29
If a *dark kitchen* delivers food faster than a regular restaurant, I feel more motivated to choose the faster option.	0.807	3.18 ± 1.37
Solidarity with the food service sector *(adapted from Hakim, Zanetta & da Cunha, 2021)* (CR = 0.901; AVE = 0.753)	-	-
If you know the restaurant is a *dark kitchen*, how willing are you to buy meals prepared in *dark kitchens* when helping a small business owner?	0.926	3.83 ± 1.21
If you know the restaurant is a *dark kitchen*, how willing are you to buy meals prepared in *dark kitchens* to prevent the restaurant from having to close due to financial problems?	0.917	3.54 ± 1.27
If you know the restaurant is a *dark kitchen*, would you rather buy a meal prepared in a *dark kitchen* than a famous standard restaurant/brand to support that business?	0.750	2.87 ± 1.26
Willingness to pay and purchase intention *(adapted from Hakim et al., 2020)* (CR = 0.914; AVE = 0.782)	-	-
If you know the restaurant is *dark kitchen*, how willing are you to buy meals from *dark kitchens*?	0.937	3.50 ± 1.20
If you know that the restaurant is a *dark kitchen*, how willing are you to buy meals prepared in *dark kitchens* if they are up to 10% cheaper than meals prepared in regular restaurants?	0.939	3.54 ± 1.25
If you know the restaurant is a *dark kitchen*, would you avoid or choose order food there based on this information?	0.766	3.41 ± 1.24

Table 3. Discriminant validity with Hetorotrait-Monotrait of correlations.

Constructs	(1)	(2)	(3)	(4)	(5)	(6)
Trust in food delivery app (1)	-					
Trust in health authorities (2)	0.686					
Quality control (3)	0.459	0.394				
Willingness to pay and purchase intention (4)	0.402	0.414	0.757			
Consumer experience (5)	0.348	0.318	0.630	0.594		
Responsiblity with the food sector (6)	0.427	0.417	0.759	0.853	0.561	
Perceived food safety (7)	0.459	0.461	0.822	0.819	0.608	0.711

4.3 Structural model

The structural model showed reasonable predictive relevance (Stone-Geisser's Q2 = 0.51) and a satisfactory coefficient of determination (adjusted R^2 = 0.66). In the structural model (Figure 3), hypotheses 1, 2, 4, 5, and 6 could be confirmed. Hypothesis 3 could not be confirmed. Willingness to pay and purchase intention for meals sold by *dark kitchens* restaurants in Brazil were influenced by perceived food safety (H1: β=0.273; p<0.001; f^2=0.11), trust in health authorities (H2: β=0.059; p=0.047; f^2=0.01), quality control (H4: β=0.125; p=0.003; f^2=0.02), consumer experience (H5: β=0.110; p=0.002; f^2=0.02), and responsibility with the food sector (H6: β=0.440; p<0.001; f^2=0.30) as positive predictors.

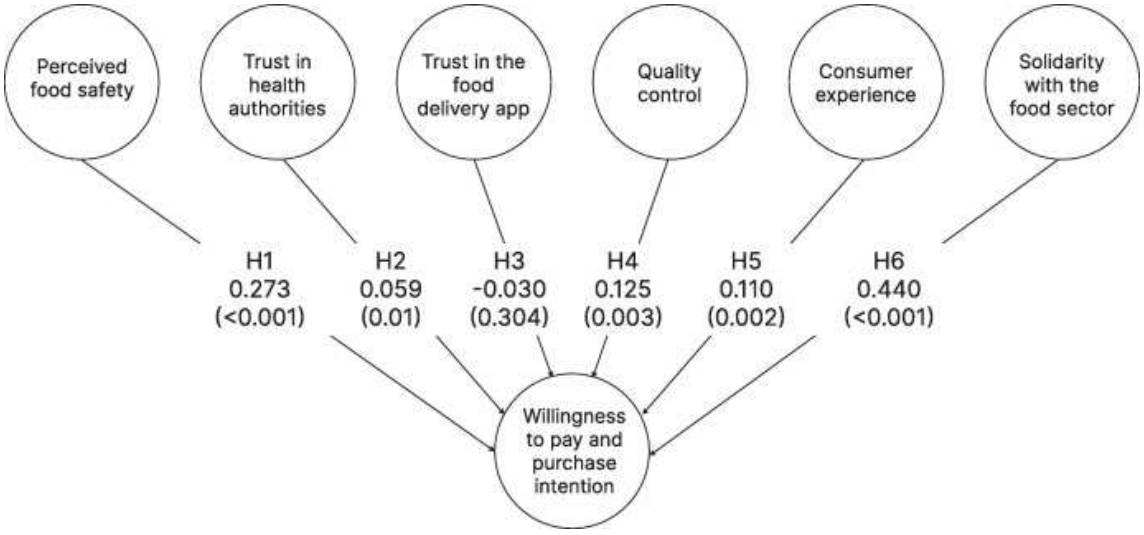

Figure 3. Final inner path model. *The numbers represent the path coefficient values (β), and the numbers within parenthesis represent the p-values.*

5. Discussion

5.1 General discussion

This study's objective was to better understand consumers' purchase intention and willingness to pay for meals sold by *dark kitchens* in Brazil. First, it was necessary to know how widespread the term *dark kitchens* is and what people understand by it. In this study, we found that most consumers have only heard of *dark kitchens* or do not even know what they are. Some consumers do know what *dark kitchens* are, but the information is fragmented. There is confusion about whether these kitchens are storefront-less, exclusive delivery services, services without on-site consumption, or shared kitchens. These four definitional classes share important information about what a *dark kitchen* is. However, incomplete information can lead to misinterpretation, bias, and difficulty in decision making. For example, the term dark seems to have a negative connotation among some consumers. Although there are several terms for a *dark kitchen* (e.g., Cloud Kitchens, Virtual Kitchens, and Ghost Kitchen), this term has been used in Brazil mainly in reports (KER, 2022; VIEIRA, 2022b). For this reason, this term was mainly used in this research. Dark, as an adjective, has the meaning of evil or sad, according to the dictionary (CAMBRIDGE DICTIONARY, [s.d.]). Metaphorically, interpretations of something positive are associated with brightness and interpretations of something negative are associated with darkness (MEIER et al., 2007). This could underpin a negative understanding of the *dark kitchen* model. In this case, food industry stakeholders and the FDA operators should carefully publicize and ensure the safety of this kitchen model to promote *dark kitchens*.

Based on SEM, this study found that the factors of perceived food safety, trust in health authorities, quality control, consumer experience, and responsibility with the foodservice sector were positive predictors of willingness to pay for meals sold by *dark kitchens*. As theoretical contributons this study enrich the literature of foodservice industry and technology. The experience of eating out in restaurants (on-site) and at home (delivery) is diverse. With this in mind, we identified several technological factors that can extend the "big four attributes" (MATHAYOMCHAN; TAECHARUNGROJ, 2020) model for choosing a restaurant.

Trust in food delivery app was not a significant factor in consumers' willingness to pay. This finding could be related to the fact that people may view the apps only as a kind of phone book they browse. Platforms such as Grubhub, DoorDash, Ele.me, Deliveroo, UberEats, and iFood are third-party restaurant recommendation services. Therefore, app operators are not considered responsible for the product offered by the third parties, and this a very relevant result. In contrast, consumer experience and quality control within the app had a positive effect on willingness to pay. The information provided by the apps about the restaurants and the way the restaurants are presented in the app are important factors in consumers' decision-making behavior. Customers seek satisfaction through previous recommendations from peers (BERMAN, 2005). This makes consumer recommendations an important marketing tool for purchase and loyalty (KAO; TSAUR; HUANG, 2020; KUMAR; OLSHAVSKY; KING, 2022).

The factors of perceived food safety and trust in health authorities also had a positive effect on consumers' willingness to pay. Health authorities in Brazil perceive *dark kitchens* as a challenge because some restaurants with this business profile are not officially registered, nor are inspections conducted before the opening of *dark kitchens* (ASSOCIAÇÃO NACIONAL DE RESTAURANTES, 2020). In addition, there are no studies or official information on food safety in these establishments in Brazil. Although *dark kitchens* are subject to the same standards as conventional establishments and enforced to have a license (SÃO PAULO, 2022), they may be not targeted by health authorities. This is because it is difficult to identify and visit these restaurants. Despite these challenges, the more consumers trust the performance of health surveillance and other food health agencies, the more likely they are to purchase a product from such an establishment. This finding underscores the responsibility of public health agencies and the need for an action plan or regulation specifically for *dark kitchens*.

When consumers perceive food safety in a *dark kitchen* as equivalent to that in a conventional kitchen, their willingness to pay for food in *dark kitchens* increases. However, consumers often underestimate the risks of FBD when eating out (ZANETTA et al., 2022b). In models OFD, uncertainties about the risks

and benefits of a product are greater due to fewer available cues, so more risks or more benefits are perceived (SWINYARD; SMITH, 2003). In the case of *dark kitchens*, it is challenging for consumers to know whether a restaurant is a *dark kitchen* since this is not explicit in FDA. So, this characteristic is not used to shape consumer risk perception. Also, people tend to lower their risk perception when perceived control is high (MCKENNA, 1993). When choosing a restaurant in an FDA, consumers might feel this control (or illusion of control) and reduce their risk perception to avoid anxiety (ZANETTA et al., 2021). Therefore, reporting whether a restaurant is a *dark kitchen* is a transparent form of communication at the FDA, but will likely have little effect on consumers' purchase intentions. With the more widespread use of the term and more data on the sector, perhaps risk perceptions may increase or decrease. This result highlights the importance of strategies to improve food safety in *dark kitchens*.

Finally, solidarity with the foodservice sector is the construct that appears to be most strongly driver for willingness to pay for food sold by *dark kitchens*. Previous findings have shown similar effects on consumers in Brazil. The study by Hakim et al. (2021) discusses the impact of solidarity on intention to visit restaurants during the pandemic of COVID -19. The study by Zanetta et al. (2021) addresses the impact of solidarity in FDA use. As discussed in both studies, we believe that solidarity is related to concerns about the economic crisis in Brazil during the study period. It is likely that this will not be a relevant factor in a period of financial stability or will be a factor with less influence on consumers' willingness to pay. The country's recent history of high levels of hunger, malnutrition, and social inequality may also play a significant role in motivating feelings of solidarity (BERTOGG; KOOS, 2021; MISHRA; RATH, 2020). In developing and emerging countries, selling food and meals is a common option for the unemployed or people in need of additional income (PEREIRA et al., 2021). Together, these factors can trigger feelings of solidarity.

5.2 Practical and policy implications

Based on consumer health and safety issues, the presence of a new business model requires careful monitoring to ensure that risks to the public are always reduced or mitigated. When dealing with potential problems in business,

it is important to know who should take responsibility for consumer safety. Consumers tended to disagree that the app operator was responsible for the food safety of restaurant meals offered and sold through the app. However, since the app is the means of product presentation and purchase transaction, the app becomes an intermediary in the sales chain. Consumers trust the information offered by the app, such as the positive opinions of other customers (as observed in quality control). In this case, it is interesting for the app operators to increase the quality and safety of the restaurants. With more trust and positive opinions, the willingness to pay is higher. The FDA operators should encourage business operators to produce and sell safer food through educational campaigns. Another measure is to require some food safety documentation, such as the open license and food safety training certificate. The app operator can also hire a team of specialists to visit the restaurants to monitor food safety and promote food safety. All these factors can be used in communication strategies to improve operator trust.

A second point highlighted is trust in health authorities. Although significant, the effect of trust in health authorities on consumer willingness to pay had a small effect size. Clearer communication about how health surveillance improves food safety in *dark kitchens* could increase consumer trust. One option would be to create specific guidelines and regulations to promote food safety in home-based kitchens and shared kitchen spaces, with specific topics for such models.

5.3 Limitations and future research

This study has some limitations. The first of these is the difficulty of identifying *dark kitchens*. This is the first study of its kind in Brazil. Despite the popularization of *dark kitchens*, many consumers do not know the term and do not identify this characteristic when choosing their meals. Therefore, consumer perception may still be superficial. Second, we only considered *dark kitchens* that are operated by a third-party provider, i.e., an FDA. There are also *dark kitchens* that sell their meals independently with their own resources and technology. If this is the case, the data may not be generalizable to these food services. Another limitation was the lack of information on which FDAs individual consumers prefer

or use. Possible differences in the way products and services are offered in the various apps from different companies were not considered. App esthetics and features may change how consumers receive and perceive information about restaurants. New studies can make assessments that take these aspects into account.

It is necessary to understand the perception and the difficulties of health authorities in relation to *dark kitchens*. This will allow the creation of new protocols and devices that will help in the monitoring of these restaurants.

Finally, studies evaluating the actual FBD risks that *dark kitchens* may offer are important to assess whether this restaurant model is consistent with consumer perceptions of risk. Is food safety really worse in *dark kitchens* than in conventional restaurants? This analysis is important for building a sustainable and safe business model for the public.

6. Conclusion

This study allowed the investigation of the intention to buy meals produced in *dark kitchens* and the willingness to pay for these meals in Brazil. It was possible to study that solidarity with the food sector was the factor with the greatest positive influence on consumer behavior, followed by perceived restaurant safety, quality control, consumer experience and trust in health authorities. It was also noted that the general public still does not know what *dark kitchens* are. It is important to correctly label this as *dark kitchens* to avoid negative and concerned perceptions of the business model. More studies are needed to better understand the profile of *dark kitchens* and their challenges so that this can be a sustainable business model for owners and safe for consumers.

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CAPÍTULO 3

HOW ARE *DARK KITCHENS* PERCEIVED BY DIFFERENT CULTURES? A CROSS-CULTURAL STUDY IN BRAZIL, POLAND AND THE UNITED KINGDOM.

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How *dark kitchens* are perceived by different cultures? A cross-cultural study in Brazil, Poland and the United Kingdom.

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Abstract

This study aimed to comprehend the knowledge and purchasing factors of dark kitchens (DK) across diverse cultures. To this end, we surveyed 926 consumers in Brazil (BR), Poland (PL), and the United Kingdom (UK). Questions were asked to evaluate subjective and objective knowledge of DK. Subsequently, Likert-scale statements were presented to evaluate trust in health surveillance, trust in food delivery apps, food safety, quality control, user experience, social responsibility, and willingness to buy from DK. Concerning participants' understanding of DK, in BR and PL the most common response was that DK are "restaurants operating exclusively online." In the UK, the predominant response was "restaurants without on-site dining areas" both answers were an accurate description of DK. The positive motivating factors for purchasing intention in DK differed across the three countries. Cultural variations among countries emphasize the importance of adaptive approaches and region-specific strategies.

Keywords: food service; cloud kitchen; virtual kitchen; ghost kitchen; food delivery.

1. Introduction

With improved connectivity, consumers can now access a variety of applications, including virtual markets and online delivery services (FORBES, 2020). Owing to benefits such as reduced costs, time efficiency, safer and healthier food, higher customer loyalty, and more personalized food alternatives, online food ordering and delivery services are considered a fast-growing industry (GVR, 2022). Online food delivery (OFD) services are emerging as a groundbreaking paradigm for meeting the demand for fresh and tasty meals. OFD has grown rapidly in recent years owing to the development of the Internet and related digital technologies, as well as social and cultural developments (BADENES-ROCHA; BIGNE; RUIZ, 2022). Interest in food delivery apps increased significantly during the pandemic (GANI et al., 2023; SHARMA et al., 2021), but even after it ended, the popularity of such apps did not wane (RAZA; ASIF; AKRAM, 2023). Ray et al. (2019) are convinced that OFD has become a popular e-commerce trend and serves as a tool for reaching a larger number of consumers in a cost-effective manner. The first OFD company, Grubhub, was founded in 2004 to replace paper menus with a single website. Since then, Grubhub has changed its business model to connect these restaurants' delivery drivers with consumers. The global OFD market size was estimated at USD 221.65 billion in 2022 and will grow at a compound annual growth rate of 10.3% from 2023 to 2030. This development is primarily driven by increasing internet penetration combined with the proliferation of smartphones, increasing technological advancements, and the emergence of dark kitchens (GVR, 2022).

