Food Insecurity and Health Outcomes in Mozambique: In What Way Does the Socioeconomic Position of the Household Head Matter?

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To my beloved wife, Laurina

And

To my beloved daughter, Kimberly

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Abstract

Background and objectives: Food insecurity (FI) is a global concern and is one of the major causes of malnutrition among vulnerable populations in low- and middle-income countries (LMICs). Food insecurity has been linked to a range of negative health outcomes, of which non-communicable diseases (NDCs) have become the world's leading causes of mortality and morbidity and are significant contributors to the global burden of disease. In addition, there is a growing recognition of mental health as an intrinsic component of general health and well-being. For a variety of reasons, however, many people in LMICs still suffer from mental health conditions in silence. Food security (FS) is paramount to maintaining not only physical but also mental health. In the context of multiple risk factors, there is an increasing need to understand the interplay between FI and NCDs, and mental health outcomes, especially among sensitive populations. The burden of FI in southern Africa including Mozambique and how several factors impact FI, is not well known, although FI remains an important public health concern in the region. There is shortage of scientific data on the relationship between socioeconomic position (SEP), FI and health outcomes in southern Africa and specifically Mozambique. Furthermore, especially when formulating and implementing policies and health programmes aimed to alleviate FI and promote better health outcomes, it is crucial to understand the specific circumstances that force food-insecure households to resort to different coping strategies. The overall objective of this thesis was to assess the impact of SEP on FI and physical and psychological health outcomes among adults in Maputo City, southern Mozambique. Specifically, the thesis objectives were to systematically review empirical evidence on the relationship between FI and health

outcomes among adults in southern Africa (including Mozambique) (Study I); to estimate the prevalence of FI and assess its associated factors among households in Maputo City (Study II); to examine the association between SEP, FI and hypertension and type 2 diabetes (Study III); to examine the association between SEP, FI and anxiety and depression (Study IV), and to understand the perceptions and coping strategies used by household heads in situations of FI (Study V).

Methods: Study I was based on 14 peer-reviewed journal articles that met the inclusion criteria. The literature search was conducted and reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Most studies assessed FI using either contextually adapted versions of the US Department of Agriculture (USDA) Household Food Security Survey Module (HFSSM) or the Household Food Insecurity Access Scale (HFIAS). Physical health outcomes (e.g. hypertension, diabetes and HIV) were assessed based on self-reports of actual diagnoses performed at hospitals, health centres or medical clinics. Mental health outcomes (e.g. anxiety and depression) were measured using various self-reporting scales with some focus on the Self-Reporting Questionnaire (SRQ). By contrast, Study II, III and IV used cross-sectional data from a sample of 1,842 household heads in Maputo City. In Study II, FI was assessed using a contextually adapted version of the USDA HFSSM, and the relationship between FI and socioeconomic and demographic factors was explored through multiple regressions. In Study III, the assessment of hypertension and diabetes relied on self-reports, by heads of households, of the actual diagnoses performed at hospitals, health centres or medical clinics. For study purposes, 1,820 self-reports were included in the data analysis. Multinomial logistic regression was used to analyse the association between FI, SEP, hypertension, and diabetes, and interaction terms were used to assess the effects of SEP

on this association. In Study IV, the Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety and depression. A composite variable for psychological health was created. Propensity score matching and interaction effect analyses were employed to examine the effects of FI on psychological health, as well as the moderating role of SEP. In Study V, a qualitative descriptive design was employed, and based on data saturation criteria, a total of 16 in-depth interviews with heads of households experiencing FI were conducted, audio-recorded, and transcribed verbatim. Accordingly, a qualitative content analysis was performed using an inductive approach.

Results: In Study I, a broad range of prevalence and severity of FI was registered (18–91%), depending on the sociodemographic characteristics of the studied population and the measurement instruments. Food insecurity was frequently associated with hypertension, diabetes, increased risk of HIV acquisition, anxiety and depression. In Study II, 79% of the households were in a situation of FI; of these, about 21% had mild FI, 35.5% moderate and 43.5% severe FI. The study showed that low income, low education, low food diversity, and reduced number of meals per day were consistently and significantly associated with increased odds of FI. In Study III, the findings revealed a significant association between FI, SEP (especially education and income), hypertension, and type 2 diabetes. Furthermore, the interaction analyses highlighted the influence of SEP on the relationship between FI and hypertension, and consistently showed a nuanced influence on type 2 diabetes. Specifically, food-insecure individuals with a higher SEP were more likely to develop diabetes than their counterparts with a lower SEP. In Study IV, of the 1,174 participants randomly assigned for propensity score matching, 787 were exposed to FI while 387 were unexposed. The analysis

revealed stark disparities in psychological health outcomes associated with FI. The risk of poor psychological health among those exposed to FI was 25.79%, which was significantly higher than the 0.26% in the unexposed group, with a risk ratio of 99.82. The attributable fractions revealed that nearly all the risk for poor psychological health in the exposed group could be ascribed to FI, particularly moderate and severe FI. The interaction effects analysis revealed that SEP greatly modifies this relationship. Specifically, the heads of food-insecure households with a lower SEP tended to report less favourable mental health compared with their food-secure counterparts with a higher SEP. Finally, in Study V, the results were summarized into five themes: experiences and perceptions of FI; coping strategies applied in situations of FI; food choices; effects of climate change on FS; and effects of FI on perceived health. A broad spectrum of experiences and coping strategies were described, starting from cooking any food available, skipping meals, receiving remittance from relatives and friends, consuming unsafe foods, and cooking least favourite foods, to having a repetitive and less-nutritious diet. The heads of households also reported emotional distress, anxiety and depression, substance use, and other adverse health outcomes as consequences of FI. Some had been diagnosed with hypertension, diabetes or HIV/AIDS.

Conclusions: Food insecurity is a great concern in southern Africa and is associated with various negative health outcomes. The studies point to the need for future research on the relationship between FI and health outcomes, to help standardize measures of FI and psychological health, and to inform government policies and interventions aimed to alleviate FI and promote better health outcomes in the region. More than three-quarters of households in Maputo City suffer from FI, and several factors (e.g. SEP, household size and structure) appear to play

a significant role, emphasizing the need for decent work and employment creation, as well as the need for women's empowerment in the country. Furthermore, the heads of households applied various coping strategies to acquire and manage food, some of which are considered risky to health. This highlights their extreme hardships and vulnerability. Lastly, FI was found to have a positive and significant association with anxiety and depression, and hypertension and type 2 diabetes. In addition, the SEP of household heads appears to modify these associations. Therefore, addressing household FI and improving the SEP of the most sensitive groups may be crucial measures in reducing the risk factors associated with NCDs and poor mental health in the country. These findings highlight the significance of an all-inclusive approach to health promotion and disease prevention. Future longitudinal studies are needed to gain deeper insight into the pathways linking socioeconomic and demographic factors to household FI and negative health outcomes, and to establish causal inferences.