OFD refers to the online channel through which consumers order food from restaurants and fast-food retailers (ELVANDARI; SUKARTIKO; NUGRAHINI, 2018) including dark kitchens. A dark kitchen is a commercial kitchen that prepares meals for delivery or takeout. In other words, these services operate in a digital space and do not have a dining room or serving area (KHAN, 2020). This means that, while dark kitchens are part of the OFD, they operate only in the virtual space. Dark kitchens are restaurants that operate without direct contact with consumers, have no premises for local consumption, and sell exclusively through online platforms such as personal websites, social media, telephones, third-party apps, or personal apps (HAKIM et al., 2023). Although dark kitchens can be considered a modern phenomenon, the same cannot be

said of food delivery. The history of food delivery dates back to 1889, when King Humberto and his Queen Margherita di Savoia visited Campania in Italy and placed an order for pizza to be delivered to their palace (GAMILLA, 2021). In the modern era, according to Miswar et al. (2022), the first online food order was placed in 1994 for a pizza from Pizza Hut. In 1995 the first online food ordering service namely “World Wide Waiter,” was founded in Silicon Valley, which is now known as Waiter.com (MISWAR et al., 2022).

Scientific literature on dark kitchens is limited, although in recent years, there has been a gradual increase in papers describing the importance and emergence of the phenomenon (CAI; LEUNG; CHI, 2022; DAREKAR; SHENDE; SHAIK, 2020). Some studies have focused on understanding dark kitchens in specific countries, such as Italy (NIGRO et al., 2023), Brazil (HAKIM et al., 2022), the United Kingdom (UK) (RINALDI; D’AGUILAR; EGAN, 2022), and the Asia-Pacific region (MUANGMEE et al., 2022). However, there is a lack of international comparative research on the acceptance of this phenomenon and its needs among consumers in different countries. To fulfill this purpose, this study aims to understand consumers’ perceptions of dark kitchens by adopting a cross-cultural approach in Brazil, the UK, and Poland. This aim is supported by the following research questions.

Q1: How do consumers from Brazil, the UK and Poland define dark kitchens?

Q2: What factors are relevant to these samples in predicting the willingness and intention to buy from dark kitchens?

Q3: Are there differences between consumers from Brazil, the UK, and Poland in their perceptions of dark kitchens?

2. Literature review and contextual background

2.1. Definition of dark kitchens and current research

Currently, there are no universally accepted terms to define dark kitchens. Thus, different names can be used to define this segment, such as cloud or ghost kitchens (NIGRO et al., 2023), gloomy or virtual (BENIWAL; MATHUR, 2022), and invisible, shared, commissary, satellite, or cyber kitchens (CHATTERJEE; SINGH; SINGH, 2022; DIAN et al., 2021; JOHN, 2021; KULSHRESHTHA; SHARMA, 2022; SYAFIQ et al., 2022; UPADHYE; SATHE, 2020). The diversity of names also affects how the phenomenon is defined. For example, Kania-Baran (2020) defined a dark kitchen as "a shared space that is typically used by several or more restaurants/dining establishments to prepare and distribute online orders." However, Syafiq et al. (2022) defined dark kitchens primarily based on their use of the online environment, defining them as "restaurants that do not offer dine-in service and instead rely on online ordering via online food aggregators and the restaurant's website or mobile application."

Based on such definitions, it is possible to elucidate several major characteristics of dark kitchens, that is, (i) Food service development: Dark kitchens focus on food preparation and delivery within offering dine-in options; (ii) Online services through mobile apps or similar: Dark kitchens rely on online platforms or similar digital applications for order placement and processing; (iii) Delivery only or/and take-out model: They operate on a delivery-only or take-out model; (iv) Commercial focus: Dark kitchens are driven by commercial motives to maximize efficiency and profitability and (v) No direct customer interaction: Dark kitchens lack direct face-to-face interaction with customers but rely on digital interfaces for communication. Recently, Da Cunha et al. (2024), proposed a new and broader definition for dark kitchens *"Dark kitchens are food service models that offer ready-to-eat meals for delivery or takeout, ordered via phone, food delivery apps, websites, or social networks. These venues may or may not have a storefront but do not have or offer a space to eat the meals on-site. Dark kitchens may be in independent locations, franchises, shared spaces, inside other restaurants, or even home-based. Dark kitchens may also be known as cloud, ghost, invisible, shared, satellite, virtual, or cyber kitchens."*

Studies on dark kitchens go beyond understanding their definitions and basic characteristics. However, they have only recently begun to appear in

the scientific literature. The literature discusses geographical location, highlighting that dark kitchens tend to be farther away from city centers and more dispersed than traditional restaurants (HAKIM et al., 2023; TALAMINI; LI; LI, 2022). Distance from city centers is one of the various characteristics of dark kitchens that make them attractive to entrepreneurs. This is due to the low initial opening, overhead costs, and reduced operating expenses (BENIWAL; MATHUR, 2022).

Other studies have indicated the presence of dark kitchens in food delivery markets. In India and Brazil, these establishments constitute approximately 30% of restaurants engaged in app-based sales (HAKIM et al., 2023; JOHN, 2021). Owing to the observed growth in the food sector, Hakim et al. (2023) and John (2021) demonstrated in their studies that there is no single operating model for dark kitchens. Although they are dark kitchens, they can have different characteristics and can be categorized into different models.

Other studies have been conducted to understand consumer perceptions and purchasing tendencies related to dark kitchens (CAI; LEUNG; CHI, 2022; CHATTERJEE; SINGH; SINGH, 2022; GUNDEN; MOROSAN; DEFRANCO, 2020; HAKIM et al., 2022; KULSHRESHTHA; SHARMA, 2022; MUANGMEE et al., 2022; WEN; POOKULANGARA; JOSIAM, 2022). Understanding the mindset of consumers is crucial for a new food safety model to strategically focus its efforts and investments on thriving and increasing competitiveness in the market, because numerous variables influence consumers' food choices. However, consumers from different cultures and countries may have different perceptions and intentions toward this model. This is particularly true in countries with different scores in the dimensions of culture, socioeconomic characteristics (HOFSTEDE; HOFSTEDE; MINKOV, 2010), and habits toward food delivery.

2.2. Online food delivery market in different cultures

The market for OFD has grown in recent years, with a growth of 86% in 2020 alone, driven by the pandemic (CHEVALIER, 2022). According to Precedence Research report (2023), a global market research and consulting organization, the key OFD market players are Uber Eats, DoorDash, Grubhub, Just Eat Takeaway, Zomato, Deliveroo, Grab Holdings Inc., Delivery Hero SE,

Ele.me, Rappi, Foodhub, and GoPuff. Many of these are multinational companies. For example, according to Olopade (2021), four companies dominate the US market, taking up 92% of the total market share, and these companies are DoorDash (45%), Uber Eats (22%), GrubHub (18%), and Postmates (8%). A similar effect can be observed in Brazil, where the food delivery market is primarily dominated by iFood, which holds 76% of the total market share. Other companies operating in Brazil have a much smaller share of the market, such as 99Food (2%), Aiqfome (2%), and Rappi (1%) (CHEVALIER, 2022). However, the current situation varies by country. To understand the cultural aspects of dark kitchens better, three countries were selected for this study based on their specific characteristics: Brazil, the UK and Poland.

Brazil is responsible for 49% of the market share in Latin America in 2023 (CHEVALIER, 2023a). However, the use of OFD in Brazil is relatively new. Apart from the already observed growth, it is anticipated in Brazil that OFD will continue to expand until 2027, with particular emphasis on platform-to-consumer delivery services. The current revenue of 6.4 billion U.S. dollars is expected to reach 10.7 billion dollars by 2027 (CHEVALIER, 2023b). Zanetta et al. (2021) identified time saving as a key motivator for OFD purchases in Brazil. However, another primary contributing factor to food ordering is the increased degree of control people have over their spending on websites or sales apps (CHEVALIER, 2023c). This scenario creates an opportunity for delivery apps in the country not to exist solely for food delivery transactions. Food delivery apps are now seen as media vehicles, offering spaces for promotion through advertisements and sales activities (i.e., exclusive promotions, discounts, and benefits offered through partnerships between the food industry and apps) (ABRASEL, 2023). The dark kitchen phenomenon was a viable option for restaurants during the pandemic, and became popular in Brazil (Zanetta et al., 2021).

The OFD market in the UK is substantial and had experienced significant growth in the preceding years. Statista (2023b) reported that revenue in the OFD segment in the UK was expected to reach US$40.64 billion in 2023. The market is projected to have an annual growth rate of 12.12%, resulting in an expected market volume of around US$64.22 billion by 2027. Some of the major OFD services in the country include Just Eat, Deliveroo, Uber Eats, Hungryhouse and Grubhub. In 2021, Just Eat had a 45% market share, and UberEats had 27%

of market share of UK's food delivery app market (DEPHNA, 2022). The average annual spending per person on takeaway food from restaurants in 2021 was £641 (STATISTA, 2023b). These figures highlight the increasing reliance of consumers on OFD services in the UK, a trend that was further accelerated by the COVID-19 pandemic, which led to lockdowns and restrictions on dining out. During this period, many restaurants pivoted or expanded their online delivery services to meet the rising demand for at-home dining experiences. For example, the UK consumer spend via food delivery services rose by 128% in 2020 and Deliveroo's customer base in the UK grew from 3.7 million active consumers to 7.8 million in 2021 (KALBUS et al., 2023). Food delivery in the UK is not just a service but an evolving landscape of food ecosystems and cultural phenomena.

Poland's food delivery market has grown rapidly, especially since the pandemic. The value of this market in Poland is already about $2.25 billion (WRONA, 2022). According to a report compiled by RebelTang, a company that created the first virtual restaurant chain in Poland in early 2022, the most popular apps used to order food are Pyszne.pl, Glovo, and Uber Eats (REBEL TANG, 2022). A similar pattern was noted in another report by the Statista agency (SAS, 2023). This has been confirmed by very few scientific studies conducted by Polish scientists (ZIÓŁKO et al., 2022). The results of a comparative study published by Gieroba & Miłosz (2022) showed that among Pyszne.pl, Glovo, and UberEats, the latter app stood out for having the best interface quality. It is this application and experience that is the focus of different scientific work in Poland (Boichuk, 2022; Kaźmierczak & Szymczyk, 2021; Strzębicki, 2020). In contrast to Brazil and the UK, Polish consumers seem to use OFD less frequently (DATA.AI, 2022). When they do use it, Poles seem to prefer to order food from well-established brands such as McDonalds, KFC and Burger King (SIMILARWEB, 2023).

A recent Food Delivery report (2022) in Poland indicated that the taste and condition of food are the most important factors in determining the opinions of those who order food via OFD. Nevertheless, only 17.3% order food through an app on their phone. The vast majority most often order food by phone (60.3%), while the rest (15.6%) order through a specific restaurant's website, and 6.7% through a website on which they can order food from different restaurants. This condition is primarily due to the fact that in the era of instant messaging and

chatbots, more than half of the consumers surveyed do not have a single food ordering app on their phones (REBEL TANG, 2022).

An analysis of the three countries shows that the UK has a better-developed landscape for OFD systems. This is attributed to the country's extensive history of food delivery, as meals-on-wheels was introduced during World War II. The "wheels" referred to prams used to deliver meals to those who needed them (CAMPBELL et al., 2015). In second place, we see Brazil a continental country, where the OFD system has developed rapidly as it considers consumer demand and access to technology. Finally, in Poland, the OFD market is still growing, but with a different behavior from that in Brazil and the UK.

Many researchers also focus on identifying the factors that influence willingness to buy and purchase intentions behind the use of OFD. Yeo et al. (2017) highlighted hedonic motivation, prior experience, time saving, price saving, convenience, usefulness, and behavioral intention are key factors associated with purchase intentions behind the use of OFD. Other researchers mention factors such as performance expectancy, congruity with self-image, habit, impulse buying tendency, mindfulness, usage intention (GUNDEN; MOROSAN; DEFRANCO, 2020); social pressure, delivery experience, ease of use, quality control (RAY et al., 2019); security app lifestyle compatibility (BELANCHE; FLAVIÁN; PÉREZ-RUEDA, 2020); self-efficacy, construal mindset, regulatory focus, perceived benefits, perceived risk, risk propensity (CAI; LEUNG, 2020); price value, health consciousness, food safety concerns, and prestige value (KAUR et al., 2020). Hong et al. (2023) and Raza et al. (2023), however, drew attention to the role of trust, and Botelho et al. (2023) and Talwar et al. (2023) to social responsibility.

2.3. Proposed model

In line with prior research on OFD (BELANCHE; FLAVIÁN; PÉREZ-RUEDA, 2020; BOTELHO et al., 2023; CAI; LEUNG, 2020; GUNDEN; MOROSAN; DEFRANCO, 2020; HONG; CHOI; JOUNG, 2023; KAUR et al., 2020; RAY et al., 2019; RAZA; ASIF; AKRAM, 2023; TALWAR et al., 2023; YEO; GOH; REZAEI, 2017), and particularly regarding dark kitchens (HAKIM et al., 2022), we present a hypothetical model comprising constructs that could impact purchase intent and willingness to buy meals from dark kitchens (Figure 1).

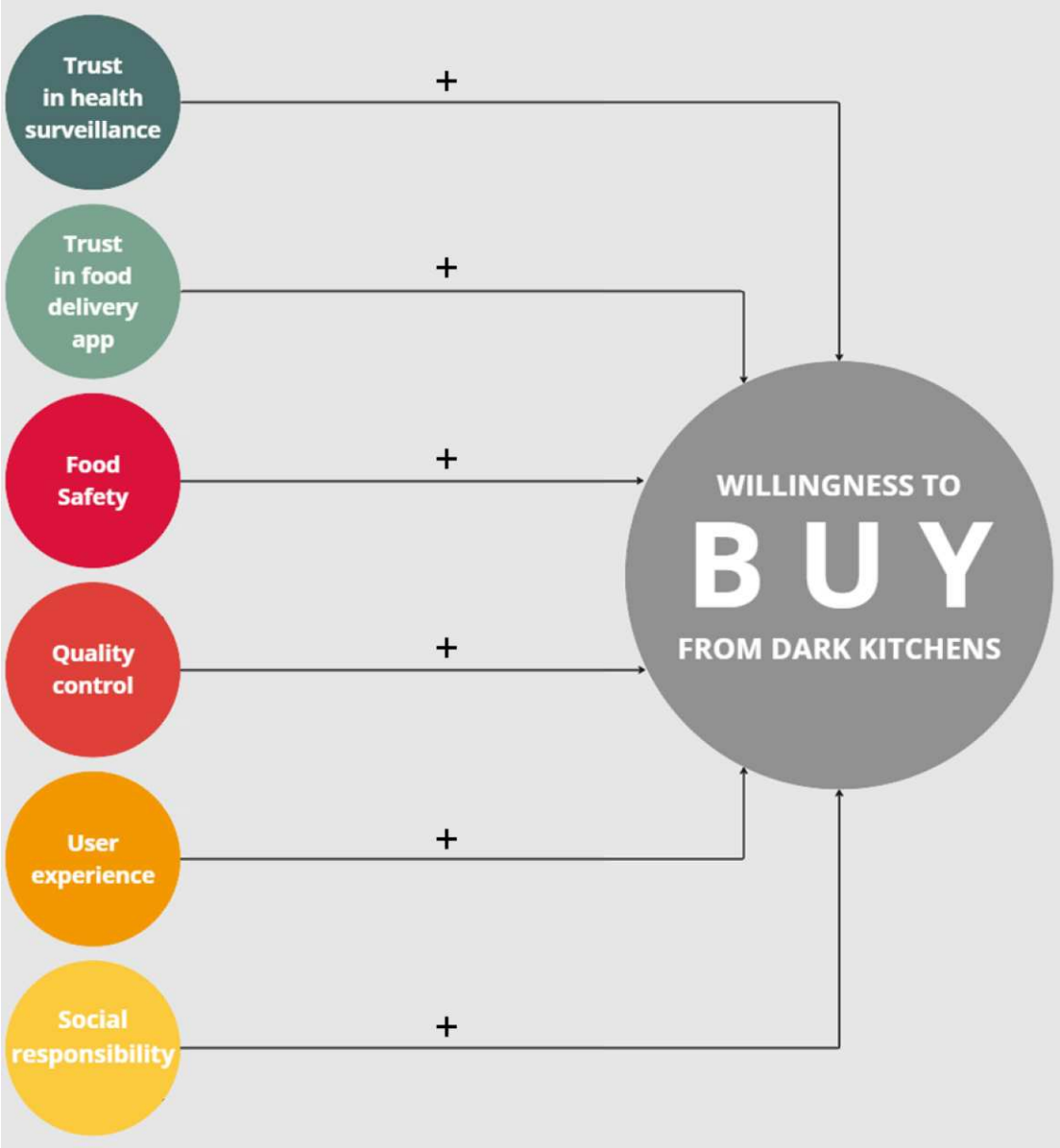

Figure. 1. Proposed model.

The following hypotheses were tested for each of the countries under study:

H1. Trust in health surveillance positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

H2. Trust in food delivery apps positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

H3. Perceived food safety positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

H4. Quality control positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

H5. User experience positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

H6. Social responsibility in the food sector positively affects purchase intentions for meals produced in dark kitchens and the willingness to buy these meals.