Keywords: food insecurity; socioeconomic position; heads of households; coping strategies; health outcomes; anxiety and depression; hypertension and type 2 diabetes; Maputo; Mozambique

Summary in Swedish

Bakgrund och mål: Osäkerhet kring livsmedel är ett globalt bekymmer och är en av de främsta orsakerna till undernäring bland utsatta befolkningar i låg- och medelinkomstländer. Osäkerhet kring mat har förknippats med en rad negativa hälsoresultat, varav icke-smittsamma sjukdomar har blivit världens främsta orsaker till dödlighet och sjuklighet, och betydande bidragsgivare till den globala sjukdomsbördan. På samma sätt finns det ett växande erkännande av mental hälsa som en inneboende komponent i allmän hälsa och välbefinnande, men av olika anledningar lider fortfarande många människor i låg- och medelinkomstländer av psykiska tillstånd i tysthet. Livsmedelssäkerhet är avgörande för att upprätthålla inte bara fysisk, utan också mental hälsa. Inom ramen för flera riskfaktorer finns det ett ökande behov av att förstå samspelet mellan livsmedelsosäkerhet och både icke-smittsamma sjukdomar, och psykiska hälsoresultat, särskilt bland utsatta befolkningsgrupper. Bördan av livsmedelsosäkerhet i södra Afrika (och Moçambique) samt hur flera faktorer påverkar matosäkerheten är inte välkänd, trots att livsmedelsosäkerhet fortfarande är ett viktigt folkhälsoproblem i regionen. Det råder brist på vetenskapliga data om sambandet mellan socioekonomisk ställning, livsmedelsosäkerhet och hälsoresultat i södra Afrika och Moçambique. Vidare är det avgörande att förstå de specifika omständigheterna som tvingar hushåll med osäkra livsmedel att tillgripa varje mönster av hanteringsstrategier, särskilt när man utarbetar och implementerar policyer och hälsoprogram som syftar till att lindra matosäkerhet och främja bättre hälsoresultat. Det övergripande syftet med denna avhandling var att bedöma inverkan av socioekonomisk ställning på matosäkerhet, fysiska och psykiska hälsoresultat bland vuxna i Maputo City, södra Moçambique. Specifikt

var avhandlingens mål att systematiskt granska empiriska bevis för sambandet mellan livsmedelsosäkerhet och hälsoresultat bland vuxna i södra Afrika (och Moçambique) (Studie I); att uppskatta prevalensen av matosäkerhet och bedöma dess associerade faktorer bland hushållen i Maputo City (Studie II); att undersöka sambandet mellan socioekonomisk ställning, livsmedelsosäkerhet och högt blodtryck och typ II-diabetes (Studie III); att undersöka sambandet mellan socioekonomisk ställning, livsmedelsosäkerhet och ångest och depression (Studie IV), och att förstå de uppfattningar och hanteringsstrategier som används av familjeöverhuvud i situationer med livsmedelsosäkerhet (Studie V).

Metoder: Studie I använde sig på 14 peer-reviewed tidskriftsartiklar som uppfyllde inklusionskriterierna. Litteratursökningen genomfördes och rapporterades med hjälp av PRISMA-riktlinjerna. De flesta studier utvärderade matosäkerhet genom användning av antingen kontextuellt anpassade versioner av US Department of Agriculture Household Food Security Survey Module eller Household Food Insecurity Access Scale. Fysiska hälsoresultat (t.ex. högt blodtryck, diabetes, HIV) bedömdes baserat på självrapporter av faktiska diagnoser utförda på sjukhus, vårdcentraler eller medicinska kliniker. Resultaten för psykisk hälsa (t.ex. ångest och depression) mättes med hjälp av olika självrapporteringsskalor med visst fokus på självrapporteringsfrågeformulär. Studie II, III och IV använde tvärsnittsdata från ett urval av 1842 familjeöverhuvud i Maputo City. I Studie II utvärderades livsmedelsosäkerhet med hjälp av en kontextuellt anpassad version av US Department of Agriculture Household Food Security Module, och dess samband med socioekonomiska och demografiska faktorer undersöktes genom flera regressionsanalyser. I Studie III förlitade sig bedömningen av högt

blodtryck och diabetes på självrapporter från hushållsöverhuvuden om de faktiska diagnoser som utförts på sjukhus, vårdcentraler eller medicinska kliniker. För studieändamålet inkluderades 1820 hushållsansvariga vid dataanalyser. Multinomial logistisk regression användes för att analysera sambandet mellan livsmedelsosäkerhet, socioekonomisk position, högt blodtryck och diabetes, därutöver användes interaktionstermer för att bedöma effekterna av socioekonomisk position på detta förhållande. I Studie IV användes Hospital Anxiety and Depression Scale för att mäta ångest och depression. En sammansatt variabel för psykisk hälsa skapades. Matchning av benägenhetspoäng och analyser av interaktionseffekter användes för att undersöka effekterna av livsmedelsosäkerhet på psykisk hälsa och den socioekonomiska ställningens modererande roll. I Studie V användes en kvalitativ deskriptiv design, och baserat på datamättnadskriterium genomfördes totalt 16 djupintervjuer med ansvariga för hushåll som upplevde livsmedelsosäkerhet, ljudinspelade och transkriberades ordagrant. Följaktligen utfördes en kvalitativ innehållsanalys med ett induktivt tillvägagångssätt.

Resultat: I Studie I registrerades ett brett spektrum av prevalens och svårighetsgrad av livsmedelsosäkerhet (18–91 %), beroende på de sociodemografiska egenskaperna hos den studerade befolkningen och mätinstrumenten. Otrygghet i maten var ofta förknippad med högt blodtryck, diabetes, ökad risk för hiv-förvärv, ångest och depression. I Studie II var 79 % av hushållen i en matosäker situation; av dessa hade cirka 21 % lindrig matotrygghet, 35,5 % måttlig och 43,5 % allvarlig matotrygghet. Studien fann att låg inkomst, låg utbildning, låg matmångfald och lågt antal måltider per dag var konsekvent och signifikant associerade med ökade odds för matosäkerhet. I Studie III visade resultaten ett signifikant samband mellan matosäkerhet,

socioekonomisk status (särskilt utbildning och inkomst), högt blodtryck och typ 2-diabetes. Vidare visade interaktionsanalyser påverkan av socioekonomisk status på sambandet mellan livsmedelsosäkerhet och högt blodtryck, och visade konsekvent en nyanserad inverkan på typ 2-diabetes. Specifikt var livsmedelsotrygga individer med en högre socioekonomisk position mer benägna att utveckla diabetes än deras motsvarigheter med en lägre socioekonomisk position. I Studie IV, av de 1174 deltagare som slumpmässigt tilldelades matchning till benägenhetspoäng, exponerades 787 för matosäkerhet medan 387 var oexponerade. Analysen avslöjade skarpa skillnader i psykologiska hälsoresultat associerade med livsmedelsosäkerhet. Risken för dålig psykisk hälsa bland dem som utsattes för mattrygghet var 25,79 %, vilket var betydligt högre än 0,26 % i den oexponerade gruppen, med en riskkvot på 99,82. De hänförbara fraktionerna avslöjade att nästan all risk för dålig psykisk hälsa berodde på livsmedelsosäkerhet, särskilt måttlig och allvarlig livsmedelsosäkerhet. Interaktionseffektanalysen avslöjade att socioekonomisk ställning i hög grad modifierar detta förhållande. Specifikt tenderade chefer för livsmedelsosäkerhet hushåll med en lägre socioekonomisk ställning att rapportera mindre gynnsam psykisk hälsa jämfört med deras matsäkra motsvarigheter med en högre socioekonomisk ställning. I Studie V sammanfattades resultaten i fem teman: upplevelser och uppfattningar om matotrygghet, copingstrategier som tillämpas i situationer med matotrygghet, val av mat, klimatförändringarnas effekter på livsmedelsförsörjningen och effekter av livsmedelsosäkerhet på upplevd hälsa. Ett brett spektrum av upplevelser och hanteringsstrategier beskrevs, från att laga all tillgänglig mat, hoppa över måltider, ta emot pengar från sina släktingar och vänner, konsumera osäker mat, till att ha en upprepande kaloridiet. Ansvariga

för hushållen rapporterade också känslomässigt lidande, ångest och depression, droganvändning och andra negativa hälsoeffekter som följder av livsmedelsosäkerhet. Vissa hade diagnostiserats med högt blodtryck, diabetes och hiv/aids.

Slutsatser: Livsmedelsosäkerhet är ett stort problem i södra Afrika och är förknippat med olika negativa hälsoresultat. Studier pekar på behovet av framtida forskning om sambandet mellan matosäkerhet och hälsoresultat, för att standardisera mått på livsmedelsosäkerhet och psykologisk hälsa, och att informera regeringens politik och insatser som syftar till att lindra livsmedelsosäkerhet och främja bättre hälsoresultat i regionen. Mer än tre fjärdedelar av hushållen i staden Maputo lider av matosäkerhet, och flera faktorer (t.ex. socioekonomisk ställning, hushållens storlek och struktur) verkar spela en betydande roll, vilket betonar behovet av anständigt arbete och skapande av sysselsättning, liksom behovet av kvinnors egenmakt i landet. Dessutom använde ansvariga för hushållen olika copingstrategier för att skaffa och hantera mat, av vilka några ansågs vara riskabla för hälsan, vilket lyfte fram deras svårigheter och sårbarhet. Slutligen hade livsmedelsosäkerhet ett positivt och signifikant samband med ångest och depression, högt blodtryck och typ 2-diabetes. Dessutom verkar den socioekonomiska ställningen för hushållens ansvariga ändra dessa associationer. Att ta itu med osäkerheten i livsmedelsförsörjningen och förbättra den socioekonomiska ställningen kan därför vara avgörande åtgärder för att minska risken för icke-smittsamma sjukdomar och dålig psykisk hälsa bland utsatta befolkningsgrupper, vilket betonar betydelsen av ett holistiskt tillvägagångssätt för hälsofrämjande och förebyggande av sjukdomar. På liknande sätt krävs framtida longitudinella studier för att få djupare insikt i vägarna som kopplar socioekonomiska och demografiska faktorer till hushållens

matosäkerhet och negativa hälsoutfall, och för att fastställa kausala slutsatser.

Nyckelord: mat osäkerhet; socioekonomisk ställning; ansvariga för hushåll; hanteringsstrategier; hälsoresultat; ångest och depression; hypertoni och diabetes typ II; Maputo; Moçambique

Summary in Portuguese

Antecedentes e objectivos: A insegurança alimentar é uma preocupação global e uma das principais causas da desnutrição nos países de baixa e média renda. A insegurança alimentar tem sido associada a uma série de resultados negativos para a saúde, dos quais as doenças crônicas não transmissíveis tornaram-se as principais causas de mortalidade e morbilidade no mundo e contribuem significativamente para o fardo global das doenças. Ademais, há um reconhecimento crescente da saúde mental como uma componente intrínseca da saúde e do bem-estar geral. No entanto, por diversas razões, muitas pessoas nos países de baixa e média renda ainda sofrem de problemas de saúde mental em silêncio. A segurança alimentar é fundamental para manter não só a saúde física, mas também mental. No contexto de múltiplos factores de risco, há uma necessidade crescente de compreender a interacção entre a insegurança alimentar e as doenças crônicas não transmissíveis, e a saúde mental, especialmente entre as populações vulneráveis. O fardo da insegurança alimentar e a forma como vários factores contribuem para a insegurança alimentar na África Austral incluindo Moçambique não são bem conhecidos, embora continue a ser uma importante preocupação de saúde pública na região. Há escassez de dados científicos sobre a relação entre a posição socioeconômica, a insegurança alimentar e a saúde na África Austral e, especificamente, em Moçambique. Além disso, especialmente na formulação e

implementação de políticas e programas de saúde destinados para aliviar a insegurança alimentar e promover melhores resultados da saúde, é crucial compreender as circsunstâncias específicas que obrigam as famílias em situações de insegurança alimentar a recorrer à diferentes estratégias de sobrevivência. O objectivo geral desta tese foi avaliar o impacto da posição socioeconômica sobre a insegurança alimentar, e saúde física e psicológica entre adultos na Cidade de Maputo, sul de Moçambique. Especificamente, os objectivos da tese foram rever sistematicamente as evidências empíricas da relação entre a insegurança alimentar e a saúde entre os adultos na África Austral (Moçambique incluso) (Estudo I); estimar a prevalência da insegurança alimentar e avaliar os seus factores associados entre os agregados familiares na Cidade de Maputo (Estudo II); examinar a associação entre posição socioeconômica, insegurança alimentar, hipertensão e diabetes tipo 2 (Estudo III); examinar a associação entre posição socioeconômica, insegurança alimentar, ansiedade e depressão (Estudo IV), e compreender as percepções e estratégias de sobrevivência utilizadas pelos chefes de família em situações de insegurança alimentar (Estudo V).

Métodos: O Estudo I foi baseado em 14 artigos revistos por pares que atenderam aos critérios de inclusão. A pesquisa bibliográfica foi realizada e relatada usando as diretrizes PRISMA. A maioria dos estudos avaliou a insegurança alimentar utilizando versões contextualmente adaptadas do Módulo de Inquérito à Segurança Alimentar Doméstica do Departamento de Agricultura dos EUA ou da Escala de Acesso à Insegurança Alimentar Doméstica. A saúde física (por exemplo, hipertensão, diabetes, HIV) foi avaliada com base em autorrelatos de diagnósticos reais realizados em hospitais, centros de saúde ou clínicas médicas. A saúde mental (por exemplo, ansiedade e depressão) foi mensurada utilizando várias escalas de autorrelato, com algum enfoque no Questionário de Autorrelato. Por outro lado, os

Estudos II, III e IV utilizaram dados transversais de uma amostra de 1842 chefes de família residentes na Cidade de Maputo. No Estudo II, a insegurança alimentar foi avaliada utilizando uma versão contextualmente adaptada do Modulo de Segurança Alimentar Doméstica do Departamento de Agricultura dos EUA, e a relação entre a insegurança alimentar e os factores sociodemográficos foi explorada com recurso a regressões múltiplas. No Estudo III, a avaliação da hipertensão e da diabetes baseou-se em autorrelatos dos chefes de família sobre diagnósticos reais realizados em hospitais, centros de saúde ou clínicas médicas. Para fins de estudo, 1820 autorrelatos foram incluídos na análise de dados. A regressão logística multinomial foi utilizada para analisar a associação entre insegurança alimentar, posição socioeconômica, hipertensão e diabetes, e os termos de interacção foram utilizados para avaliar os efeitos da posição socioeconômica nesta associação. No Estudo IV, foi utilizada a Escala Hospitalar de Ansiedade e Depressão para mensurar ansiedade e depressão. Foi criada uma variável composta para a saúde psicológica. Análises de correspondência de pontuação de propensão e dos efeitos de interacção foram empregadas para examinar os efeitos da insegurança alimentar na saúde psicológica bem como o papel moderador da posição socioeconômica. No Estudo V, foi empregado um desenho descritivo qualitativo e, com base no critério de saturação de dados, um total de 16 entrevistas em profundidade com chefes de família em situação de insegurança alimentar foram conduzidas, gravadas em áudio e transcritas na íntegra. Com efeito, foi realizada uma análise qualitativa de conteúdo usando uma abordagem indutiva.