3. Methods

3.1. Sample and data collection

Data were collected via the online platform Survey Monkey (SurveyMonkey Inc., San Mateo, US). Data were collected from Brazil, the UK, and Poland in their respective languages: Portuguese, English and Polish. The samples were calculated using the inverse square root method (KOCK; HADAYA, 2018), with a significance level of 5% and a path coefficient of at least 0.15. A sample of 274 people per country was required to estimate the path coefficients.

Invitations to participate in the study, were sent out starting August 2023 via social networks, email lists and personally. A total of 926 questionnaires (Brazil = 310, UK = 306, Poland = 310) were collected by October 2023. All participants were required to be over 18 years and reside in Brazil, the UK, or Poland. The sample was selected considering quotas for gender (approximately 60% women), age (approximately 50% are older than 30), and approximately 50% use food delivery apps at least one to three times a month. To ensure data quality, participants with monotonous responses (i.e., a standard deviation equal to zero) across the indicators were excluded (n = 6). Participants with incomplete data in the main questionnaire (regarding dark kitchens) were excluded (n = 61). Incomplete answers for demographics were considered as missing data.

All the participants provided written informed consent. This study was approved by the Ethics Committee of the University of Campinas (January 10, 2022; protocol number: CAAE42944221.4.0000.5404).

3.2. Measures

This questionnaire was previously used by Hakim et al. (2022). First, all researchers reviewed the original English version of the questionnaire. Minor adaptations were made to the original questionnaire. This new version was adapted to Portuguese and Polish by native speakers with good English proficiency. A back-translation was made into English to ensure consistency, clarity, and meaning.

The questionnaire consisted of 36 questions. There were 12 questions to determine sociodemographic characteristics, typical purchasing behavior on food delivery apps, and knowledge of dark kitchens. Two knowledge-oriented questions were included: one for self-reporting of knowing or not knowing about

a dark kitchen (subjective knowledge), and the other regarding the reported definition of dark kitchens (objective knowledge). In the original questionnaire (HAKIM et al., 2022), knowledge was assessed using an open-ended question. Owing to some limitations in comparing different languages and meanings in the current study, a multiple-choice question was used. Following the responses to this first stage, the definition of a dark kitchen was presented: “Dark kitchen, cloud kitchen, ghost kitchen, or virtual kitchen are restaurants without direct customer interaction and are delivery-only commercial kitchens that rent out shared or private kitchen spaces for food businesses.” Then, 24 statements related to the seven constructs were presented to the consumers. The constructs included trust in health surveillance, trust in food delivery apps, food safety, quality control, user experience, social responsibility, and willingness to buy from dark kitchens. Statements were measured using a five-point Likert scale adapted to each type of affirmative response, ranging from 1 (totally unwilling/totally suspicious/totally disagree) to 5 (totally willing/totally confident/totally agree).

3.3. Data analysis

Partial least squares structural equation modeling (PLS-SEM) was used to test the hypotheses presented by Hakim et al. (2022). PLS-SEM makes less stringent assumptions regarding normality, which differs from covariance-based methods. Additionally, this study tests a new theoretical framework from a predictive perspective, another indication of PLS models, which differs from well-stated theories (HAIR et al., 2019).

The measurement model (the part of the model that describes the relationships between the latent variables and their indicators) was assessed using factor loadings (> 0.40), composite reliability (CR > 0.80), and the average variance extracted (AVE > 0.50). This step was performed for the entire sample and for each country to ensure data quality. The heterotrait-monotrait ratio (HTMT) of the correlations was used to assess discriminant validity (< 0.85) (HAIR et al., 2016; HENSELER; RINGLE; SINKOVICS, 2009). Multicollinearity was assessed using the variance inflation factor (VIF) value (< 5.0). A multigroup analysis (MGA) using PLS was conducted to test whether the data from countries had significant differences in their group-specific parameter estimates. In this case, we aim to determine whether the complete model differs across groups.

First, measurement invariance was tested using measurement invariance of composite models (MICOM). To reduce family-wise errors in this analysis, it was considered p = 0.05 / 3 (groups) = 0,016.

The structural model (part of the model describing the relationships between the latent variables) was assessed based on the variance explanation of the endogenous constructs, effect size (f2 > 0.15), and predictive relevance (Stone-Geisser's Q^2 > 0.15). Effect size was classified as small ($f^2 \geq 0.02$), medium ($f^2 \geq 0.15$), or large ($f^2 \geq 0.35$) (COHEN, 1988). A bootstrapping procedure with 5,000 samples was used to estimate the estimated loadings' t-statistics and p-values. Statistical significance was set at $p < 0.05$.

Chi-square test was used to test the associations and proportions among different countries. Statistical analyses were performed using JASP 0.16.1 (University of Amsterdam), and SmartPLS v3.2.8 (SmartPLS GmbH. Bönningstedt, Germany) (RINGLE; WENDE; BECKER, 2015).

4. Results and discussion

4.1. Descriptives and '*dark kitchen*' definitions

The sample consisted of 859 valid questionnaires from Brazil (n= 271, 31.5%), the UK (n= 296, 34.5%), and Poland (n= 292, 34.0%). Table 1 presents the sample characteristics for each country. Regarding the level of education, more than half of the respondents had higher education, regardless of country. The sample obtained in relation to gender, age, and education level was comparable to the profile of food delivery app users (Data.ai, 2022; Zanetta et al., 2021; Zhao & Bacao, 2020). The monthly income of the participants in this study differed between countries. In Brazil, the highest percentage of the sample was between 4 and 10 minimum wages (39.3%). In the UK (40.9%) and Poland (59.6%), the most common group in the sample was people who reported earning between 1 and 4 minimum wages.

Table 1. Sample socioeconomic characteristics.

Variable	Brazil		UK		Poland		p*
	n	%	n	%	n	%	
Gender							
Female	161	60.3%	167	60.5%	193	66.1%	0.10
Male	105	39.3%	102	37.0%	86	29.5%	
Non-binary	0	0.0%	5	1.8%	5	1.7%	
I prefer not to say	0	0.0%	0	0.0%	1	0.3%	
I prefer to describe myself	1	0.4%	2	0.7%	7	2.4%	
Age							
18-39	120	45.5%	159	57.6%	136	46.9%	0.07
30-39	57	21.6%	52	18.8%	52	17.9%	
40-49	36	13.6%	35	12.7%	48	16.6%	
50-59	37	14.0%	21	7.6%	44	15.2%	
60 or more	14	5.3%	9	3.3%	10	3.4%	
Education level							
higher education (undergraduate)	140	51.6%	167	56.4%	231	79.1%	0.001
I prefer not to say	2	0.7%	2	0.7%	0	0.0%	
primary education	3	1.1%	0	0.0%	0	0.0%	
secondary education	16	5.9%	17	5.7%	17	5.8%	
not answered	110	40.6%	110	37.2%	44	15.1%	
Monthly family income ł							
less than one minimum wage	8	3.0%	31	11.2%	51	17.5%	0.001
1 to 4 minimum wages	38	14.2%	113	40.9%	174	59.6%	
4 to 10 minimum wages	105	39.3%	77	27.9%	64	21.9%	
more than 10 minimum wages	78	29.2%	3	1.9%	3	1.0%	
prefer not to say	38	14.2%	41	14.9%	0	0.0%	
do not know	0	0.0%	11	4.0%	0	0.0%	

*Chi-square test; ł Approximate minimum wage values in Brazil (U$ 286,28), the UK (U$ 2190,00), and Poland (U$ 878,00), considering the differences in minimum wage values in the countries in their currencies (BRASIL, 2023).

In addition to socioeconomic characteristics, this study investigated the respondents' profiles regarding the use of food delivery apps (Table 2). The

samples across the three countries are similar, with most people using food delivery apps one to three times a month. In Brazil, this group corresponds to 55.4%, in the UK, 43.1%, and in Poland, 41.1%. Therefore, our sample represents a group with some experience and familiarity with purchasing food online. Time pressure, coupled with the ease of buying ready-made meals with just one click, becomes an obstacle in preparing meals for consumption (XUE; WANG; WANG, 2024). The most popular meal times for OFD purchases were evening meals and lunches (38.5% for evening meals during weekends in Brazil, 34.8% in UK, and 23.3% in Poland).

Table 2. Sample characteristics towards the use of food delivery app.

Variable	Brazil		UK		Poland		p
	n	%	n	%	n	%	
Frequency of usage of food delivery apps							
once a day or more frequently	3	1.1%	2	0.7%	3	1.0%	<0.001
3 to 6 times a week	57	21.3%	11	4.0%	16	5.5%	
1 to 3 times a month	148	55.4%	119	43.1%	120	41.1%	
less than once a month	31	11.6%	99	35.9%	112	38.4%	
never or rarely	28	10.5%	45	16.3%	41	14.0%	
Types of meal/food most frequently purchased using food delivery apps							
breakfast (weekdays)	0	0.0%	0	0.0%	7	1.2%	
breakfast (weekends)	2	0.3%	1	0.2%	5	0.9%	
brunch (weekdays)	3	0.5%	0	0.0%	10	1.7%	
brunch (weekends)	2	0.3%	2	0.3%	9	1.5%	
lunch (weekdays)	69	12.1%	3	0.5%	116	19.9%	
lunch (weekends)	87	15.2%	1	0.2%	113	19.4%	
afternoon tea (weekdays)	8	1.4%	13	2.3%	19	3.3%	
afternoon tea (weekends)	27	4.7%	30	5.2%	18	3.1%	
evening meals (weekdays)	105	18.4%	140	24.5%	101	17.3%	
evening meals (weekends)	220	38.5%	199	34.8%	136	23.3%	
groceries (weekdays)	21	3.7%	72	12.6%	27	4.6%	
groceries (weekends)	13	2.3%	71	12.4%	22	3.8%	
not applicable	15	2.6%	40	7.0%	0	0.0%	

Regarding the respondents' knowledge of dark kitchens, participants were allowed to select multiple definitions that corresponded to characteristics that either fit with or deviated from the concept of a dark kitchen (Figure 2). In Brazil (21.3%) and Poland (26.6%), the most representative answer was "Restaurants that sell exclusively online," an answer that fits the group of correct

options in the proposed definitions. In the UK, the most representative response was “restaurants without on-site dining facilities” (18.0%), which is also an accurate definition of dark kitchens. Some of the definition options provided in Figure 2 included inaccurate descriptions of dark kitchens that carry negative connotations about the establishment. This includes illegal restaurants and dirty or inadequate kitchens. Dirty or inadequate kitchens was the second most common response in Brazil (17.4%). In the dendrograms, two combinations of definitions were observed for each country. In Brazil, definitions 1 and 2 were combined with negative definitions (3 and 4) (albeit with some distance between them). Interestingly, definition 3, dirty or inadequate kitchens, was close to definition 2 in all three countries, while definition 9, illegal restaurants, was close to definitions related to direct contact with customers (c8, Brazil and Poland) and kitchens in private homes (c7, UK).

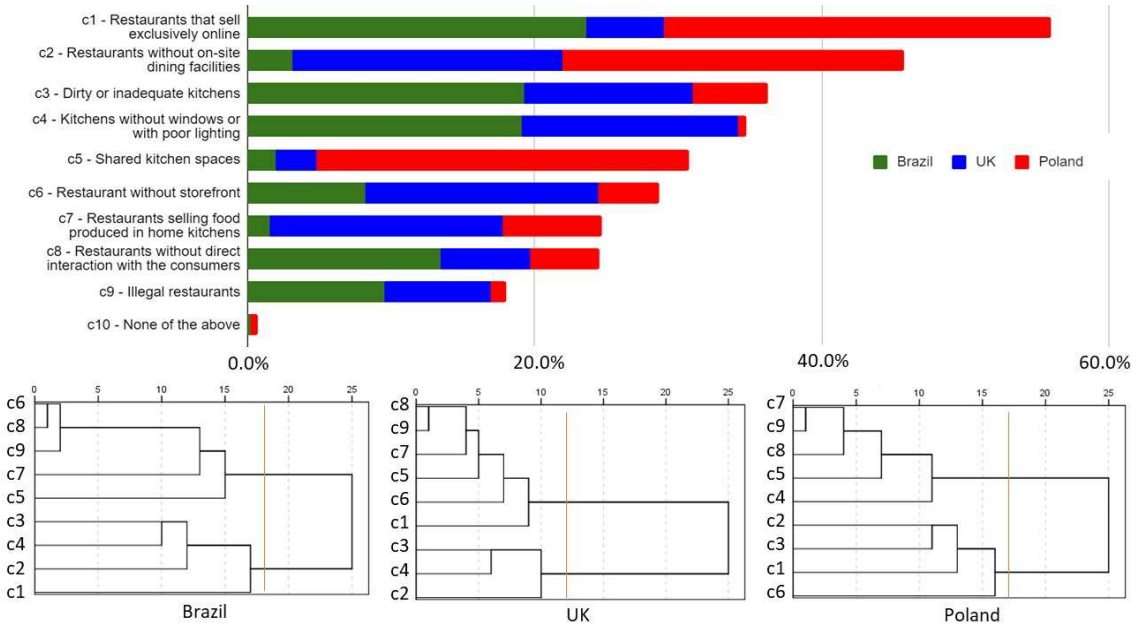

Fig. 2. *Dark kitchen* definitions.

4.2. Measurement model

Table 3 shows the mean values of all the indicators. All constructs had adequate reliability, with CR >0.80 and indicators with a factor loading >0.73. All AVE values were >0.60, showing that the indicators explained more of the variance in constructs than the errors (FORNELL; LARCKER, 1981). All VIF scores ranged from 1.36 to 4.12, which was below the threshold of 5.0, indicating

no significant collinearity problems. The HTMT values ranged from 0.318 to 0.822, which were below the threshold of 0.85, demonstrating adequate discriminant validity (Table 4). Although overall indexes for reliability and validity were presented, all indexes were checked for each country and showed adequate values.

Table 3 - Factor loadings, means, standard deviation, composite reliability, and average variance extracted of constructs and indicators.

Constructs/ Indicators	Brazil	UK	Poland
Trust in health authorities	-	-	-
How much do you trust health authorities to actually guarantee the safety of food produced in dark kitchens?	2.406	3.737	3.107
How much do you trust the health authority to monitor, regulate, and enforce food hygiene legislation in dark kitchens?	2.278	3.248	3.003
How much confidence do you have in the work of the health authority?	3.541	3.949	3.175
There is no difference between the health authority's inspection of regular restaurants and dark kitchens.	2.120	3.252	3.079
Trust in the food delivery app	-	-	-
How much do you trust the app company to actually guarantee the safety of food produced in dark kitchens?	1.891	2.964	2.653
How much do you trust the app company to verify the restaurants' food safety before adding it to their platform?	1.756	2.361	2.515
If a restaurant is available on the platform, it is certainly safe regarding food hygiene.	2.045	3.274	2.708
Perceived food safety	-	-	-
I am just as likely to get a stomachache, diarrhea, or vomiting from meals served in dark kitchens as I am from regular restaurants.	3.158	2.551	3.945
I do not care if a restaurant has regular or dark kitchen if it was recommended by a friend or family member.	3.286	3.642	3.749
The quality of the food is the same in a regular restaurant as it is in a dark kitchen.	2.981	2.861	3.491
Quality Control	-	-	-
Knowing that the restaurant is a dark kitchen, you feel safe buying when the app shows pictures of food being sold in a dark kitchen.	3.049	3.015	2.818
Knowing that the restaurant is a dark kitchen, you feel safe buying it when the app shows a good consumer rating of food from dark kitchens.	3.861	3.810	3.669
Knowing that the restaurant is a dark kitchen, you feel safe to buy a meal prepared there if the restaurant appears in the top 15 in the app's list of options.	3.365	3.624	3.684
Knowing that the restaurant is a dark kitchen, I feel safe to buy a meal prepared there when the restaurant appears in a banner (featured ad) in the app.	2.936	3.237	2.512
User experience	-	-	-
Possessing a discount coupon is a more important factor in choosing a restaurant than whether it is regular or dark kitchen type.	2.816	3.182	2.890
The purchase advantage with cashback (money back when you buy this product/service) is a more important factor in choosing a restaurant than whether it is a standard or dark kitchen.	2.677	3.095	2.691
The presence of special offers in the restaurant (discount, buy two, pay one, etc.) is a more important factor in choosing a restaurant than if it is a standard or dark kitchen.	2.895	3.551	2.990
If a dark kitchen delivers food faster than a standard restaurant, I feel more motivated to choose the faster option.	2.974	3.476	3.217
Social responsibility	-	-	-
If you know the restaurant is a dark kitchen, how willing are you to buy meals prepared in dark kitchens when helping a small business owner?	2.711	3.124	2.780
If you know the restaurant is a dark kitchen, how willing are you to buy meals prepared in dark kitchens to prevent the restaurant from having to close due to financial problems?	3.632	4.026	3.787
If you know the restaurant is a dark kitchen, would you rather buy a meal made in a dark kitchen than a famous standard restaurant/brand to support that business?	3.203	4.219	3.426
Willingness to buy and purchase intention	-	-	-
If you know the restaurant is dark kitchen, how willing are you to buy meals from dark kitchens?	3.429	3.464	2.966
If you know that the restaurant is a dark kitchen, how willing are you to buy meals prepared in dark kitchens if they are up to 10% cheaper than meals prepared in regular restaurants?	3.560	3.777	3.663
If you know the restaurant is a dark kitchen, would you avoid the restaurant or order food there based on that information?	3.523	3.507	3.286

Table 4 – Composite reliability, average variance extracted and discriminant validity with HTMT of correlations.