Resultados: No Estudo I, foi registada uma ampla variação na prevalência e gravidade da insegurança alimentar (18–91%), dependendo das características sociodemográficas da população estudada e do instrumento de medição. A insegurança alimentar foi frequentemente associada à hipertensão, diabetes, risco acrescido de

aquisição do HIV, ansiedade e depressão. No Estudo II, 79% das famílias apresentaram insegurança alimentar; destes, cerca de 21% apresentaram insegurança alimentar leve, 35,5% moderada e 43,5% severa. O estudo mostrou que o baixo rendimento, a baixa escolaridade, baixa diversidade alimentar e o número reduzido de refeições por dia foram consistente e significativamente associados à probabilidade acrescida de insegurança alimentar. No Estudo III, os achados revelaram uma associação significativa entre insegurança alimentar, posição socioeconômica (especialmente escolaridade e renda), hipertensão e diabetes tipo 2. Além disso, as análises de interacção destacaram a influência da posição socioeconômica na relação entre insegurança alimentar e hipertensão, e mostraram consistentemente uma influência diferenciada na diabetes tipo 2. Especificamente, os indivíduos em situação de insegurança alimentar e com uma posição socioeconômica mais elevada tinham maior probabilidade de desenvolver diabetes em relação aos seus homólogos com uma posição socioeconômica mais baixa. No Estudo IV, dos 1174 participantes designados aleatoriamente para a correspondência de pontuação de propensão, 787 foram expostos à insegurança alimentar, enquanto 387 não foram expostos. A análise revelou disparidades acentuadas na saúde psicológica associadas à insegurança alimentar. O risco de problemas de saúde psicológica entre os expostos à insegurança alimentar foi de 25,79%, valor significativamente superior aos 0,26% do grupo não exposto, com uma razão de risco de 99,82. As fracções atribuíveis revelaram que quase todo o risco de problemas de saúde psicológica no grupo exposto poderia ser atribuído à insegurança alimentar, particularmente à insegurança alimentar moderada e severa. A análise dos efeitos de interacção revelou que a posição socioeconômica modifica muito essa relação. Especificamente, os chefes de família em situação de insegurança alimentar e com uma posição socioeconômica mais baixa tenderam a reportar uma saúde

mental menos favorável em comparação com os seus homólogos em situação de segurança alimentar e com uma posição socioeconômica mais elevada. Finalmente, no Estudo V, os resultados foram resumidos em cinco temas: experiências e percepções de insegurança alimentar; estratégias de sobrevivência aplicadas em situações de insegurança alimentar; escolhas alimentares; efeitos de mudanças climáticas sobre a segurança alimentar; e efeitos da insegurança alimentar sobre a saúde percebida. Foram descritas várias experiências e estratégias de sobrevivência, desde cozinhar qualquer alimento disponível, pular refeições, receber remessas de familiares e amigos, consumir alimentos inseguros, cozinhar alimentos menos preferidos até ter uma dieta repetitiva e menos nutritiva. Os chefes de família relataram igualmente sofrimento emocional, ansiedade e depressão, uso de substâncias e outros resultados negativos para a saúde como consequências da insegurança alimentar. Alguns tinham diagnósticos de hipertensão, diabetes ou HIV/SIDA.

Conclusão: A insegurança alimentar é uma grande preocupação na África Austral e está associada a vários resultados negativos para a saúde. Os estudos apontam para a necessidade de pesquisas futuras sobre a relação entre a insegurança alimentar e os resultados da saúde, para ajudar a padronizar medidas de insegurança alimentar e saúde psicológica, bem como para informar políticas e intervenções governamentais destinadas a aliviar a insegurança alimentar e promover melhores resultados da saúde na região. Mais de três quartos dos agregados familiares na Cidade de Maputo sofrem de insegurança alimentar, e vários factores (por exemplo, posição socioeconómica, tamanho e estrutura do agregado familiar) parecem desempenhar um papel significativo, enfatizando a necessidade de trabalho digno e criação de emprego, bem como a necessidade de empoderamento das mulheres no país. Além disso, os chefes de família utilizaram diversas estratégias de sobrevivência para adquirir e gerir

alimentos, algumas das quais consideradas arriscadas para a saúde. Isso destaca a extrema dificuldade e vulnerabilidade das famílias. Por último, a insegurança alimentar teve uma associação positiva e significativa com a ansiedade e depressão, hipertensão e diabetes tipo 2. Além disso, a posição socioeconômica dos chefes de família parece modificar estas associações. Portanto, abordar a insegurança alimentar e melhorar a posição socioeconômica dos grupos mais senvíveis podem ser medidas cruciais para mitigar o risco associado às doenças crônicas não transmissíveis e de problemas de saúde mental no país. Esses resultados enfatizam a importância de uma abordagem holística para a promoção da saúde e prevenção de doenças. Futuros estudos longitudinais são necessários para obter uma visão mais profunda sobre os mecanismos que ligam os factores socioeconômicos e demográficos à insegurança alimentar das famílias e aos resultados negativos da saúde, e para estabelecer inferências causais.

Palavras-chave: insegurança alimentar; posição socioeconômica; chefes de família; estratégias de sobrevivência; resultados da saúde; ansiedade e depressão; hipertensão e diabetes tipo 2; Maputo; Moçambique

List of papers

This thesis is based on the following articles:

Study I   Militao EMA, Salvador EM, Uthman OA, Vinberg S, Macassa G. Food Insecurity and Health Outcomes Other than Malnutrition in Southern Africa: A Descriptive Systematic Review. *IJERPH* 2022; 19: 5082.

Study II   Militao EMA, Uthman OA, Salvador EM, Vinberg S, Macassa G. Food Insecurity and Associated Factors among Households in Maputo City. *Nutrients* 2023; 15: 2372.

Study III   Militao EMA, Uthman OA, Salvador EM, Vinberg S, Macassa G. Association between food insecurity, socioeconomic status of the household head and hypertension and diabetes in Maputo City. (submitted).

Study IV   Militao EMA, Uthman OA, Salvador EM, Vinberg S, Macassa G. Association between socioeconomic position of the household head, food insecurity and psychological health: an application of propensity score matching. *BMC Public Health* 2024; 24: 2590.

Study V   Militao EMA, Salvador EM, Silva JP, Uthman OA, Vinberg S, Macassa G. Coping Strategies for Household Food Insecurity, and Perceived Health in an Urban Community in Southern Mozambique: A Qualitative Study. *Sustainability* 2022; 14: 8710.

List of abbreviations

AIDS   acquired immunodeficiency syndrome

ART   antiretroviral therapy

CASP   Critical Appraisal Skills Programme

CI   confidence interval

CSDH   Commission on Social Determinants of Health

CVD   cardiovascular disease

DALY   disability-adjusted life year

ESAN   Food Security and Nutrition Strategy and Action Plan

FAO   Food Agriculture Organization

FBD   food-borne disease

FI   food insecurity

FS   food security

HADS   Hospital Anxiety and Depression Scale

HADS-A   Hospital Anxiety and Depression Scale – Anxiety

HADS-D   Hospital Anxiety and Depression Scale – Depression

HFIAS   Household Food Insecurity Access Scale

HFSSM   Household Food Security Survey Module

HIC   high-income country

HIV   human immunodeficiency virus

LMIC   low- and middle-income country

NCD   non-communicable disease

PLHIV	people living with human immunodeficiency virus
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SADC	Southern African Development Community
SDG	Sustainable Development Goal
SEP	socioeconomic position
SETSAN	Technical Secretariat for Food Security and Nutrition
SRH	self-reported health
SRQ	Self-Reporting Questionnaire
SSA	Sub-Saharan Africa
SSAC	Sub-Saharan African country
UN	United Nations
USDA	United States Department of Agriculture
WHO	World Health Organization
YLD	year lived with disability

1 Introduction

Food insecurity (FI) is a global and urgent public health issue linked to human nutrition, health and well-being.[1,2] Food insecurity can be defined in various ways. One of the definitions of the Food Agriculture Organization (FAO) of the United Nations (UN) describes FI as either a shortage of nutritionally adequate and safe food or the restricted capability to secure food in socially acceptable ways.[3,4] Others defined FI as a set of circumstances in which people compromise on the quality, variety or quantity of food as a result of constrained resources and/or the inability to afford food.[2] The concept of FI is based on four hierarchical dimensions required to achieve food security (FS). These are food availability, accessibility, utilization, and stability,[5,6] but in this thesis the focus is first and foremost on household accessibility to food in terms of quality, variety and quantity for an active life.

According to a report by FAO et al.[7] about 735 million people worldwide (i.e. 9.2% of the global population) are undernourished. A total of 726 million reside in low- and middle-income countries (LMICs) including 281.6 million who live in Africa as a whole, of whom 262 million live in Sub-Saharan Africa (SSA). Within the sub-Saharan region, southern Africa continues to maintain a more favourable situation as compared with Central African countries, while the highest burden in numbers is still found in East Africa.[7] Furthermore, estimates suggest that about 2.4 billion people (29.6% of the global population) suffer from moderate or severe FI. The number of undernourished people in the world has grown, pointing out the pressing challenges of attaining the UN Sustainable Development Goal (SDG) of Zero Hunger, eliminating FI and all forms of malnutrition by 2030. Today, it is expected that by 2030 about 600 million people will still face hunger, and right now, the fraction of people who cannot

afford a healthy diet has greatly increased, mainly because of armed conflicts, climate change, and the COVID-19 pandemic.[7] Similarly, rapid population growth together with soil degradation is a grave threat that has been neglected but requires urgent consideration, especially when addressing global FI and malnutrition.[8,9]

In parallel, there is a body of research evidence from the LMICs pointing to an association between FI and adverse health outcomes. To date, most research exploring the impact of FI on health outcomes is largely limited to high-income countries (HICs) and has focused on children.[10,11] Such studies in general have associated FI with poor general health, decreased intellectual and emotional development, poor academic performance, iron deficiency anaemia, underweight and stunting.[12–16] In adults, FI has often been associated with hypertension, diabetes,[17,18] anxiety, depression, and suicide ideation,[19,20] as well as other health-related outcomes,[18,21] which include intimate partner violence perpetration.[22,23]

Specifically, Trudell et al.[24] in their systematic review in Africa found FI to be associated with poor mental health, and this relationship could be amplified in specific populations depending on various mediating factors (e.g. age, sex, presence or absence of social networks, and HIV). The authors suggested the need for further research to involve populations at risk to better understand those factors that may facilitate this connection, and especially to inform policies and suitable interventions.[24] Another systematic review by Haines et al.[25] carried out in southern Africa on risk factors for depression in young people living with HIV (PLHIV), found FI to be one of the key risk factors for depression, which could be considered to guide interventions to boost antiretroviral therapy (ART) outcomes.[25] Along the same lines, Nkambule et al.[26] in their systematic review in SSA on the association

between FI and key risk factors for diet-sensitive non-communicable diseases (NCDs), found FI to be linked to dyslipidaemia, hypertension, and overweight, particularly among women. Therefore, Nkambule and his colleagues called for the need to deal with FI as an essential aspect of diet-sensitive NCD prevention programmes.[26]

In short, there is a need to conduct empirical studies on the relationship between FI and health outcomes in southern Africa in general and Mozambique in particular. As yet, the burden of FI in southern African countries including Mozambique, and the factors that are intimately associated with FI are not well known. In addition, the association between FI and adverse health outcomes and the specific circumstances that compel households to resort to risky coping strategies are poorly described in Mozambique. At the same time, the urgency of household FI in the country calls for the need to design and develop multifaceted and multisectoral programmes supported by research that include FS and nutrition as an essential aspect, to promote better health outcomes (physical and mental), especially among populations at risk. Simultaneously, understanding coping strategies from the perspective of food-insecure households becomes necessary when formulating and implementing policy strategies and health programmes aimed to combat FI and malnutrition at a national, regional, and global level.

2 Background

2.1 Factors associated with food insecurity among households

The factors that are intimately associated with FI at a global, regional, national, and household level have been well documented.[27] Accordingly, it is necessary to examine the main factors that contribute to FI and the rise in FI, taking a closer look at the four dimensions of FS.[6,28] For instance, the availability of food depends on factors governed by the supply side, while the demand side governs factors contributing to food access. Consequently, factors that cause differences in the supply and demand side would additionally impact availability and access to food, resulting ultimately in FI.[29]

Household FI is related to several factors, that include poverty, employment status, low income, educational level, household size and structure, age, gender of the household head, food prices, and other factors.[30,31] Understanding the characteristics and determinants of household FI is crucial to developing appropriate policies and interventions aimed at alleviating household FI and malnutrition.[31,32]

The conceptual model of household FI takes into consideration the three FS dimensions, availability, accessibility, and utilization, as well as the factors that influence each of them.[30] Likewise, there is a need to consider the fourth dimension of FS, stability, which recognizes that FI can be transitory or cyclic[6] as it is closely linked to climate change, conflict and political instability, job loss, illness, and any other factor that can disrupt one of the first three dimensions.[31,33] In this context, factors such as food production and the distribution of food, import capacity, education, age of the household head, food aids, and stocks have been identified as determinants of availability. Purchasing power,

income, and distribution of money within households, household size, food prices, and employment status are recognized determinants of accessibility. Dietary intake, food safety, gender, and hygiene, as well as societal values, are considered determinants of utilization.[30,34,35]

2.1.1 Household income and poverty

Poverty is the major underlying factor that hinders access to nutritionally adequate, and safe food among low-income households. Because of their low socioeconomic status, poor households are prone to limited access to food, which could further prevent its distribution among family members.[32,36] In SSA, low income is one of the key determinants of hunger, FI, and malnutrition among the population. In other words, poverty and FI are linked and they lead to malnutrition.[32,37] Similarly, the poor cannot afford adequate housing or quality health care; nor can they afford quality education for their families.[38] Thus, poverty combined with other socioeconomic and political issues lead to FI and malnutrition in LMICs.[39]

2.1.2 Occupation

In many societies, especially in the LMICs, occupation (paid work) can be viewed as a proxy for employment, which is known to largely determine income and social prestige and contribute to social networks.[40–42] Consequently, the absence of paid work for household heads would likely propel their families into poverty and household FI, which, in turn, will contribute to and exacerbate nutrition deficits that are linked to chronic diseases and mental health conditions (through nutritional, mental, and behavioural pathways).[32,43]

Indeed, in SSA where most people live below the poverty line, the main and often sole asset of the poor is their labour. Therefore, labour markets and labour earnings need to be understood in a different way

than in HICs.[44,45] In fact, research evidence points out that the formal labour force participation rate in SSA is very low in contrast with a very extensive informal employment rate.[44,45] For instance, recent estimates suggest a rate of about 66% and 83% of informal employment for SSA and Mozambique, respectively,[45,46] the bulk of which consists of informal enterprises and self-employment. According to Fields,[44] formal wage employment rates are not only low but also vary by LMIC, and within the same country, by region and rural vs urban setting.[44]

In short, research evidence from LMICs and HICs indicates that the strongest predictor of FI is family poverty status, where households with the lowest incomes linked to certain occupations (e.g. odd jobs, self-employed, and retailers) are the most vulnerable.[30,47,48] In contrast to HICs, which have a strong social security system (and unemployment insurance), being unemployed or lacking paid work in the LMICs is associated with poverty.[49] Lack of paid work or unemployment (and underemployment) leads to financial strain, which in turn increases the likelihood of unhealthy food purchases and unhealthy eating behaviours within households, which worsen household FI.[49]