Constructs	CR	AVE	(1)	(2)	(3)	(4)	(5)	(6)
Trust in health authorities (1)	0.902	0.755	-					
Trust in the food delivery app (2)	0.930	0.769	0.707	-				
Perceived food safety (3)	0.839	0.638	0.436	0.528	-			
Quality control (4)	0.902	0.690	0.502	0.613	0.718	-		
User experience (5)	0.919	0.743	0.409	0.439	0.459	0.650	-	
Social responsiblity (6)	0.882	0.710	0.531	0.564	0.589	0.687	0.616	-
Willingness to pay and purchase intention (7)	0.943	0.843	0.467	0.464	0.628	0.719	0.643	0.832

CR = composite reliability; AVE = Average variance extracted

4.3. Structural model

The overall model showed adequate predictive relevance, with a Stone-Geisser Q^2 = 0.61. The MICOM procedure established partial measurement invariance. Significant differences were observed in the means of user experience, trust in food delivery apps, social responsibility (Brazil vs. UK); food safety, trust in food delivery apps, trust in health authorities (Brazil vs. Poland); food safety, trust in food delivery apps, and user experience (UK vs. Poland). Based on partial measurement invariance, we proceeded with the MGA's group-specific differences.

Figure 3 illustrates the three models. In the Brazil model the willingness to buy from dark kitchens were predicted by trust in health surveillance (f^2 = 0.01), food safety (f^2 = 0.02), quality control (f^2 = 0.05), user experience (f^2 = 0.05) and social responsibility (f^2 = 0.47). In the UK model, willingness to buy from dark kitchens was predicted by food safety (f^2 = 0.04), quality control (f^2 = 0.06), user experience (f^2 = 0.09), and social responsibility (f^2 = 0.26). In the Poland model, food safety (f^2 = 0.03), user experience (f^2 = 0.07) and social responsibility (f^2 = 0.18) were positive predictors.

The coefficient of determination of the UK model (R^2 = 0.79) was significantly higher than that of the Brazil (R^2 = 0.64) and Polland (R^2 = 0.59) models ($p<0.01$, permutation MGA).

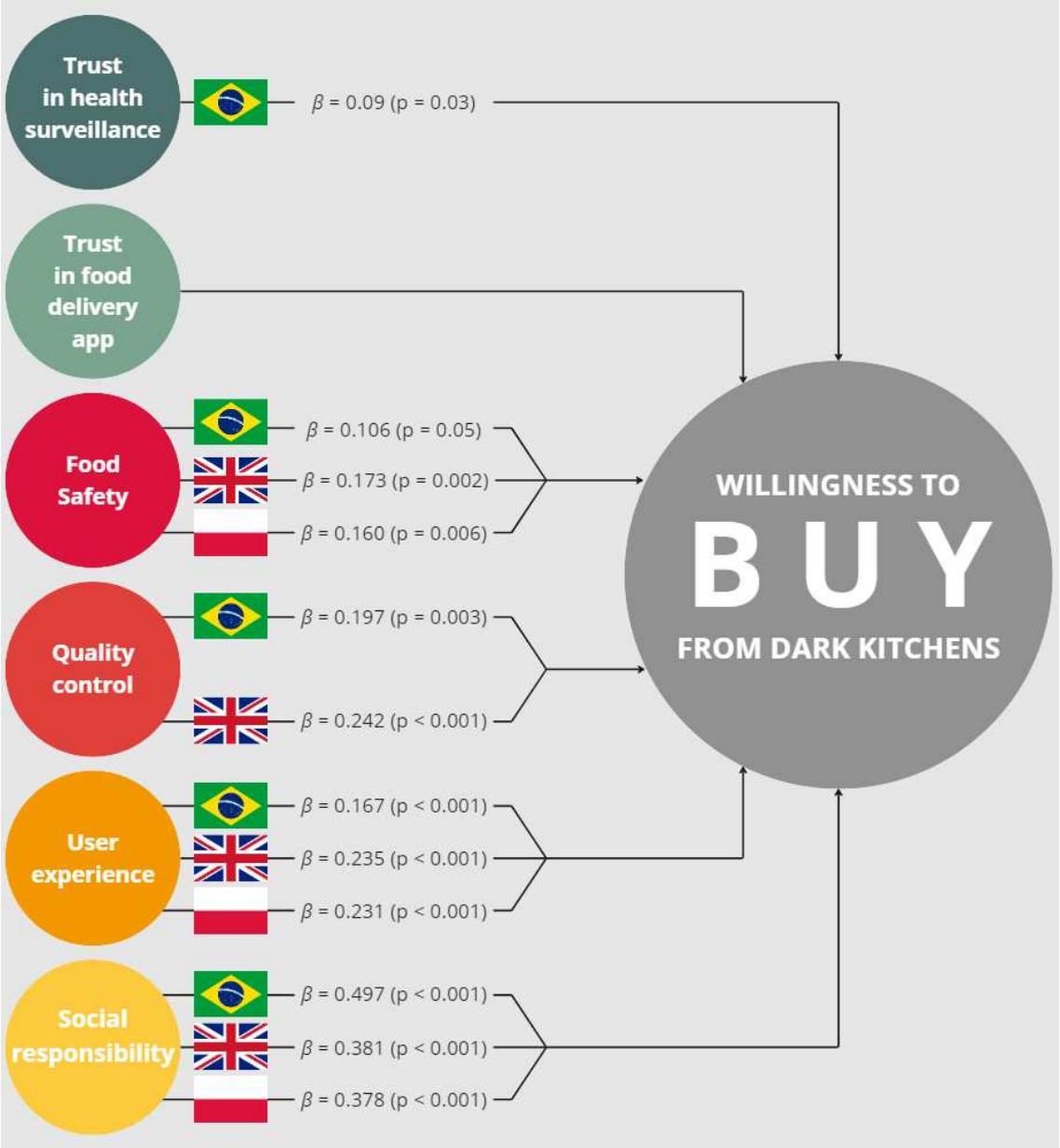

Fig. 3. Final inner path model of willingness to buy from *dark kitchen*s.

5. Discussion

With these research questions in mind, it can be emphasized that consumers in each country understand the nature of dark kitchens and primarily associate them with online services. This is in line with observable market trends in these countries, confirming an increase in the popularity of such services (CHEVALIER, 2023a, 2023b; DEPHNA, 2022; SAS, 2023; STATISTA, 2023b, 2023a). However, because there are also certain associations among consumers with dirt, and thus with a lack of hygiene, it seems necessary to educate consumers, which should primarily be the responsibility of establishments providing such services. Our survey showed that consumers, regardless of their country of origin, do not use this form of meal ordering very often, and are most concerned with evening meals and lunches. Nevertheless, the finding that the definition of illegal restaurants is closely associated with the definition of residential kitchens in Brazil and Poland underscores the need to address both the negative perceptions and low receptivity toward this business model. This suggests a concept with a negative connotation and emphasizes the importance of effectively communicating the profile and purpose of establishments to consumers, provided these purposes are aligned with an appropriate standard of food safety.

Using SEM, this study demonstrated the factors that influence the willingness to buy and purchase intentions from dark kitchens. Although the behavior was similar, it was not the same for all participating samples. Regarding purchase intentions in Brazil, the results were similar to those of an earlier study conducted in Brazil by Hakim et al. (2022). The factors that positively predicted purchase intentions were trust in health surveillance, food safety, quality control, user experience and social responsibility. Similar results were observed in the UK sample, except that trust in health surveillance had no impact on purchase intention from dark kitchens. In Poland, the factors that predicted purchase intention were food safety, user experience, and social responsibility.

Trust in health surveillance factors influencing purchase intentions for dark kitchens was significant only for Brazilians. Interestingly, the Brazilian sample exhibited lower scores for this construct than samples from the UK and Poland. Although there is no nationwide regulation of dark kitchens in Brazil, if consumers have confidence in health surveillance (which is responsible for

regulating and ensuring the food safety of the population), they believe that the food has passed the inspection of the surveillance agency, and the safety of the final consumer is guaranteed. This can be seen as an optimistic bias toward the potential dangers of eating food produced in dark kitchens. When an optimistic bias exists, people tend to reduce their anxiety about the potential dangers of their choices (MILES; SCAIFE, 2003). De Andrade et al. (2019) observed that consumers choose restaurants that they believe have control over the situation, even if that control is illusory. A sense of control may arise from a belief in the health surveillance that controls the safety of the food chosen. In these cases, trust in health surveillance is expected. For consumers in the UK and Poland who have more confidence in their health regulators, there may be no need for this expectation. It can also be explained based on the dimensions of culture, which is different in each country; that is, regarding the dimension “long term orientation” Brazil scores as a normative culture, while Poland and the UK are more pragmatic cultures, where people believe that truth depends very much on situation, context, and time

Furthermore, the systems in both countries (UK and Poland) effectively communicate food safety information to consumers. In the UK, the Food Hygiene Rating Scheme (FHRS) in England, Wales, and Northern Ireland and the Food Hygiene Information Scheme (FHIS) in Scotland provide information about hygiene standards at food outlets to enable consumers to make informed choices when deciding where to purchase food or where to eat out (FHIS, 2022). For example, the FHRS ratings range from 0 to 5, where 0 indicates that urgent improvement is required, and 5 indicates that the hygiene standards are very good (FOOD STANDARDS AGENCY (FSA), 2022). Given that dark kitchens are not easily identified by consumers when observing the app, labeling or safety classifications regarding restaurant food safety could contribute to building confidence in these services. A recent study by Armstrong et al. (2023) found that 78% of respondents (n=5,991) reported that they trust the Food Standards Agency to make sure “food is safe and what it says it is.” Similarly, Murphy et al. (2021) revealed a high level of consumer trust in government organizations that oversee part of the food chain in the UK. The high level of trust among UK consumers was further explained by Murphy et al. (2021) and Soon-Sinclair et al. (2023) where the Elliott Review (ELLIOTT, 2014) conducted public

enquiries into the Horsemeat scandal and created fundamental change in food integrity measures and thus increased trust over time.

In this study, food safety positively predicted purchase intentions in dark kitchens in all three countries. Food safety is a major concern when consumers are worried about foodborne diseases, which not only harm their physical health, but also cause losses in terms of consumers' time (Zanetta et al., 2022). Food safety, a characteristic that determines consumer food choices, has been confirmed in various studies. For example, in Poland, the results of a survey conducted by the KPMG agency (2020) were published, confirming that the factor that has gained the most importance in purchasing decisions is product safety, and 58% more Poles have begun to pay attention to this aspect than before the pandemic. Niewczas-Dobrowolska (2022) examined the importance of food safety and its influence on consumers in Poland. There is no difference between Brazil and the UK, where people are more motivated to consume food when they feel that the food safety- associated risks are mitigated (HAKIM; ZANETTA; DA CUNHA, 2021; JIN et al., 2023). Risk-related events can directly impact risk behavior. The results presented here as well as those of other studies show that food safety issues can shape consumer behavior (CHUNG; YUN, 2013; MASUDA; GARVIN, 2006). However, food safety in dark kitchens remains a concern. To date, no study has examined food safety management in dark kitchens, which raises some important questions for future studies: Can physical distance between consumers and dark kitchen employees potentially impact employees' commitment to food safety? When employees have limited or no direct interactions with consumers, do they perceive food safety practices as less critical?

Food safety is not as easily perceived in virtual purchases as in brick-and-mortar restaurants. This can lead to other concerns, such as quality control and user experience, which are important in the purchasing decision process in an OFD. The characteristics observed when evaluating the quality control of brick-and-mortar restaurants differ from those of restaurants that rely on technology for sales and do not have physical premises. As Ray et al. (2019) defined, customers seek virtually available quality indicators to form their opinions. Viewing photos of food preparations, along with reading comments and reviews from other users, can guide a person's expectations of food quality.

Unlike quality control, user experience revolves around the various opportunities that applications possess to attract different consumers by offering distinct experiences. Experience reflects all stages of interaction with the consumer, from decision-making to the moment they receive and enjoy the meal. These include, but are not limited to, the ease of use and interface of the application (KUMAR; JAIN; HSIEH, 2021), information (ALLARD; DUNN; WHITE, 2020) and images available about restaurants and meals (KUMAR; JAIN; HSIEH, 2021), consumer utility actions (e.g., ease in the order placement process, the comfort of filtering food choices and restaurants, and ease of tracking the order) (RAY et al., 2019), and service quality and speed (KHAN, 2020). In this study, we focus on understanding the experiential aspects associated with beneficial actions, such as loyalty programs, coupons, promotions, free shipping, and other practices that can enhance or diminish the appeal of the purchasing experience when using a food delivery app (RAY et al., 2019). User experience was another factor that unanimously affected purchase intentions in the countries studied.

Nowadays, consumers seek personalized experiences through food delivery apps (KAUR et al., 2021). In this sense, promoting actions that make sense to the user can be extremely beneficial from a commercial perspective. Research in Poland shows that experience plays a significant role in food-purchasing decisions. This was confirmed by the results collected by Sowa (2015), covering the years 2013–2019. A very large role of the influence of the experience of others, such as family members or friends, on the consumer's purchasing behavior was indicated in research, which included observations from 1995 to 2018 (MAZUREK-ŁOPACIŃSKA, 2020). The survey questions focused on different purchase types. Positive shopping experiences were also the subject of a study by Dembicka (2021), which confirmed that they directly affect customer loyalty and satisfaction. It can also be explained by the dimensions of culture, as Poland is characterized by a very high preference for avoiding uncertainty, which means that they maintain rigid codes of belief and behavior (HOFSTEDE, 2023; MINKOV; KAASA, 2022).

In terms of social responsibility, this factor positively predicted the intention to buy from dark kitchens in all three countries. This confirms the findings of Hakim et al. (2022) in Brazil. Social responsibility did not appear to be related to dark kitchens alone. Other studies on the food sector have also

identified the importance of solidarity in purchasing decisions (Hakim et al., 2021; Zanetta et al., 2021). Feelings of solidarity arise during times of difficulty, and social and economic uncertainty (BERTOGG; KOOS, 2021; MISHRA; RATH, 2020). Globally, the pandemic has contributed to the growth of this sentiment (GRIMALDA et al., 2021; MISHRA; RATH, 2020) and may explain similar outcomes in Brazil, Poland, and the UK. Grimalda et al. (2021) revealed that individuals exposed to COVID-19 had higher levels of altruism and were more likely to help others. Similarly, our respondents in Brazil, Poland, and the UK were more likely to purchase from dark kitchens to prevent the closure of establishments.

Some peculiarities of the individual countries may have contributed to this result. As discussed by Zanetta et al. (2021), Brazil's economic crisis during the study period could have been related to an increase in solidarity as a purchase driver. Moreover, Brazil is a collective society in terms of the dimension of culture and people belong to 'in groups' that take care of them in exchange for loyalty (Hofstede, 2024). In Poland, the high rate of solidarity with the sector could be due to the fact that Polish consumers are characterized by consumer patriotism. This is confirmed by the results of Kaczmarek & Wieja (2021) study on food market behavior. Nevertheless, this study and the results presented by Maison & Baran (2014), Wolanin-Jarosz (2015) and Górski & Metrycki (2018) on various products show that Poles are moderately ethnocentric.

In seeking to understand the purchasing intent among consumers in Brazil, the UK, and Poland, this study's findings underscore the cultural nuances that shape consumer preferences in each country. Trust in health safety agencies appears to play a crucial role in Brazil, where consumers view inspections and food safety assurances as pivotal factors in making purchase decisions. Conversely, in the UK and Poland, where regulatory systems are perceived as more effective, trust may not be pivotal for consumers. Moreover, differences in consumer preferences may reflect varying perceptions of risk and confidence in health-surveillance systems across each country.