2.1.3 Educational level

Education is a critical determinant of food production, access, and utilization.[30] Besides improving household income and access to food, education can offer employment opportunities (and lead to safer jobs).[30] Education may also have a positive impact on how the resources within the household are managed, meaning that improving households' financial management skills can reduce household FI.[50] Household heads with a higher educational attainment are more likely to take informed decisions about food consumption and healthy eating.[50,51] In addition, they are potentially more able to access and

make better use of social programmes to improve their nutrition.[50] Likewise, higher education, especially in women, can positively impact food preparation and nutrition practices that improve eating habits, for example preventing malnutrition among children.[30] Lastly, education may allow farmers to adopt new technological inputs into agriculture, make proper application of fertilizers, as well as engage in other income-generating activities which improve household FS and nutrition.[30]

2.1.4 Household size and structure

One of the main challenges among food-insecure households is sharing limited food among family members. For this reason, household size is a significant determinant of household FI.[52] Having a large household may put an extra burden on food consumption.[30,51] Household structure, household size, gender and age define food intake, allocation and nutritional needs within households and influence household FI.[37] Large households, with more young and school-going children, tend to be more susceptible to FI than smaller households with fewer children.[53] However, a large household that consists of more adult members contributing financially to that household's affairs, has improved FS.[30,54]

2.1.5 Gender of the household head

Gender inequality is undoubtedly a significant factor of FI.[30,55] As there is an inequitable distribution of education and employment across male- and female-headed households, female-headed households are more prone FI. This trend is largely linked to the educational attainment and employment status of women in the region,[30,56] and also to the social safety nets available to women.[57,58] In rural African areas for instance, besides inequalities in education and employment, factors such as cultural norms and values, ownership of quality land

and other productive resources, as well as the provision of extension services, e.g. in agriculture, are critical drivers of gender inequality. They tend to favour men over women.[58] Therefore, there is a need for implementation of appropriate policies and interventions towards gender equity in education and employment,[56] including social protection,[57] as well as a need for economic support to empower women and reduce gender disparities in FI.[32,59]

2.1.6 Age of the household head

The age of the household head is an important factor in decision-making for the family. In rural areas, research evidence from LMICs has shown a direct association between the age of the household head and their ability to engage in food production.[60] An increase in age decreases food production and affects household FS and nutrition, as compared with younger adults.[60] Similarly, the elderly are more prone to FI, as they cannot actively engage in hard labour jobs, as compared with younger adults.[29] On the other hand, Bogale and Shimelis[54] suggest that, as rural households often devote their lifetime on agriculture, the older the head of household, the more experience they have in farming and weather forecasting. In addition, the elderly avoid greater risks and tend to diversify their production. Consequently, these households are less likely to suffer from FI,[54] for example when one crop fails. At the same time, younger adults, especially in urban areas, may be more food-insecure than older adults because they lack lifetime earnings.[61] Likewise, an increase in age may imply more experience in managing resources in the household, more work experience, which may represent a higher income, thus reducing the likelihood of household FI. Additionally, the odds of having children in old age are very low, which means fewer family members, and less pressure linked to a situation of FI.[50]

2.1.7 Cultural and societal norms and values

Culture is a multidimensional concept that involves institutions, ideas, knowledge, beliefs, values, norms, customs and social behaviour which characterize a particular people or society.[62] In this sense, culture is a part of every aspect of a society. Similarly, FI is a multidimensional concept that can be viewed as a limited ability to secure food in socially acceptable ways.[3] The expression "socially acceptable ways" refers to practices that are deemed "dignified and in keeping with social norms."[63] These practices may vary from society to society, and culture can determine what is considered acceptable for consumption within a particular society, as well as which ways of acquiring and managing food (including coping strategies) are considered acceptable. Therefore, culture influences food choices, as well as how we produce, process, prepare, and utilize food.[64,65]

Culture can shape meal and eating patterns and determine what constitutes a "proper" meal and how, when and where one should eat. It can determine individual access to food through food distribution within a household. Beliefs and norms about the value of specific foods, the order in which, and how, different household members are served, and what constitutes a fair share of the meal are shaped by culture. In certain communities, for cultural or religious reasons, men are often favoured over women in quantity and quality of food. Food prescriptions (what should be eaten) and proscriptions (what should not be eaten), as well as food taboos can impact food access and food choices.[64,65]

Food preparation is strongly determined by culture and involves the combination of different individual foods into meals, and the way these foods are processed. These processes have impact on the safety of foods, palatability, digestibility, as well as nutrient intake and

absorption, all of which contribute to FS and nutrition.[64] Some processes such as fermentation, soaking, or malting are effective methods of improving the nutritional value, safety, palatability, or digestibility of food. Yet trade-offs may occur as one technique can impact food components in distinct ways. For instance, prolonged heating or sun drying may improve food safety at the expense of nutritional value. Culture impacts food processing and storage, contributing to factors such as length of shelf life. This can alleviate limitations such as seasonality and poorly functioning markets, contributing to greater stability in food consumption.[64] At the household level, gender, household structure, and decision-making power are mechanisms through which culture impacts FI. Furthermore, culture shapes social and individual access to food.[64,65]

2.1.8 Food prices

High food prices are crucial determinants of FI as they hinder consumption of nutritionally adequate and safe food among households, thereby jeopardizing their FS and nutritional status, especially in urban areas.[32,66] At the same time, high food prices can offer an opportunity to rural households, especially farmers and farm workers, to raise their income. Actual benefits will, however, depend on market structure, the magnitude of increase in commodity prices relative to the increase in input costs, and whether they are net sellers or buyers.[67–69]

Despite potential benefits for food production and supply,[66] the social and macroeconomic consequences of rising food prices can be detrimental for the most sensitive groups.[67,70] Given that food purchases account for most of the total expenditure of poor households, global increases in food prices hit developing countries and underprivileged consumers the hardest as high prices cause food

inflation and increased cost of living.[67,70] Whether a given country is a net importer or exporter of staple foods is an important factor in that country's vulnerability to rising food prices. Countries that have net exporter positions may benefit from better terms of trade, while net importers, which term describes many African countries including Mozambique, inevitably suffer because their food import bills rise as they strive to meet domestic needs in an international market.[67] Therefore, government policies and agricultural investments (e.g. tax and tariff reductions and fertilizer subsidies including rural infrastructure and marketing) are crucial to shield domestic consumers and producers while simultaneously ensuring that policy actions required for long-term rural development are not undermined.[67,70,71]

2.1.9 Climate change

Climate change is believed to significantly reduce the yields and production of main staple crops (e.g. rice, wheat, and maize) and livestock productivity, especially in LMICs. These effects have been, and will be, particularly shocking in places where agriculture is largely rain-fed, and they are, and will be, linked to biodiversity loss, FI, water scarcity and pronounced droughts.[72] Food supply shortages, due to negative impacts of climate change on yields and production, will increase food prices and household FI.[72,73] Onyutha[74] posits that extreme patterns of climate can significantly diminish agricultural output in many Sub-Saharan African countries (SSACs), thus exacerbating the supply and demand for food products in the context of rapid population growth vs low productivity.

Climate change can reduce food access via its adverse impacts on both food prices and rural livelihoods.[72] In addition, Onyutha[74] points out that rising temperatures can significantly reduce available arable land and cereal yields in LMICs, contributing to a rise in household FI and

poverty. Climate change can contribute to poverty in several ways, including displacement and migration, high food prices, and extreme weather events (e.g. pronounced droughts, cyclones). These processes are interconnected, as displacement and migration from rural areas can lead to reduced agricultural production, which can induce a further increase in food prices.[72] Similarly, pronounced droughts (interspersed with flooding and cyclones) and lengthening of the seasons can prompt an increase in food prices.[73] Some studies also report increased incidence of animal diseases because of climate change.[75]

The changes in production systems caused by climate change may trigger changes in food use and eating patterns. Climate change may also affect the stability and resilience of food systems, with long-term consequences for global FS and nutrition. Therefore, climate change has a dramatic impact on all four dimensions of FS. At the same time, the quest for FS and nutrition, through agricultural intensification and land expansion, can increase greenhouse gas emissions because of deforestation and land use changes. The intricate relationship between climate change and FS highlights the need for integrated policies that maximize co-benefits while addressing trade-offs. This is critical to ensure that strategies for climate change mitigation and adaptation do not compromise efforts for eliminating hunger, FI and all forms of malnutrition, and vice versa.[72]

2.1.10 Conflicts

The growing wave of armed conflicts puts at risk the little progress made in relation to global FS and nutrition. In 2022, a shift in the global distribution of armed conflicts was noticeable; major conflicts in the Middle East and North Africa and South Asia declined, while they intensified in SSA, Europe, and the Asia−Pacific region.[76] On this topic,

scholars continue to rely on four competing theories (i.e. of frustration–aggression; resource curse; relative deprivation; and state failure) to elucidate the trajectory in armed conflicts, political violence, militancy and terrorism in LMICs.[77,78] Some have broadly classified the causes of armed conflicts into natural and human-made.[78] The natural causes include climate change, population size, competition and diversity,[79] while the human-made causes include religious extremism, security weakness, a sense of alienation, elite corruption, military brutality, an adverse economy, dilapidated systems and a weak infrastructure.[80]

All of the above, climate change, social injustices, property right, FI, religious extremism and poor governance are considered predictors of armed conflicts. Pinstrup-Andersen and Shimokawa[81] argue that poverty, FI and hunger, and unequal distribution of resources (e.g. income, land, other material goods) create anger, hopelessness, a sense of unfairness and a lack of social justice. These factors provide a fertile ground for outrage and conflict. Armed conflicts, especially in Africa, exacerbate FI and hunger, poverty, and hopelessness.[78] For instance, since October 2017 armed conflicts with jihadist groups have been occurring and escalating in Mozambique (first in Cabo Delgado Province and more recently in the north of Nampula Province as well) and have displaced the rural population from their sources of livelihood.[82] Thus, armed conflicts disrupt all human activities such as food production, distribution, acquisition, preparation and consumption, among others, which significantly contributes to the rise in poverty and household FI.[78]

2.2 The burden of non-communicable diseases

Non-communicable diseases are medical conditions or diseases that are not transmitted between persons, but result from a combination of genetic, physiological, environmental and behavioural factors. They are chronic and tend to be of long duration with slow disease progression.[83]

As the world is increasingly sharing similar risk factors, such as demographic ageing, rapid urbanization, and unhealthy lifestyles, NCDs have become the leading causes of mortality and morbidity.[84] They are posing an additional challenge to the health systems in SSA, which have to date largely focused on fighting infectious diseases and maternal and neonatal illnesses.[85]

According to the World Health Organization (WHO),[83] NCDs kill 41 million people each year, and the bulk (more than three-quarters) of these deaths occur in LMICs. The four main types of NCDs are cardiovascular disease (CVD) (e.g. heart attacks and stroke), cancer, chronic respiratory diseases (e.g. chronic obstructive pulmonary disease and asthma) and diabetes. Globally, CVDs account for most NCD deaths (17.9 million people annually), followed by cancer (9.3 million), chronic respiratory diseases (4.1 million), and diabetes (2.0 million).[83]

In SSA, communicable diseases (e.g. malaria, tuberculosis, and HIV) have long been among the main contributors to the burden of disease. However, like most LMICs, SSACs including Mozambique are today undergoing a rapid epidemiological transition characterized by a shift from disease-burden profiles controlled by communicable diseases

and childhood illnesses to profiles with an increasing prevalence of NCDs.[85]

Moreover, the epidemiological understanding of NCDs across SSA is limited for a number of reasons (e.g. weak health systems, lack of reliable data).[86,87] Yet studies are pointing to a growing burden of NCDs in various SSACs.[85] The health systems in these countries remain fragile, fragmented, under-resourced, and limited in terms of infrastructure and capacity to address the growing burden of NCDs.[88,89] Therefore, as the prevalence of NCDs increases, existing barriers to treatment become more visible.[88,90] Hence, there is a need to determine which NCDs should be prioritized for local health service planning and ongoing global health efforts to prevent and control NCDs.[85]

At the same time, several risk factors need to be considered, as most adults in SSA are exposed to at least one of these risk factors. Modifiable behavioural factors, such as tobacco use, physical inactivity, unhealthy eating, and harmful use of alcohol, increase the risk of NCDs. Similarly, metabolic risk factors, with focus on hypertension, diabetes, overweight/obesity and hyperlipidaemia, contribute to key metabolic changes that increase the risk of NCDs.[83] Qiao et al.[91] report that dietary risk factors for NCDs have increased significantly since 1990 and vary across regions. Greater efforts are required to raise public awareness and improve dietary practices and thus reduce the burden of disease caused by suboptimal dietary intake, especially in LMICs.[91] In addition, several environmental risk factors contribute to NCDs, with air pollution being most relevant, notably in LMICs.[83,92] Likewise, efforts to promote universal health coverage should address infectious risks leading to NCDs, particularly in countries with high rates of infectious diseases, to reduce existing regional disparities.[92]

A simple way to control NCDs is to reduce the risk factors associated with these diseases. Monitoring progress and trends of NCDs and their risk is fundamental for guiding policy and priorities. Similarly, it is critical to invest in better management of NCDs, which includes screening, early detection and timely treatment, and provision of palliative care for people in need. Countries with poor health care coverage are, however, unlikely to provide universal access to basic NCD interventions.[83]

Global recognition of the growing challenges posed by NCDs is echoed in the UN SDGs, signifying that heads of state and government are committed to developing national responses to reduce premature deaths from the main NCDs by one-third by 2030 (SDG target 3.4). In 2019, the World Health Assembly extended the WHO Global action plan for prevention and control of NCDs, originally spanning the years 2013–2020, to 2030. Moreover, they proposed the development of an Implementation Roadmap for 2023–2030 to hasten progress on preventing and controlling NCDs.[83] To this end, health systems should be equipped to address the changing patterns of disease burden. Nevertheless, according to the NCD policy indicators defined in the action plan, most SSACs do not have adequate measures in place to achieve these targets.[85]

2.3 The burden of mental ill health

Mental health is a state of mental wellbeing that enables people to cope with life situations, realize their potential, and contribute to their surroundings. Mental health is not just the absence of mental disorders; it is an essential aspect of general health and wellbeing that supports individual and collective capabilities to make decisions, build relationships and give meaning to the world. Therefore, mental health

exists on a complex continuum, which is experienced differently from one person to another, varying from an optimal state of welfare to unbearable states of suffering and emotional discomfort.[93]

Mental health conditions encompass mental disorders, psychosocial disabilities, and other mental states causing substantial distress, impairment in functioning, or risk of self-harm. The economic consequences associated with mental health conditions are gigantic. For instance, productivity loss and other indirect costs to society repeatedly exceed the costs of health care. Economically, schizophrenia is considered the most expensive mental disorder per person to society. Depression and anxiety are much less costly per person, but they are more prevalent and therefore contribute significantly to overall costs; in addition, they are severely underserved.[93]