5.1. Study limitations and future research

Our study has some limitations. First, the results cannot be generalized to other geographical areas, as they apply only to three countries.

Another limitation is the lack of previous, similar studies on dark kitchens in Poland. Previous studies explored consumer perceptions and general characteristics of dark kitchens in Brazil and the UK, but not the willingness or intent to purchase from dark kitchens. This fact limits the efficacy of the comparative analysis.

Despite these limitations, this study makes a substantial contribution to literature. Our study adds to the knowledge on consumer behavior in the face of a relatively new phenomenon that is growing rapidly worldwide. We believe that this study fills a gap in the literature on this topic. Importantly, our research is international and cross-cultural, providing additional insights into how the dark kitchen phenomenon is perceived. The model we have developed to assess the perceptions of dark kitchens and which has been tested for reliability, holds considerable importance, with this, the model can be recommended to other researchers for future application, thus making our next original contribution to science. Moreover, we believe that the model can also be used by practitioners such as trade associations involved in promoting such services. Timely insights into consumer behavior can inform service design to cater to various consumer needs.

6. Conclusion

This study provides valuable insights into the factors that predict consumer behavior related to dark kitchens in Brazil, the UK, and Poland and shows the importance of trust in health authorities, concern for food safety, consumer experience, and social responsibility on consumer purchase intentions. The importance of food safety to consumer perceptions and purchasing decisions cannot be overstated. These findings have significant implications for companies operating in international markets, highlighting the need to tailor marketing and operational strategies to the dimension of cultures and cultural preferences of consumers in different regions. It is also important to recognize that companies are not solely responsible for considering these factors. Governments also play an important role in developing appropriate regulations for service provision, promoting food safety and safety perceptions, and increasing consumer awareness. By working hands-in-hand, businesses and government agencies can help create an environment that promotes consumer confidence in dark kitchen services.

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Credit authorship contribution statement

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6 CONCLUSÕES E IMPLICAÇÕES PRÁTICAS

Este projeto busca fornecer um olhar mais preciso sobre o status das *dark kitchens* no Brasil, além de uma compreensão das intenções dos consumidores frente a este modelo. O trabalho foi realizado em três partes para desvendar esses restaurantes por diferentes ângulos.

A primeira etapa desse projeto promoveu uma análise pioneira da presença e caracterização das *dark kitchens* em diferentes centros urbanos do Estado de São Paulo, Brasil. O resultado revelou uma notável participação das *dark kitchens* (27%) dentro de aplicativos de *delivery* de alimentos, sugerindo a relevância desse novo modelo de restaurante como parte do setor de alimentação. Ainda, foi possível observar uma maior dispersão geográfica das *dark kitchens* em comparação com os estabelecimentos tradicionais. A localização é uma característica importante para o sucesso de restaurantes padrão (CHIDAMBARAM; PERVIN, 2018; FISHER, 1997; JUNG; JANG, 2019). Porém, as *dark kitchens* não precisam de atributos como facilidade de acesso e proximidade de aglomerações comerciais para prosperarem, pela não necessidade de fachada e atendimento direto ao público. Assim, não há vantagem competitiva em escolher locais de serviço em regiões mais centrais e consequentemente, mais caras.

Essa redução de gastos com o espaço somada a não necessidade de grandes quantidades de funcionários para serviço, contribuem para o menor custo inicial e de manutenção das *dark kitchens* (RESTAURANT OWNER, 2020). Esse fato se reflete nos preços a serem cobrados pelos estabelecimentos. Foi possível observar que as *dark kitchens* têm uma faixa de preço inferior aos restaurantes padrão. O preço é um fator importante no processo de tomada de decisão dos consumidores em aplicativos de *delivery* de alimentos (TAM; SANTOS; OLIVEIRA, 2020; TANDON et al., 2021; VENKATESH; THONG; XU, 2012; ZANETTA et al., 2021b) e pode ser uma vantagem competitiva desse novo modelo de restaurante. Outra característica que se mostrou diferente para restaurantes padrão e *dark kitchens,* foi o volume de avaliações feitas, que parece ser menor em *dark kitchens.* A menor quantidade de avaliações pode estar relacionada com a menor satisfação do consumidor, reputação da empresa

e, até mesmo, a lucratividade (NIETO; HERNÁNDEZ-MAESTRO; MUÑOZ-GALLEGO, 2014). Assim, esses resultados mostram a importância de criar estratégias específicas para as *dark kitchens.*

No entanto, também foi evidenciado que nem toda *dark kitchen* terá as mesmas características. Ainda nessa etapa, foi possível identificar seis modelos distintos de *dark kitchens*, abrangendo desde cozinhas independentes até *franchising* e *dark kitchens* em restaurantes convencionais, destacando a adaptabilidade e a diversidade desse fenômeno em resposta às diferentes demandas locais e contextos econômicos. Embora sejam necessários estudos futuros para aprofundar a compreensão das características, desafios e benefícios de cada um desses modelos, é crucial ressaltar a urgência de regulamentação, levando em conta os atributos e os potenciais riscos associados a esses modelos. Especialmente considerando que muitos desses estabelecimentos são de difícil identificação para os órgãos reguladores, o que torna ainda mais complexa a fiscalização e compromete a proteção da saúde do consumidor.

Após explorar as características das *dark kitchens*, tornou-se evidente a necessidade de compreender como o consumidor percebe esses restaurantes. A segunda etapa desse trabalho foi o primeiro estudo a abordar o conhecimento, a intenção de compra e a disposição para pagar por refeições provenientes de *dark kitchens* no Brasil. Com relação ao conhecimento, constatou-se que a maioria dos consumidores ouviu falar no termo *dark kitchen,* mas apenas 1% dos participantes descreveu completamente e corretamente o que ele significa.

Ainda que, com pouca disseminação do termo, ao analisar os dos fatores que afetam as tomadas de decisão dos consumidores, foi possível observar que a solidariedade foi o fator com maior influência positiva na disposição de pagar por refeições feitas em nestes restaurantes. A solidariedade, apesar de sua relevância, possivelmente está relacionado com períodos de insegurança e instabilidade financeira (BERTOGG; KOOS, 2021; MISHRA; RATH, 2020). Sendo assim, pode ser algo transitório devido ao momento de crise econômica vivido no Brasil no período que o estudo foi conduzido. Outros fatores, como percepção de segurança do restaurante, controle de qualidade, experiência do consumidor e confiança nas autoridades de saúde também afetaram positivamente a disposição de pagar de *dark kitchens.*

Quando os consumidores percebem que uma *dark kicthen é* tão segura quanto um restaurante padrão, sua disposição de pagar pelo novo modelo aumenta. A segurança dos alimentos, então, possui um papel importante e deve ser priorizada pelos estabelecimentos para atração de novos clientes, uma vez que a redução da percepção do risco pode evitar ansiedade e auxiliar na escolha do consumidor (ZANETTA et al., 2022a) e pelos órgãos de vigilância para promoção da segurança do consumidor.

Os resultados dessa segunda etapa, ainda que tragam informações que auxiliem no direcionamento de como promover as *dark kitchens,* devem ser observados considerando as limitações do estudo. A dificuldade de identificar esses restaurantes no momento da escolha do consumidor ao utilizar um aplicativo, assim como o baixo conhecimento do termo *dark kitchen,* podem acarretar em resultados superficiais.

Na terceira etapa, ao expandir esta pesquisa para compreender o comportamento de compra em distintas culturas, examinou-se as percepções e intenções dos consumidores em relação às *dark kitchens* em três países: Brasil, Reino Unido e Polônia. Os resultados revelaram que, embora os consumidores associem predominantemente as *dark kitchens* a serviços *online*, há também uma preocupação com a falta de higiene, o que ressalta a necessidade de educação por parte dos estabelecimentos. A confiança nos órgãos de vigilância emergiu como um fator crítico na intenção de compra nas *dark kitchens*, especialmente no Brasil, onde os consumidores valorizam as garantias de segurança dos alimentos (HAKIM et al., 2022). No entanto, no Reino Unido e na Polônia, onde os sistemas regulatórios são percebidos como mais eficazes, essa confiança pode não ser tão crucial para os consumidores. A segurança dos alimentos foi consistentemente identificada como um fator determinante nas intenções de compra em todos os países estudados, refletindo a preocupação dos consumidores com doenças transmitidas por alimentos (ZANETTA et al., 2022b).

Além disso, a experiência do usuário e a responsabilidade social também desempenharam papéis importantes na intenção de compra nas *dark kitchens*. A qualidade da experiência do usuário, incluindo a facilidade de uso do aplicativo, informações disponíveis e ações úteis ao consumidor, influenciou positivamente a intenção de compra (RAY et al., 2019). Por outro lado,

responsabilidade social foi um fator positivo na decisão de compra em todos os três países, assim como observado na segunda etapa desse trabalho, sugerindo uma tendência global em momentos de vulnerabilidade (BERTOGG; KOOS, 2021). Esses resultados destacam a importância de considerar as nuances culturais e regulatórias ao avaliar as preferências do consumidor e desenvolver estratégias adaptativas para cada país.

Apesar do estudo possuir limitações, principalmente pelo fato de não ser adequada a generalização dos resultados para outros países, foi possível ter maior profundidade em entender o comportamento do consumidor frente às *dark kitchens,* para satisfazer cada vez mais suas necessidades.

Em síntese, esta tese não apenas oferece uma visão aprofundada das *dark kitchens* no contexto brasileiro e em outras culturas, mas também destaca considerações cruciais para empreendedores e legisladores. A pesquisa sugere a necessidade contínua de adaptação e compreensão das dinâmicas desse modelo de negócios inovador, a fim de promover um mercado de *dark kitchens* sustentável e segura para o consumidor, orientada pelas necessidades do consumidor e em consonância com as regulamentações específicas.

7 REPERCUSSÕES

Matéria divulgada em TV (1 total):

https://globoplay.globo.com/v/11653255/

Citação em Exame Nacional (1 total):

Questão elaborada para o ENADE 2023 de Nutrição

Matéria publicada na Agência FAPESP (2 total):

Tres de cada diez pedidos a domicilio en la principal aplicación de Brasil salen de cocinas fantasmas

Quase 30% dos restaurantes do iFood são *dark kitchens*, revela estudo inédito

Matérias publicadas em outras mídias (62 total):

Portal do Instituto Claro: O que é *dark kitchen*? (2023-11-28)

Scientific Inquirer (EUA): Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-09)

Newswise (EUA): Mind what you eat and drink. Food and Water Safety stories for media (2023-08-08)

ReportWire: Mind what you eat and drink. Food and Water Safety stories for media (2023-08-08)

Medindia (Índia): Uprise of Dark Kitchens in Brazil's Food Delivery Market (2023-08-07)

Friday Takeaway Blog: Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-07)

Eurasia Review (Espanha): Three Out Of Every Ten Meals Ordered From Main Food Delivery App In Brazil Come From Dark Kitchens (2023-08-04)

One News Page: Three Out Of Every Ten Meals Ordered From Main Food Delivery App In Brazil Come From Dark Kitchens (2023-08-04)

Que Gostoso!: Quase 30% dos restaurantes do Ifood são *dark kitchens*, revela estudo (2023-08-04)

DailyGuardian: Three Out Of Every Ten Meals Ordered From Main Food Delivery App In Brazil Come From Dark Kitchens (2023-08-04)

Phys.Org (Reino Unido): Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from '*dark kitchens*' (2023-08-03)

Newswise (EUA): Three Out Of Every Ten Meals Ordered From Main Food Delivery App In Brazil Come From Dark Kitchens (2023-08-03)

Newswise (EUA): Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-03)

Bioengineer (Reino Unido): Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-03)

Scienmag Science Magazine (Reino Unido): Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-03)

News Break (EUA): Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from '*dark kitchens*' (2023-08-03)

PressNews.org: Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-03)

invesBrain (Canadá): Three out of every ten meals ordered from the main food delivery app in Brazil come from *dark kitchens* (2023-08-03)

Life Technology: Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from '*dark kitchens*' (2023-08-03)

Brazil Business Newswire (EUA): Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from '*dark kitchens*' (2023-08-03)

Brazil Business Newswire (EUA): Three Out Of Every Ten Meals Ordered From Main Food Delivery App In Brazil Come From Dark Kitchens (2023-08-03)

Nation Online: Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from '*dark kitchens*' (2023-08-03)

Physics Club English: Study shows three of every 10 meals ordered from the main food delivery app in Brazil come from ‘*dark kitchens*’ (2023-08-03)

Jornal da USP online: Aluguéis mais baratos atraem “*dark kitchens*” para áreas periféricas de São Paulo (2023-07-14)

Jornal da USP online: Cotidiano das Cidades #01: Qual é o futuro das “*dark kitchens*” em São Paulo? (2023-07-14)

JDV - Jornal do Vale do Itapocu online: Estudo aponta que um em cada três restaurantes cadastrados em aplicativos de comida é 'cozinha fantasma' (2023-06-14)

TV Jovem Pan News: Estudo aponta que um em cada três restaurantes cadastrados em aplicativos é 'cozinha fantasma' (2023-06-12)

IHU - Instituto Humanitas Unisinos: Dark kitchen: um novo modelo de negócio ainda pouco conhecido, mas cheio de questões. Entrevista especial com Diogo da Cunha e Mariana Hakim (2023-06-02)

Capitalist: Existe ou não? Estudo revela que quase 30% dos restaurantes do iFood são 'cozinhas fantasma' (2023-06-02)

Economia em Pauta: Existe ou não? Estudo revela que quase 30% dos restaurantes do iFood são 'cozinhas fantasma' (2023-06-02)

Batatais 24h: Quase 30% dos restaurantes do iFood são *dark kitchens*, mostra estudo (2023-05-29)

O Povo online (CE): As cozinhas sem lei (2023-05-28)

TV Globo: Campinas conta com 24% '*dark kitchens*', restaurantes que atendem apenas por delivery (2023-05-27)

Rede Estação Democracia (RED): Dark kitchens já são mais de um terço dos restaurantes do iFood em São Paulo (2023-05-27)

G1: 'Dark Kitchens', restaurantes que só atendem por entrega, já concentram 24% dos pedidos em Campinas, diz estudo da Unicamp (2023-05-26)

G1: 'Dark kitchens': estudo aponta que 215 restaurantes de Limeira só atendem por entrega via aplicativo; lanche e sobremesa predominam (2023-05-26)

Bem Blogado: Dark kitchens já são mais de um terço dos restaurantes do iFood em São Paulo (2023-05-26)

O Joio e O Trigo: Lei regulamentou *dark kitchens* em São Paulo, mas, para moradores, pouco mudou: barulho, fuligem e cheiro de fritura 24h (2023-05-26)

A Cidade On (São Carlos, SP): Quase 30% dos restaurantes do iFood são *dark kitchens*, revela estudo da Unicamp (2023-05-25)

SBVC – Sociedade Brasileira de Varejo e Consumo: Quase 30% dos restaurantes do iFood são *dark kitchens*, revela estudo (2023-05-25)

Galileu online: Quase 30% dos restaurantes do iFood são *dark kitchens*, revela estudo (2023-05-24)

Jornal Floripa: Quase 30% dos restaurantes do iFood são cozinhas fantasma, diz estudo (2023-05-24)

Jornal GGN: Dark kitchens já são mais de um terço dos restaurantes do iFood em São Paulo (2023-05-24)

IHU - Instituto Humanitas Unisinos: Dark kitchens já são mais de um terço dos restaurantes do iFood em São Paulo (2023-05-24)

Dinâmicas Sul-Sur: SP: O avanço desenfreado das “cozinhas-fantasmas” (2023-05-24)

The World News (Ucrânia/Brasil): Dark kitchens já são mais de um terço dos restaurantes do iFood em São Paulo (2023-05-24)

Plantão dos Lagos: Quase 30% dos restaurantes do iFood são “*dark kitchens*”, revela estudo inédito (2023-05-24)

Folha.com: Quase 30% dos restaurantes do iFood são cozinhas fantasma, diz estudo (2023-05-23)

UOL: Quase 30% dos restaurantes do iFood são 'cozinhas fantasma', revela estudo (2023-05-23)

BOL: Quase 30% dos restaurantes do iFood são 'cozinhas fantasma', revela estudo (2023-05-23)

Estado de Minas online: Dark kitchens representam um terço dos restaurantes no iFood, aponta estudo (2023-05-23)

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APÊNDICES

Apêndice A - Scripts em Python, utilizando o padrão de representação JSON (JavaScript Object Notation) para mineração de dados

```
def getRightRequest(driver):
    for request in driver.requests:
        if request.response is not None:
            try:
                return request.response.body.decode("utf-8")
            except:
                pass

profile = webdriver.FirefoxProfile()

driver = webdriver.Firefox(profile)

def getFieldRaw(data, field):
    for f in field.split("."):
        data=data[f]
    return data

def getField(d, field):
    if type(field) is str:
        return getFieldRaw(d, field)

    return field[1](getFieldRaw(d, field[0]))

def getColumn(column):
    if type(column) is str:
        return column
    return column[0]

extra_data_query = "https://marketplace.ifood.com.br/v1/merchants/%s/extra"

data = pd.read_csv("out.csv",";")

ids = data["id"]

field_to_print = ["userRatingCount", "address.district","address.city","address.st
ate","address.country",
"address.latitude","address.longitude","address.zipCode","address.streetName",
"address.streetNumber","documents.CNPJ.value",
    ("features", lambda x: " ".join(x))]

fields_names = [getColumn(c) for c in field_to_print]

appendingData = pd.DataFrame(columns=["id"]+ fields_names)
```

```
for id in ids:
    try:
        driver.get(extra_data_query%(id,))
        time.sleep(0.1)
        request = json.loads(getRightRequest(driver))
        fields = [id]+[ str(getField(request,f)).replace("\"","") for f in field_to_print]
        del driver.requests
        appendingData = pd.concat([appendingData, pd.DataFrame(columns=["id"
] + fields_names,data= [fields])])
    except:
        continue


data.index = ids
appendingData.index = appendingData["id"]

print(appendingData)
data[fields_names]=appendingData[fields_names]


data.to_csv("with_address.csv",";",index=False)
print(data)
```

```
def getRightRequest(driver):
    for request in driver.requests:
        if request.response is not None:
            try:
                return request.response.body.decode("utf-8")
            except:
                pass

profile = webdriver.FirefoxProfile()

driver = webdriver.Firefox(profile)


latitude = "-22.5650698"
longitude ="-47.4046777"
page = 0
query = "https://marketplace.ifood.com.br/v2/merchants?latitude=%s&longitude
=%s&page=%d&channel=IFOOD&size=300&features=&categories=&payment_
types=&delivery_fee_from=0&delivery_fee_to=25&delivery_time_from=0&delive
ry_time_to=240"

execQuery = query%(latitude,longitude,page)
driver.get(execQuery)
time.sleep(1)
# text = driver.requests[2].response.body.decode("utf-8")
text = getRightRequest(driver)
```

```
data = json.loads(text)
total = data["total"]
merchants = data["merchants"]

# for i in range(1,2):
for i in range(1,math.ceil(total/300)):
    del driver.requests

    execQuery = query%(latitude,longitude,i)
    driver.get(execQuery)
    time.sleep(1)
    text = getRightRequest(driver)
    merchant_data = json.loads(text)
    merchants.extend(merchant_data["merchants"])


field_to_print=["id", "name", "distance", "userRating", "priceRange", "mainCateg
ory.name", "deliveryTime"]

def getField(d, field):
    for f in field.split("."):
        d=d[f]
    return d

"https://marketplace.ifood.com.br/v1/merchants/4155ced7-2069-4369-b599-
0d274e3b894f/extra"
"https://wsloja.ifood.com.br/ifood-ws-v3/restaurants/eb622996-1521-4c16-9171-
c323308e925a/menu"

print(";".join(field_to_print+["url"]))
for merchant in merchants:
    fields = [ str(getField(merchant,f)).replace("\"","") for f in field_to_print]
    url = "https://www.ifood.com.br/delivery/%s/%s"%(getField(merchant,"slug"),
getField(merchant, "id"))
    fields.append(url)

    print(";".join(fields))
    # print(merchant["id"], merchant["distance"])
```

Apêndice B – Termo de Consentimento Livre e Esclarecido de consumidores

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO DOS CONSUMIDORES

Título do Projeto: Desvendando as *dark kitchens* no Brasil: mapeamento, perfil de segurança dos alimentos e percepção do consumidor
Diogo Thimoteo da Cunha, Mariana Piton Hakim

Número do CAAE: 42944221.4.0000.5404 **Página 1 de 2**

Você está sendo convidado a participar de uma pesquisa. Este documento, chamado Termo de Consentimento Livre e Esclarecido, visa assegurar seus direitos como participante da pesquisa, ele está apresentado em formato digital, caso necessite de versão em formato pdf anteriormente a sua participação, solicite ao pesquisador. Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador por meio dos meios de contato presentes nesse Termo.

Não haverá nenhum tipo de penalização ou prejuízo se você não aceitar participar ou retirar sua autorização em qualquer momento. Você receberá uma cópia do Termo assinado pelo pesquisador responsável por meio de um link anexado a um e-mail que será encaminhado para você.

Aconselhamos que você imprima (em papel) seu Termo, pois ele será seu "recibo", atestando sua participação nessa pesquisa.

Justificativa e objetivos:

O objetivo da pesquisa é analisar as percepções e conhecimento de consumidores em relação aos restaurantes presentes em aplicativos de *delivery* de comidas. Os resultados dessa pesquisa irão ajudar a compreender a percepção do consumidor sobre novos modelos de negócio disponíveis para a população fazer uso, e dessa forma colaborar na criação de estratégias para direcionar investimentos e atitudes para a maior chance de estabilização desses estabelecimentos no setor de alimentação. A pesquisa também irá contribuir para o desenvolvimento de estudos futuros.

Procedimentos:

A sua participação constituirá em responder perguntas de um questionário online de etapa única, ou seja, você não será contatado posteriormente para novas etapas dessa pesquisa. O questionário tratará do perfil socioeconômico do consumidor e a percepção e conhecimento desse com relação aos restaurantes disponíveis em aplicativos de delivery.

As respostas serão dadas por meio de opções que serão disponibilizadas a você e não é necessário que todas as questões sejam respondidas. Você poderá responder a pesquisa pelo seu próprio dispositivo, em sequência desse termo, por meio desse mesmo link. O tempo de duração médio para responder as questões é de aproximadamente 10 minutos, sendo realizado conforme sua disponibilidade.

Desconfortos e riscos:

Você **não deve** participar deste estudo se sentir-se desconfortável, desconfiado ou intimidado com o preenchimento do questionário. A pesquisa, por ser feita em ambiente virtual, possui riscos de compartilhamento das informações disponibilizadas pelos participantes para a oferta de produtos e serviços. Os pesquisadores irão tomar todos os cuidados possíveis para resguardar quaisquer informações, porém existem limitações aos pesquisadores para assegurar a total confidencialidade dos dados, existindo um potencial risco.

Como previsto no código civil, os participantes da pesquisa que vierem a sofrer qualquer tipo de dano resultante de sua participação na pesquisa, previsto ou não no TCLE, têm direito à indenização, por parte do pesquisador, patrocinador e das instituições envolvidas.

Benefícios:

Os dados obtidos com os resultados desta pesquisa irão beneficiar a população, pois poderão trazer melhorias nos aspectos de maior importância na tomada de decisão dos consumidores. Não há benefício direto ao participante da pesquisa.

Sigilo e privacidade:

Serão tomadas todas as providências a fim de garantir que a sua identidade será mantida em sigilo e que nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores, ainda que existam limitações dessa garantia para as pesquisas em ambiente virtual, como explicado anteriormente no campo “Desconfortos e Riscos”. Na divulgação dos resultados desse estudo, seu nome e o nome do local onde trabalha não serão citados.

Ressarcimento:

O ressarcimento em caso de despesas exclusivamente decorrentes do projeto poderá ser feito por meio de solicitação aos pesquisadores por meio dos contatos disponibilizados nesse Termo.

Acompanhamento e assistência:

Você tem o direito à assistência integral e imediata, de forma gratuita e pelo tempo necessário.

Divulgação dos resultados da pesquisa e retorno aos participantes:

Conforme a res 466/12, é uma exigência ética das pesquisas: “comunicar às autoridades competentes, bem como aos órgãos legitimados pelo Controle Social, os resultados e/ou achados da pesquisa, sempre que estes puderem contribuir para a melhoria das condições de vida da coletividade, preservando, porém, a imagem e assegurando que os participantes da pesquisa não sejam estigmatizados”. Sendo assim, os resultados dessa pesquisa serão apresentados as autoridades sanitárias dos municípios participantes, sem a identificação dos participantes. Os resultados também serão divulgados em publicações de revistas científicas, também mantendo sempre o anonimato dos participantes.”

Contato:

Em caso de dúvidas sobre o estudo, você poderá entrar em contato com o professor Dr. Diogo Thimoteo da Cunha, Telefone: (019) 3701-6732, e-mail: diogo.cunha@fca.unicamp.br ou com a pesquisadora Mariana Piton Hakim, Telefone: (019) 98206-9706, e-mail: pitonmariana@gmail.com, e também no endereço: Rua Pedro Zaccaria, 1300 - Cx. Postal 1068, em Limeira – SP, Faculdade de Ciências Aplicadas. Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você pode entrar em contato com a secretaria do Comitê de Ética em Pesquisa (CEP) da UNICAMP das 08:30hs às 13:30hs e das 13:00hs as 17:00hs na Rua: Tessália Vieira de Camargo, 126; CEP 13083-887 Campinas – SP; telefone (19) 3521-8936; fax (19) 3521-7187; e-mail: cep@fcm.unicamp.br

O Comitê de Ética em Pesquisa (CEP):

O papel do CEP é avaliar e acompanhar os aspectos éticos de todas as pesquisas envolvendo seres humanos. A Comissão Nacional de Ética em Pesquisa (CONEP) tem por objetivo desenvolver a regulamentação sobre proteção dos seres humanos envolvidos nas pesquisas. Desempenha um papel coordenador da rede de Comitês de Ética em Pesquisa (CEPs) das instituições, além de assumir a função de órgão consultor na área de ética em pesquisas.

Consentimento livre e esclarecido:

Após ter recebido esclarecimentos sobre a natureza da pesquisa, seus objetivos, métodos, benefícios previstos, potenciais riscos e o incômodo que esta possa acarretar, aceito participar:

Nome do (a) participante: _____.

_____ Data: ____/_____/_____.

(Assinatura do participante)

Responsabilidade do Pesquisador: Asseguro ter cumprido as exigências da resolução 466/2012 CNS/MS e complementares na elaboração do protocolo e na obtenção deste Termo de Consentimento Livre e Esclarecido. Asseguro, também, ter explicado e fornecido uma via deste documento ao responsável pelo participante. Informo que o estudo foi aprovado pelo CEP perante o qual o projeto foi apresentado. Comprometo-me a utilizar o material e os dados obtidos nesta pesquisa exclusivamente para as finalidades previstas neste documento ou conforme o consentimento dado pelo participante.

_____Data:____/_____/_____

(Assinatura do pesquisador)

Rubrica pesquisador:_____ Rubrica participante:_____

Apêndice C – Parecer de aprovação do Comitê de Ética em Pesquisas da Unicamp

UNICAMP - CAMPUS CAMPINAS

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: DESVENDANDO AS DARK KITCHENS NO BRASIL: MAPEAMENTO, PERFIL DE SEGURANÇA DOS ALIMENTOS E PERCEPÇÃO DO CONSUMIDOR

Pesquisador: MARIANA PITON HAKIM

Área Temática:

Versão: 7

CAAE: 42944221.4.0000.5404

Instituição Proponente: Faculdade de Ciências Aplicadas - FCA

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.196.581

Apresentação do Projeto:

Trata-se de uma emenda que visa alteração na metodologia de aplicação de questionário ao consumidor, passando do modo presencial para o modo online, e no número de participantes a serem recrutados nessa etapa do trabalho (total = 1.000 participantes).

Objetivo da Pesquisa:

Mantidos em relação ao projeto original.

Avaliação dos Riscos e Benefícios:

Descrição de Benefícios mantida em relação ao projeto original.

Descrição de Riscos alterada em relação ao projeto original:

Segundo a pesquisadora, "Você não deve participar deste estudo se sentir-se desconfortável, desconfiado ou intimidado com o preenchimento do questionário. Será assegurado o sigilo de todas as respostas. A pesquisa não envolve riscos previsíveis, além do desconforto mencionado. Segundo a Resolução 466/12 (item IV.3), "os participantes da pesquisa que vierem a sofrer qualquer tipo de dano resultante de sua participação na pesquisa, previsto ou não no TCLE, têm direito à indenização, por parte do pesquisador, patrocinador e das instituições envolvidas". No caso dos proprietários de restaurantes, não haverá risco de penalidades ao estabelecimento. No caso da pesquisa em ambiente virtual foram adicionados os seguintes riscos: A pesquisa, por ser feita em ambiente virtual, possui riscos de compartilhamento das informações disponibilizadas

pelos participantes para a oferta de produtos e serviços. Os pesquisadores irão tomar todos os cuidados possíveis para resguardar quaisquer informações, porém existem limitações aos pesquisadores para assegurar a total confidencialidade dos dados, existindo um potencial risco. Como previsto no código civil, os participantes da pesquisa que vierem a sofrer qualquer tipo de dano resultante de sua participação na pesquisa, previsto ou não no TCLE, têm direito à indenização, por parte do pesquisador, patrocinador e das instituições envolvidas".

Comentários e Considerações sobre a Pesquisa:

A pesquisadora responsável informou no Formulário de Informações Básicas (documento "PB_INFORMAÇÕES_BÁSICAS_1859977_E1.pdf", de 16/11/2021) da Plataforma Brasil que "Foi feita alteração na metodologia da etapa da pesquisa relacionada ao questionário aplicado em consumidores. A pesquisa anteriormente seria feita de forma presencial e agora será feita de forma online/virtual. A mudança foi feita com o objetivo de aumentar o número de participantes avaliados. Foram feitas mudanças no projeto e no TCLE referente a essa etapa da pesquisa. Também foi feita a alteração no número de participantes da pesquisa".

Considerações sobre os Termos de apresentação obrigatória:

Foram analisados os seguintes documentos:

1 - "PB_INFORMAÇÕES_BÁSICAS_1859977_E1.pdf", de 21/12/2021.

2 – "CARTA_DE_RESPOSTA_EMENDA.pdf", de 21/12/2021;

3 – "TCLE_consumidores_v6online.pdf", de 21/12/2021.

4 – "ProjetoDetalhado_v6online.pdf", de 21/12/2021

4 – "Folha_de_rosto.pdf", de 21/01/2021

Recomendações:

PRIMEIRA VERSÃO:

Recomenda-se o download dos dados coletados e os registros de consentimento livre e esclarecido para um dispositivo eletrônico local, imediatamente após o encerramento da coleta dos dados, não sendo indicado a sua manutenção em qualquer plataforma virtual, ambiente compartilhado ou "nuvem".

RESPOSTA DA PESQUISADORA: Foi adicionada a metodologia do projeto um trecho esclarecendo sobre o armazenamento e manutenção dos dados coletados em pesquisa: "Imediatamente após o encerramento da coleta de dados, será feito o download de todos os dados e registros de consentimento livre e esclarecido em um dispositivo eletrônico local, onde será feita a manutenção desses dados."

ANÁLISE DO CEP: Recomendação atendida.

SEGUNDA VERSÃO:
Recomenda-se que a pesquisadora tenha o cuidado de garantir que o participante será abordado no máximo duas vezes, e caso não concorde em participar da pesquisa, a pesquisadora deve garantir que novos e-mails e convites online não sejam mais disparados para estes participantes.

—
A Comissão Nacional de Ética em Pesquisa (Conep), do Conselho Nacional de Saúde (CNS) orienta a adoção das diretrizes do Ministério da Saúde (MS) decorrentes da pandemia causada pelo Coronavírus SARS-CoV-2 (Covid-19), com o objetivo de minimizar os potenciais riscos à saúde e a integridade dos participantes de pesquisas e pesquisadores.
De acordo com carta circular da CONEP intitulada "ORIENTAÇÕES PARA CONDUÇÃO DE PESQUISAS E ATIVIDADE DOS CEP DURANTE A PANDEMIA PROVOCADA PELO CORONAVÍRUS SARS-COV-2 (COVID-19)" publicada em 09/05/2020, referente ao item II. "Orientações para Pesquisadores":
- Aconselha-se a adoção de medidas para a prevenção e gerenciamento de todas as atividades de pesquisa, garantindo-se as ações primordiais à saúde, minimizando prejuízos e potenciais riscos, além de prover cuidado e preservar a integridade e assistência dos participantes e da equipe de pesquisa.
- Em observância às dificuldades operacionais decorrentes de todas as medidas impostas pela pandemia do SARS-CoV-2 (COVID- 19), é necessário zelar pelo melhor interesse do participante da pesquisa, mantendo-o informado sobre as modificações do protocolo de pesquisa que possam afetá-lo, principalmente se houver ajuste na condução do estudo, cronograma ou plano de trabalho.
- Caso sejam necessários a suspensão, interrupção ou o cancelamento da pesquisa, em decorrência dos riscos imprevisíveis aos participantes da pesquisa, por causas diretas ou indiretas, caberá aos investigadores a submissão de notificação para apreciação do Sistema CEP/Conep.
- Nos casos de ensaios clínicos, é permitida, excepcionalmente, a tramitação de emendas concomitantes à implementação de modificações/alterações no protocolo de pesquisa, visando à segurança do participante da pesquisa, assim como dos demais envolvidos no contexto da pesquisa, evitando-se, ainda, quando aplicável, a interrupção no tratamento dos participantes da pesquisa. Eventualmente, na necessidade de modificar o Termo de Consentimento Livre e Esclarecido (TCLE), o pesquisador deverá proceder com o novo consentimento, o mais breve

possível.

Conclusões ou Pendências e Lista de Inadequações:

EM RELAÇÃO ÀS PENDÊNCIAS E LISTA DE INADEQUAÇÕES ENCONTRADAS NA PRIMEIRA VERSÃO DA EMENDA, SEGUEM AS RESPOSTAS DA PESQUISADORA RESPONSÁVEL (documento "CARTA_DE_RESPOSTA_EMENDA.pdf", de 21/12/2021) E A ANÁLISE DO CEP:

1. Quanto ao documento "PB_INFORMAÇÕES_BÁSICAS_1859977_E1.pdf", de 16/11/2021:

1.1. No campo "Riscos", a pesquisadora manteve a descrição como no projeto original. Considerando as orientações do OFÍCIO CIRCULAR Nº 2/2021/CONEP/SECNS/MS, sobre "Orientações para procedimentos em pesquisas com qualquer etapa em ambiente virtual" (http://conselho.saude.gov.br/images/Oficio_Circular_2_24fev2021.pdf), solicita-se a inclusão dos riscos característicos do ambiente virtual, meios eletrônicos, ou atividades não presenciais, em função das limitações das tecnologias utilizadas. Adicionalmente, devem ser informadas as limitações dos pesquisadores para assegurar total confidencialidade e potencial risco de sua violação. Solicita-se que as adequações sejam feitas também na descrição de riscos do TCLE.

RESPOSTA DA PESQUISADORA: Foi adicionado ao TCLE informações mais adequadas sobre os riscos e sigilo de informações: "A pesquisa, por ser feita em ambiente virtual, possui riscos de compartilhamento das informações disponibilizadas pelos participantes para a oferta de produtos e serviços. Os pesquisadores irão tomar todos os cuidados possíveis para resguardar quaisquer informações, porém existem limitações aos pesquisadores para assegurar a total confidencialidade dos dados, existindo um potencial risco." Também foram feitas alterações nesse contexto no campo "Riscos" no documento de informações básicas.

ANÁLISE DO CEP: Atendida.

2. Quanto ao documento "ProjetoDetalhado_v5online.pdf", de 16/11/2021:

2.1. No item "3.1.3 Avaliação do conhecimento e percepção dos consumidores", a pesquisadora apresenta o texto do convite para participação na pesquisa. Considerando que qualquer convite individual deve esclarecer ao candidato a participante de pesquisa, que antes de responder às perguntas do pesquisador disponibilizadas em ambiente não presencial ou virtual (questionário/formulário ou entrevista), será apresentado o Termo de Consentimento Livre e Esclarecido (ou Termo de Assentimento, quando for o caso) para a sua anuência (OFÍCIO CIRCULAR

Nº 2/2021/CONEP/SECNS/MS), solicita-se que a pesquisadora deixe claro ao participante da pesquisa, no convite, que o consentimento será previamente apresentado e, caso, concorde em participar, será considerado anuência quando responder ao questionário/formulário ou entrevista da pesquisa.
RESPOSTA DA PESQUISADORA: Foi adicionado no texto da carta convite de participação o seguinte trecho para esclarecimento sobre p TCLE: "Antes de responder às perguntas da pesquisa, será apresentado a você um Termo de Consentimento Livre e Esclarecido que você poderá consentir ou não a sua participação. Caso concorde em participa após a leitura do Termo, será considerado seu consentimento para participação da pesquisa."
ANÁLISE DO CEP: Atendida.

2.2. No item "3.1.3 Avaliação do conhecimento e percepção dos consumidores", a pesquisadora apresenta o texto do convite para participação na pesquisa. A pesquisadora informa que o "questionário ficará disponível em grupos públicos nas redes sociais, como Facebook e também serão compartilhados via conta pessoal dos pesquisadores responsáveis pela pesquisa". Considerando as orientações do OFÍCIO CIRCULAR Nº 2/2021/CONEP/SECNS/MS, sobre "Orientações para procedimentos em pesquisas com qualquer etapa em ambiente virtual" (http://conselho.saude.gov.br/images/Oficio_Circular_2_24fev2021.pdf), solicitam-se as seguintes adequações:
2.2.1. O convite para a participação na pesquisa deverá conter, obrigatoriamente, link para endereço eletrônico ou texto com as devidas instruções de envio, que informem ser possível, a qualquer momento e sem nenhum prejuízo, a retirada do consentimento de utilização dos dados do participante da pesquisa. Nessas situações, o pesquisador responsável fica obrigado a enviar ao participante de pesquisa, a resposta de ciência do interesse do participante de pesquisa retirar seu consentimento;
RESPOSTA DA PESQUISADORA: Foi adicionado na carta convite esclarecimentos e instruções sobre a retirada do consentimento do participante: "A qualquer momento e sem nenhum prejuízo é possível que você faça a retirada do consentimento de utilização dos seus dados disponibilizados para a pesquisa e nesse caso iremos enviar para você uma resposta de ciência do interesse do participante de pesquisa em retirar seu consentimento." Após acordo nos documentos com o CEP, será criado um link a ser submetido junto a carta convite. Esse link não será disponibilizado até que os Termos estejam todos corretos com as exigências do CEP.
ANÁLISE DO CEP: Atendida. Recomenda-se que o link seja informado ao CEP no relatório.

2.2.2. Garantia de que o convite para participação na pesquisa não será feito com a utilização de listas que permitam a identificação dos convidados nem a visualização dos seus dados de contato (e-mail, telefone, etc) por terceiros. Qualquer convite individual enviado por e-mail só poderá ter um remetente e um destinatário, ou ser enviado na forma de lista oculta.
RESPOSTA DA PESQUISADORA: Foi adicionado a metodologia da pesquisa esclarecimento sobre a não utilização de listas para divulgação da pesquisa e sobre os cuidados para a não divulgação de contato dos participantes: "O convite e divulgação da participação da pesquisa não será feito com a utilização de listas que permitam a identificação dos convidados e nem a visualização dos dados de contato (e-mail, telefone, etc) por terceiros. Qualquer convite individual enviado por e-mail só terá um remetente e um destinatário ou será enviado na forma de lista oculta."
ANÁLISE DO CEP: Atendida.

2.2.3. Inclusão no projeto de pesquisa que o participante será abordado no máximo duas vezes, e caso não concorde em participar da pesquisa, e-mails e convites online não serão mais disparados para estes participantes.
RESPOSTA DA PESQUISADORA: Não respondido.
ANÁLISE DO CEP: Não Atendida. Vide "RECOMENDAÇÕES".

3. Quanto ao documento "TCLE_consumidores_v5online.pdf", de 16/11/2021
3.1. No campo "Ressarcimento", a pesquisadora informa que "Não haverá ressarcimento de gastos decorrentes do uso de internet para o preenchimento do questionário em questão". A Resolução CNS N° 466 de 2012, item II.21, define ressarcimento como "compensação material, exclusivamente de despesas do participante e seus acompanhantes, quando necessário, tais como transporte e alimentação". Ainda, o item IV.3.g orienta que o TCLE deve conter obrigatoriamente "explicitação da garantia de ressarcimento e como serão cobertas as despesas tidas pelos participantes da pesquisa e dela decorrentes". Solicita-se adequação com inclusão da garantia de ressarcimento.
RESPOSTA DA PESQUISADORA: Foi feita alteração no TCLE para esclarecimentos adequados sobre ressarcimento: "O ressarcimento em caso de despesas exclusivamente decorrentes do projeto poderá ser feito por meio de solicitação aos pesquisadores por meio dos contatos disponibilizados nesse Termo."
ANÁLISE DO CEP: Atendida.

3.2. O texto como foi descrito no TCLE não garante indenização por danos decorrentes da pesquisa. A Resolução 466/12 (item IV.3) define que "os participantes da pesquisa que vierem a sofrer qualquer tipo de dano resultante de sua participação na pesquisa, previsto ou não no TCLE, têm direito à indenização, por parte do pesquisador, patrocinador e das instituições envolvidas". Cabe enfatizar que a questão da indenização não é prerrogativa da Resolução 466/12, estando prevista no código civil. Portanto, solicitamos que seja assegurado, de forma clara e afirmativa, que o participante de pesquisa tem direito à indenização em casos de danos decorrentes da pesquisa.
RESPOSTA DA PESQUISADORA: Foi corrigido no termo sobre a indenização dos participantes: "Como previsto no código civil, os participantes da pesquisa que vierem a sofrer qualquer tipo de dano resultante de sua participação na pesquisa, previsto ou não no TCLE, têm direito à indenização, por parte do pesquisador, patrocinador e das instituições envolvidas."
ANÁLISE DO CEP: Atendida.

Considerações Finais a critério do CEP:
- O participante da pesquisa deve receber uma via do Termo de Consentimento Livre e Esclarecido, na íntegra, por ele assinado (quando aplicável).

- O participante da pesquisa tem a liberdade de recusar-se a participar ou de retirar seu consentimento em qualquer fase da pesquisa, sem penalização alguma e sem prejuízo ao seu cuidado (quando aplicável).

- O pesquisador deve desenvolver a pesquisa conforme delineada no protocolo aprovado. Se o pesquisador considerar a descontinuação do estudo, esta deve ser justificada e somente ser realizada após análise das razões da descontinuidade pelo CEP que o aprovou. O pesquisador deve aguardar o parecer do CEP quanto à descontinuação, exceto quando perceber risco ou dano não previsto ao participante ou quando constatar a superioridade de uma estratégia diagnóstica ou terapêutica oferecida a um dos grupos da pesquisa, isto é, somente em caso de necessidade de ação imediata com intuito de proteger os participantes.

- O CEP deve ser informado de todos os efeitos adversos ou fatos relevantes que alterem o curso normal do estudo. É papel do pesquisador assegurar medidas imediatas adequadas frente a evento adverso grave ocorrido (mesmo que tenha sido em outro centro) e enviar notificação ao CEP e à

Agência Nacional de Vigilância Sanitária – ANVISA – junto com seu posicionamento.

- Eventuais modificações ou emendas ao protocolo devem ser apresentadas ao CEP de forma clara e sucinta, identificando a parte do protocolo a ser modificada e suas justificativas e aguardando a aprovação do CEP para continuidade da pesquisa. Em caso de projetos do Grupo I ou II apresentados anteriormente à ANVISA, o pesquisador ou patrocinador deve enviá-las também à mesma, junto com o parecer aprovatório do CEP, para serem juntadas ao protocolo inicial.

- Relatórios parciais e final devem ser apresentados ao CEP, inicialmente seis meses após a data deste parecer de aprovação e ao término do estudo.

-Lembramos que segundo a Resolução 466/2012 , item XI.2 letra e, "cabe ao pesquisador apresentar dados solicitados pelo CEP ou pela CONEP a qualquer momento".

-O pesquisador deve manter os dados da pesquisa em arquivo, físico ou digital, sob sua guarda e responsabilidade, por um período de 5 anos após o término da pesquisa.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1859977_E1.pdf	21/12/2021 12:15:14		Aceito
Outros	CARTA_DE_RESPOSTA_EMENDA.pdf	21/12/2021 12:14:25	MARIANA PITON HAKIM	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_consumidores_v6online.pdf	21/12/2021 12:13:24	MARIANA PITON HAKIM	Aceito
Projeto Detalhado / Brochura Investigador	ProjetoDetalhado_v6online.pdf	21/12/2021 12:13:12	MARIANA PITON HAKIM	Aceito
Folha de Rosto	Folha_de_rosto.pdf	21/01/2021 10:53:58	MARIANA PITON HAKIM	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

CAMPINAS, 10 de Janeiro de 2022

Assinado por:
Renata Maria dos Santos Celeghini
(Coordenador(a))

Endereço: Rua Tessália Vieira de Camargo, 126, 1° andar do Prédio I da Faculdade de Ciências Médicas
Bairro: Barão Geraldo **CEP:** 13.083-887
UF: SP **Município:** CAMPINAS
Telefone: (19)3521-8936 **Fax:** (19)3521-7187 **E-mail:** cep@unicamp.br

Apêndice D – Questionário de conhecimento e intenção do consumidor

1. Qual sua idade? _____ anos

2. Autorização: (pergunta aplicada para assinatura digital do TCLE)
   ( ) Autorizo a participação nesta pesquisa.

3. Você conhece ou já ouviu falar nos termos "*dark kitchen*, cloud kitchen, cozinha fantasma ou cozinha virtual?"
   ( ) Sim, já ouvi falar ( ) Sim, eu conheço o termo ( ) Não

4. Ao que esse termo se refere? (Pergunta feita apenas para os que responderam 'Sim, eu conheço o termo').
   _____
   _____

   Apresentação do termo aos participantes:

5. Sabendo o que é uma *dark kitchen*, se você tiver conhecimento que um restaurante é uma *dark kitchen*, e com base apenas nessa informação, você evitaria ou escolheria pedir comida nesse restaurante?
   ( ) Certamente evitaria
   ( ) Talvez evitaria
   ( ) Não tenho uma opinião definida
   ( ) Talvez escolheria
   ( ) Certamente escolheria

6. Assinale a opção que achar mais adequada para cada afirmação ou questão. Caso esteja respondendo pelo celular, use-o na horizontal para uma melhor visualização do questionário. Apenas uma resposta válida por linha.

1	Quanto você confia que a Vigilância Sanitária garante de forma efetiva a segurança no consumo de alimentos feitos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
2	O quanto você confia que a Vigilância Sanitária consegue fiscalizar, regular e fazer cumprir as legislações relacionadas a higiene dos alimentos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
3	O quanto você confia no trabalho da Vigilância Sanitária?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
4	Quanto você confia que o aplicativo garante de forma efetiva a segurança no consumo de alimentos feitos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
5	O quanto você confia que a empresa do aplicativo verifica se um restaurante é seguro antes de adicioná-lo à sua plataforma?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
6	O quanto você confia que a empresa do aplicativo consegue fiscalizar, regular e fazer cumprir as legislações relacionadas a higiene dos alimentos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
7	Não existe diferença entre a fiscalização de restaurantes padrão e *dark kitchens* por parte da Vigilânciaa Sanitária.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
8	Se um restaurante está disponível na plataforma, com certeza ele é seguro com relação à higiene dos alimentos.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
9	A chance de eu ter dor de barriga, diarreia ou vômito é a mesma emm *dark kitchens* e em restaurantes padrão.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
10	Eu não me importo se um restaurante é padrão ou *dark kitchen* se ele foi indicado por um amigo ou familiar.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
11	A qualidade do alimento é a mesma em refeições vendidas por um restaurante padrão e em uma *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
12	Considerando que você sabe que o restaurante é uma *dark kitchen*, se o aplicativo mostra imagens dos alimentos vendidos em uma *dark*	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente

	kitchen, eu me sinto seguro para compra-lo.					
13	Considerando que você sabe que o restaurante é uma *dark kitchen*, se o aplicativo mostra uma boa avaliação dos consumidores sobre as refeições das *dark kitchens*, me sinto seguro para compra-las.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
14	Considerando que você sabe que o restaurante é uma *dark kitchen*, se o restaurante é mostrado entre os 15 primeiros da lista de opções do aplicativo, eu me sinto mais seguro para comprar uma refeição, mesmo o restaurante sendo uma *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
15	Considerando que você sabe que o restaurante é uma *dark kitchen*, se um restaurante é mostrado em um banner (publicidade em destaque) no aplicativo, me sinto mais seguro para comprar uma refeição feita nele, mesmo sendo uma *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
16	Possuir cupom de desconto é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
17	A compra me beneficiar com cash-back (dinheiro de volta caso você compre esse produto/serviço) é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
18	A presença de promoção no estabelecimento (desconto, compre dois e pague um...) é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
19	Se uma *dark kitchen* entregar a refeição mais rapidamente que um restaurante padrão, me sinto motivado a escolher a opção mais rápida.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
20	Considerando que você sabe que o restaurante é uma *dark kitchen*, você optaria por uma refeição produzida em uma *dark kitchen* do que em um restaurante padrão famoso/marca conhecida para apoiar esse estabelecimento.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
21	Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchens*?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
22	Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchens*s se eles forem até 10% mais baratos do que refeições feitas em restaurantes padrão?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
23	Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchens* se elas forem até 30% mais baratos do que refeições feitas em restaurantes padrão?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
24	Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchens* se	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto

	você estiver ajudando um pequeno empreendedor?					
25	Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchens* para evitar que eles fechem por problemas financeiros?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto

7. Qual é seu gênero?
   - ( ) Feminino
   - ( ) Masculino
   - ( ) Não binário
   - ( ) Prefiro não dizer
   - ( ) Prefiro me autodescrever

8. Caso você tenha assinalado a opção 'prefiro me autodescrever' use o espaço abaixo para isso. _____

9. Estado civil
   - ( ) Solteiro(a)
   - ( ) Casado(a)
   - ( ) Separado(a)
   - ( ) Divorciado(a)
   - ( ) Viúvo(a)

10. Escolaridade
    - ( ) Ensino fundamental incompleto
    - ( ) Ensino fundamental completo
    - ( ) Ensino médio incompleto
    - ( ) Ensino médio completo
    - ( ) Ensino superior incompleto
    - ( ) Ensino superior completo
    - ( ) Pós-graduação

11. Caso tenha escolaridade superior, qual o curso feito? _____
12. Caso tenha escolaridade pós-graduação, qual a especialização? _____

13. Reside de qual estado?

( ) AC ( ) AL ( ) AP ( ) AM ( ) BA
( ) CE ( ) ES ( ) ES ( ) GO ( ) MA
( ) MT ( ) MS ( ) MG ( ) PA ( ) PB
( ) PR ( ) PE ( ) PI ( ) RJ ( ) RN
( ) RS ( ) RO ( ) RR ( ) SC ( ) SP
( ) SE ( ) TO ( ) DF

14. Reside de qual cidade? _____

15. Contando você, quantas pessoas moram na sua casa? _____

16. Qual sua renda familiar?

( ) Nenhuma renda
( ) Até 1 salário mínimo
( ) De 1 a 3 salários mínimos
( ) De 3 a 6 salários mínimos
( ) De 6 a 9 salários mínimos
( ) De 9 a 12 salários mínimos
( ) De 12 a 15 salários mínimos
( ) Mais de 15 salários mínimos

17. Com quem você mora? (Marque totas que se aplicam)

□ Sozinho(a)
□ Esposo(a) ou namorado(a)
□ Pai e/ou mãe
□ Filhos
□ Irmão(s)
□ Outros parentes
□ Amigo(s) e/ou colega(s)
□ Outro

Apêndice D – Aprovação do Comitê de Ética da Universidade de Gdansk (Polônia)

Uniwersytet Gdański

Research Ethics Committee
at University of Gdańsk

Gdańsk, 23.07.2023

Ethics Board Opinion in response to inquiry no. 29/2023/WZ

Research Ethics Committee at University of Gdańsk, having acquainted itself with the documentation of the planned research project submitted for ethical evaluation by

Prof. dr hab. Małgorzata Wiśniewska

entitled Unraveling the dark kitchen: consumer perception, mapping and food safety profile

issues a positive opinion.

As presented by prof. dr hab. Małgorzata Wiśniewska the research project, if carried out following the presented procedures and fulfilling the commitment to obtain the surveyed persons' conscious consent to participation in the research, is ethically acceptable.

Research Ethics Committee represented by:
dr hab. Krystyna Adamska, prof. UG – chairwoman
dr. hab. Anna Nikodemska-Wołowik, prof. UG – member
dr hab. Marcin Boryczko, prof. UG – member

Chairwoman of Research Ethics Committee

.....

Signed by / Podpisano przez:
Krystyna Adamska
Uniwersytet Gdański
Date / Data:
2023-07-12 08:28

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Apêndice E – Questionário revisado sobre conhecimento e intenção do consumidor

1. Você conhece ou já ouviu falar nos termos "*dark kitchen*, cloud kitchen, cozinha fantasma ou cozinha virtual?"
   ( ) Sim, e sei o que os termos significam
   ( ) Sim, mas não sei exatamente o que são
   ( ) Não conheço ou ouvi falar

2. Você conhece ou já ouviu falar nos termos "*dark kitchen*, cloud kitchen, cozinha fantasma ou cozinha virtual?"
   ( ) Restaurantes sem interação direta com o público
   ( ) Restaurantes/cozinhas sujas ou inadequadas
   ( ) Restaurantes com vendas exclusivamente *online*
   ( ) Restaurantes/cozinhas sem janelas ou com pouca iluminação
   ( ) Restaurantes sem fachada
   ( ) Restaurantes que vendem comidas produzidas em cozinhas residenciais
   ( ) Restaurantes ilegais
   ( ) Espaços compartilhados de cozinhas
   ( ) Restaurantes sem consumo local
   ( ) Nenhuma das anteriores

3. Com base nessa definição, responda

Quanto você confia que a Vigilância Sanitária garante de forma efetiva a segurança no consumo de alimentos feitos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
O quanto você confia que a Vigilância Sanitária consegue fiscalizar, regular e fazer cumprir as legislações relacionadas a higiene dos alimentos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
O quanto você confia no trabalho da Vigilância Sanitária?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Quanto você confia que o aplicativo garante de forma efetiva a segurança no consumo de alimentos feitos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
O quanto você confia que a empresa do aplicativo verifica se um restaurante é seguro antes de adicioná-lo à sua plataforma?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
O quanto você confia que a empresa do aplicativo consegue fiscalizar, regular e fazer cumprir as legislações relacionadas a higiene dos alimentos em *dark kitchens*?	Desconfio totalmente	Desconfio parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Não existe diferença entre a fiscalização de restaurantes padrão e *dark kitchens* por parte da Vigilânciaa Sanitária.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Se um restaurante está disponível na plataforma, com certeza ele é seguro com relação à higiene dos alimentos.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
A chance de eu ter dor de barriga, diarreia ou vômito é a mesma emm *dark kitchens* e em restaurantes padrão.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Eu não me importo se um restaurante é padrão ou *dark kitchen* se ele foi indicado por um amigo ou familiar.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
A qualidade do alimento é a mesma em refeições vendidas por um restaurante padrão e em uma *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, se o aplicativo mostra imagens dos alimentos vendidos em uma *dark kitchen*, eu me sinto seguro para comprá-lo.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, se o aplicativo mostra uma boa avaliação dos consumidores sobre as refeições das *dark kitchens*, me sinto seguro para comprá-las.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, se o restaurante é mostrado entre os 15 primeiros da lista de opções do aplicativo, eu me sinto mais seguro para comprar uma refeição/alimento deste restaurante.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, se um restaurante é mostrado em um banner (publicidade em destaque) no aplicativo, me sinto mais seguro para comprar uma refeição preparada por ele.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Possuir cupom de desconto é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente

A compra me beneficiar com cash-back (dinheiro de volta caso você compre esse produto/serviço) é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
A presença de promoção no estabelecimento (desconto, compre dois e pague um...) é um fator mais importante na escolha de um restaurante do que se ele é do tipo padrão ou *dark kitchen*.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Se o tempo de entrega de refeição de uma *dark kitchen* for mais rápido que o tempo de entrega de um restaurantes padrão, sinto-me motivado a escolher a opção mais rápida, independente do tipo de restaurante.	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, você optaria por uma refeição produzida em uma *dark kitchen* ao invés de uma refeição produzida por um restaurante padrão famoso/marca conhecida para apoiar essa *dark kitchen*	Discordo totalmente	Discordo parcialmente	Não concordo e nem discordo	Concordo parcialmente	Concordo totalmente
Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas este restaurante se você estiver ajudando um pequeno empreendedor, como por exemplo, o dono da *dark kitchen*?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas por este restaurante para evitar que eles fechem por problemas financeiros?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas por este restaurante?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para comprar refeições feitas em *dark kitchenss* se eles forem até 10% mais baratos do que refeições feitas em restaurantes padrão?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto
Considerando que você sabe que o restaurante é uma *dark kitchen*, o quão disposto você está para escolher esses estabelecimentos no futuro?	Totalmente indisposto	Parcialmente indisposo	Nem disposto e nem indisposto	Parcialmente disposto	Totalmente disposto

4. Qual a sua idade? ____
5. Qual o seu gênero?
    - ( ) Feminino
    - ( ) Masculino
    - ( ) Não binário
    - ( ) Prefiro não dizer
    - ( ) Prefiro me autodescrever

6. Caso você tenha assinalado a opção ‘prefiro me autodescrever’, use o espaço abaixo para isso.

   _____

7. Escolaridade
   ( ) Ensino fundamental incompleto
   ( ) Ensino fundamental completo
   ( ) Ensino médio incompleto
   ( ) Ensino médio completo
   ( ) Ensino superior incompleto
   ( ) Ensino superior completo
   ( ) Pós-graduação (completa ou incomplete)
   ( ) Prefiro não responder

8. Em qual cidade você mora? _____

9. Qual sua renda familiar? (soma de todos os rendimentos)
   ( ) Nenhuma renda
   ( ) Até 1 salário mínimo
   ( ) De 1 a 3 salários mínimos
   ( ) De 3 a 6 salários mínimos
   ( ) De 6 a 9 salários mínimos
   ( ) De 9 a 12 salários mínimos
   ( ) De 12 a 15 salários mínimos
   ( ) Mais de 15 salários mínimos
   ( ) Prefiro não responder

10. Qual a sua frequência de uso de aplicativos de delivery de alimentos?
   ( ) uma vez ao dia ou mais
   ( ) 3 a 6 vezes na semana
   ( ) 1 a 3 vezes no mês
   ( ) menos de uma vez no mês
   ( ) nunca ou raramente

11. Tipo de refeição que usa mais frequentemente aplicativos de delivery de alimentos? (Marque todas que se aplicam)

□ café da manhã (em dias de semana)
□ café da manhã (em fins de semana)
□ lanche da manhã/brunch (em dias de semana)
□ lanche da manhã/brunch (em fins de semana)
□ almoço (em dias de semana)
□ almoço (em fins de semana)
□ lanche da tarde (em dias de semana)
□ lanche da tarde (em fins de semana)
□ jantar (em dias de semana)
□ jantar (em fins de semana)
□ produtos de mercado (em dias de semana)
□ produtos de mercado (em fins de semana)
□ não se aplica (caso não utilize)

12. Qual aplicativo de delivery você mais utiliza?

( ) iFood
( ) Rappi
( ) 99 Foods
( ) aiqfome
( ) James delivery
( ) Uai Rango
( ) outros
( ) não se aplica

13. Se você selecionou “outros”, por favor descreva:

_____

ANEXOS

Anexo 1 - Primeira página do artigo referente ao Capítulo 1

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Exploring dark kitchens in Brazilian urban centres: A study of delivery-only restaurants with food delivery apps

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ABSTRACT

Dark kitchen is a delivery-only restaurant that operates without direct contact with the consumer, has no premises for local consumption and sells exclusively through online platforms. The main objective of this work is to identify and characterise dark kitchens in three urban centres featured in the most used food delivery app in Brazil. To this end, data collection was conducted in two phases. In the first phase, through data mining, we collected information from restaurants in three cities (Limeira, Campinas and São Paulo - Brazil) that were provided in the food delivery app. A total of 22,520 establishments were searched from the central point of each of the cities. In the second phase, the first 1,000 restaurants in each city were classified as dark kitchens, standard, or undefined restaurants. A thematic content analysis was conducted to further distinguish the dark kitchen models. Of the restaurants evaluated, 1,749 (65.2%) were classified as standard restaurants, 727 (27.1%) as dark kitchens, and 206 (7.7%) as undefined. In terms of the characteristics of dark kitchens, they were more dispersed and located further away from the central points compared to standard restaurants. Meals in dark kitchens were cheaper than in standard restaurants, and had a lower number of user reviews. Most of the dark kitchens in São Paulo served Brazilian dishes, while in the smaller cities, Limeira and Campinas, it was mainly snacks and desserts. Six different models of dark kitchen were identified: Independent dark kitchen; shell-type (hub); franchise; virtual kitchen in a standard restaurant (different menu); virtual kitchen in a standard restaurant (similar menu but different name); and home-based dark kitchen. The modelling approach and methodology used to classify and identify dark kitchens is considered a contribution to science as it allows a better understanding of this fast growing sector of the food industry. This in turn can help to develop management strategies and policies for the sector. Our study is also of value to regulators to determine their proliferation through urban planning and to promote appropriate guidelines for dark kitchens as they differ from standard restaurants.

1. Introduction

The use of food delivery apps is becoming more commonplace in people's everyday lives. As a result, the market for food delivery has grown exponentially in Brazil and worldwide in recent years (CREST & Grupo, 2020; Statista, 2022b). This scenario has contributed to the emergence of a new trend in the food industry: dark kitchens. There are many names for dark kitchens such as: cloud or ghost kitchens, invisible, shared, commissary, satellite, virtual, or even cyber kitchens (Chatterjee et al., 2022; Dian et al., 2021; John, 2021; Upadhye & Sathe, 2020). These food businesses are characterised by having no spaces for local consumption, no direct contact with the public and selling exclusively through online platforms (Khan, 2020).

It is estimated that dark kitchens are not just a temporary solution.

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Anexo 2 - Primeira página do artigo referente ao Capítulo 2

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What is a dark kitchen? A study of consumer's perceptions of deliver-only restaurants using food delivery apps in Brazil

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ABSTRACT

Dark kitchens are restaurants with no storefronts, no direct customer interaction and delivery-only commercial kitchens that rent out shared or private kitchen spaces to food businesses. The objective of this study is to determine consumers' knowledge about dark kitchens and the factors that influence willingness to pay and intention to purchase meals in this restaurant model. It were surveyed 623 Brazilian consumers. First, consumers' knowledge of the term dark kitchen was determined using specific questions. Then, consumers were presented with the actual meaning of dark kitchens and were asked about their intention to use this restaurant model. To this end, participants were presented with 25 indicators to assess the following constructs: willingness to pay and purchase intention, trust in health authorities, trust in food delivery app, perceived food safety, quality control, consumer experience, and solidarity with the foodservice sector. Overall, 73.4 % of participants reported having heard of the term dark kitchen. Using a descending hierarchical classification, four classes of definitions were found. The factor solidarity with the foodservice sector ($\beta = 0.440$; $p < 0.001$) had the greatest positive influence on willingness to pay and purchase intention, followed by perceived food safety ($\beta = 0.273$; $p < 0.001$); quality control ($\beta = 0.125$; $p = 0.003$); consumer experience ($\beta = 0.110$; $p = 0.002$) and trust in health authorities ($\beta = 0.059$; $p = 0.047$). Even if consumers cannot accurately describe what a dark kitchen is, there is a positive intention to purchase food produced in this kitchen model. It is important to develop strategies to promote and improve dark kitchen models. Finally, it is suggested that health authorities and app operators pay more attention to improving food safety in these establishments, as consumers have low risk perception about them.

1. Introduction

Some challenges and new conditions in modern society are driving disruptive innovation (Buhalis et al., 2019). This is evident, for example, in the rapid increase in the use of smartphones, application technologies, and Internet access (GSMA, 2022), which are changing the use of time for everyday activities, such as time to prepare food (Barbosa & Campbell, 2006; Smith, Ng, & Popkin, 2013; Warde, 2016). More recently, the COVID −19 pandemic challenges encouraged the growth of the shopping sector in a virtual environment as the pandemic negatively impacted physical stores during restrictions, lockdowns, and stay-at-home orders (Chang et al., 2021; Talwar, Talwar, Kaur, Tripathy, & Dhir, 2021). In addition, many consumers avoided visiting restaurants for fear of COVID −19 infection (Hakim et al., 2021). These conditions favored the search for ready-to-eat foods sold online and, in parallel, the development of mobile apps that provide solutions and convenience. As a result, an increase in cost-effective business models, and the transition from physical stores to online services that can serve consumers in different circumstances have been observed (Owner, 2020).

The online food delivery (OFD) industry is one of the fastest growing among mobile apps. This industry generated $107.4 billion in global revenue in 2019 and is expected to reach $182.3 billion by 2024 (Statista, 2021). In Brazil, OFD orders grew 71 % in 2019 and could still represent a large part of restaurant sales, accounting for 40 % of the total (CREST & GS&NPD, 2020). In a previous study, we found that Brazilian consumers are willing to continue using food delivery apps (FDA) after the pandemic (Zanetta et al., 2021). This result shows that the growth of the OFD market in the last years will permanently occupy a share of the food market. This expansion of the OFD market and the aftermath of the pandemic have also created space for the emergence of a new business

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