Research evidence indicates that mental disorders are significant contributors to the global burden of disease and are among the leading causes of years lived with disability (YLDs), accounting for 4.9% of all disability-adjusted life years (DALYs).[94] Approximately one in three persons experiences a common mental disorder (e.g. anxiety, depression, or somatic symptom disorder) during their lifetime, and FI is believed to be a significant contributor to the burden of mental disorders.[95] Estimates indicate that more than 300 million people worldwide (4.4% of the global population) suffer from major depression,[96] and the same number applies to anxiety.[97]

Mental health systems worldwide are marked by major gaps and inequalities in information, governance, resources and services. Most societies and social systems disregard mental health conditions and do not provide the care and support people need and deserve.[93,98] A report

by the WHO[93] indicates that countries on average allocate less than 2% of their health care budget to mental health. More than 70% of mental health costs in LMICs still go to psychiatric hospitals. Most people suffering from mental health issues go completely untreated.[93]

Several factors prevent people from seeking help for mental health conditions. These include poor quality of services, low health literacy in mental health, stigma, and discrimination. Basic mental health services do not exist in many situations, and when they do, they are often inaccessible or unaffordable. As a result, millions of people suffer in silence.[93]

Reporting on mental health, Dos Santos et al.[99] and Na et al.[100] point out that mental health resources, such as infrastructure, funding, human resources, and essential medicines are often very limited in LMICs including Mozambique. In addition to the strong stigma attached to mental illness in such countries, this contributes significantly to underestimating the extent and severity of a mental health problem.[98,101–103] This despite the fact that mental health conditions have dire consequences for the social and economic welfare of individuals, communities, and societies at large.[104,105]

The recognition that this is so is outlined in the Comprehensive Mental Health Action Plan for 2013–2030 adopted by the World Health Assembly in 2013. The overall goal of the plan is to foster mental welfare, prevent mental disorders, provide care, boost recovery, promote human rights and reduce the mortality of, and morbidity and disability for, people with mental disorders.[106] To this end, information systems, evidence and research are explicitly recognized in the action plan as critical components for proper mental health policy, planning and assessment. Likewise, several targets are recognized in the action

plan, with an emphasis on the need for 80% of countries to have mental health integrated into primary health care by 2030 to ensure universal health coverage (Global target 2.3).[106]

2.4 Socioeconomic position and health inequalities

Socioeconomic inequities are the most primary causes of health inequalities and inequities between and within societies as they underlie the major health determinants.[107,108] "Health inequality" refers to variations in the health of individuals or social groups that are free from any moral judgement. In this sense, any measurable aspect of health that varies across people can be labelled as health inequality. By contrast, a "health inequity" is a specific type of health inequality that implies an unjust variation. In other words, health inequities are systematic differences in health that could be prevented or avoided. Therefore, allowing these health inequities to persist between and within societies is wrong and unjust.[109]

Socioeconomic position has long been a commonly used concept in research on health inequalities.[110,111] This concept describes a person's place in society and is influenced by several factors. Traditionally, SEP has been measured by education, occupation and income. Each factor has its impact on health outcomes.[112,113] For instance, education shapes a person's occupational opportunities. It can provide knowledge and skills that allow better-educated individuals to access more information and resources required to promote their health.[111] Income, particularly higher income, provides the means for purchasing better health care, nutrition, housing, schooling, and recreation. Occupation can be seen in terms of whether a person is employed or not, as the employed are more likely to have a better health outcome. Moreover,

occupations differ in prestige, qualifications, rewards, and job characteristics. Lower-status jobs are more likely to expose workers to both physical (labour injuries and exposure to toxic substances) and psychosocial risks (job strain and lack of control), and therefore, undermine their health outcomes.[111–113] In addition, chronic stress linked to lower SEP can also increase morbidity and mortality.[107,112]

Individuals with a disadvantaged income or occupation and with disadvantaged education are more likely to suffer from ill health in their lifetime, as well as to develop illnesses earlier, spend more years with disability, and die at younger age than those at the top.[111] Similarly, SEP underlies main determinants of health such as health care, environmental exposure, and health behaviour. Therefore, higher occupational positions hold advantages in accessing resources, information and circumstances that are more conducive to better health outcomes.[108,111,114] Reducing SEP inequities will require coordinated and joint efforts from various actors and policy initiatives addressing each component of SEP as well as the mechanisms by which these components impact health outcomes.[32,107]

2.5 Conceptual framework

A person's health is shaped by an array of factors collectively called "social determinants of health". These include individual factors (e.g. age, sex and genetics), behavioural factors affecting health (e.g. smoking, alcohol use, diet, and physical activity), conditions in which people are born, grow up, live, work and age (e.g. social and family networks, socioeconomic, cultural and environmental conditions), and health systems.[115,116]

This thesis draws on the conceptual framework developed by the WHO Commission on Social Determinants of Health (CSDH).

According to the CSDH, these determinants are divided into two categories: the structural and the intermediary determinants of health. The structural determinants include the socioeconomic and political context (e.g. governance, policies, and values placed on health). They determine and may lead to unequal distribution of material and financial resources which shape the SEP of individuals and influence the intermediary determinants (material circumstances such as quality of housing and financial means, the working environment, nutrition, psychosocial factors, and behavioural and biological factors).[115,116] Socioeconomic position, which describes an individual's place in society, shows a hierarchical system entailing power, prestige and access to resources; it can affect individuals' exposure, vulnerability, and health outcomes. This is influenced by an array of factors such as education, income, occupation, social class, ethnicity, and gender.[108,114]

Health systems have an impact on the type and quality of health services available to people. However, social cohesion and social capital are factors that bridge structural and intermediary determinants, and that describe the willingness of people living in communities to make sacrifices and collaborate with each other for the greater good.[116,117] In addition, structural determinants are rooted in institutions and processes within a context, and they create stratifications in society depending on SEP; thus, health outcomes are moulded through intermediary determinants.[118,119]

However, the interrelations between these factors and how they could be proxies for each other may dramatically vary between and within societies.[118] Therefore, the inequitable distribution of power, income, resources, and other social factors where the risk for ill health in a person's life course increases with reductions in SEP, creates social gradients in health.[111,120,121] This situation in which the poorest suffer

most is considered a matter of justice, and the negative health outcomes (physical and psychological) produced as a consequence are deemed inequities in health that are avoidable and unfair.[119] Accordingly, appropriate policies and interventions aiming to promote health equity can be implemented. These can influence social stratifications by providing equal access to better education, and equal occupational opportunities. They can also influence exposure and vulnerability to harmful risks at workplaces, and mitigate differences in consequences of occupational health inequities.[111,115,122]

In this thesis, the socioeconomic and political context of Mozambique is understood to be, and to have been to date, shaped by the country's laws, social and public health policies, governance, and FS policies, including cultural and societal norms and values. For the purposes of the studies included in this thesis, the SEP of household heads was measured through education, occupation (paid/no paid work) and household income. As discussed, these structural factors can have an impact on the household FS, and therefore, on the health outcomes of the household head. On the other hand, FS status (food-secure/food-insecure), sociodemographic factors (covariates), coping strategies, and health systems were considered to constitute intermediary determinants of health outcomes. These intermediary determinants are influenced not only by the socioeconomic and political context of Mozambique, but also by the SEP of the heads of households. In fact, research evidence indicates that socioeconomic and political circumstances, along with the educational level of household heads, including their occupation and income, play a crucial role in shaping their FS status.

Furthermore, inequalities in SEP between household heads, combined with inequalities in household FS, may result in differential

distribution of negative health outcomes among household heads in Maputo City. The negative health outcomes (regarding, e.g., type 2 diabetes, hypertension, anxiety and depression) derived from inequalities in SEP and household FS can in turn influence the SEP of the heads of households and further exacerbate household FI and the health outcomes of household members in a vicious circle which strengthens each condition (e.g. household FI and negative health outcomes) (see Figure 1).
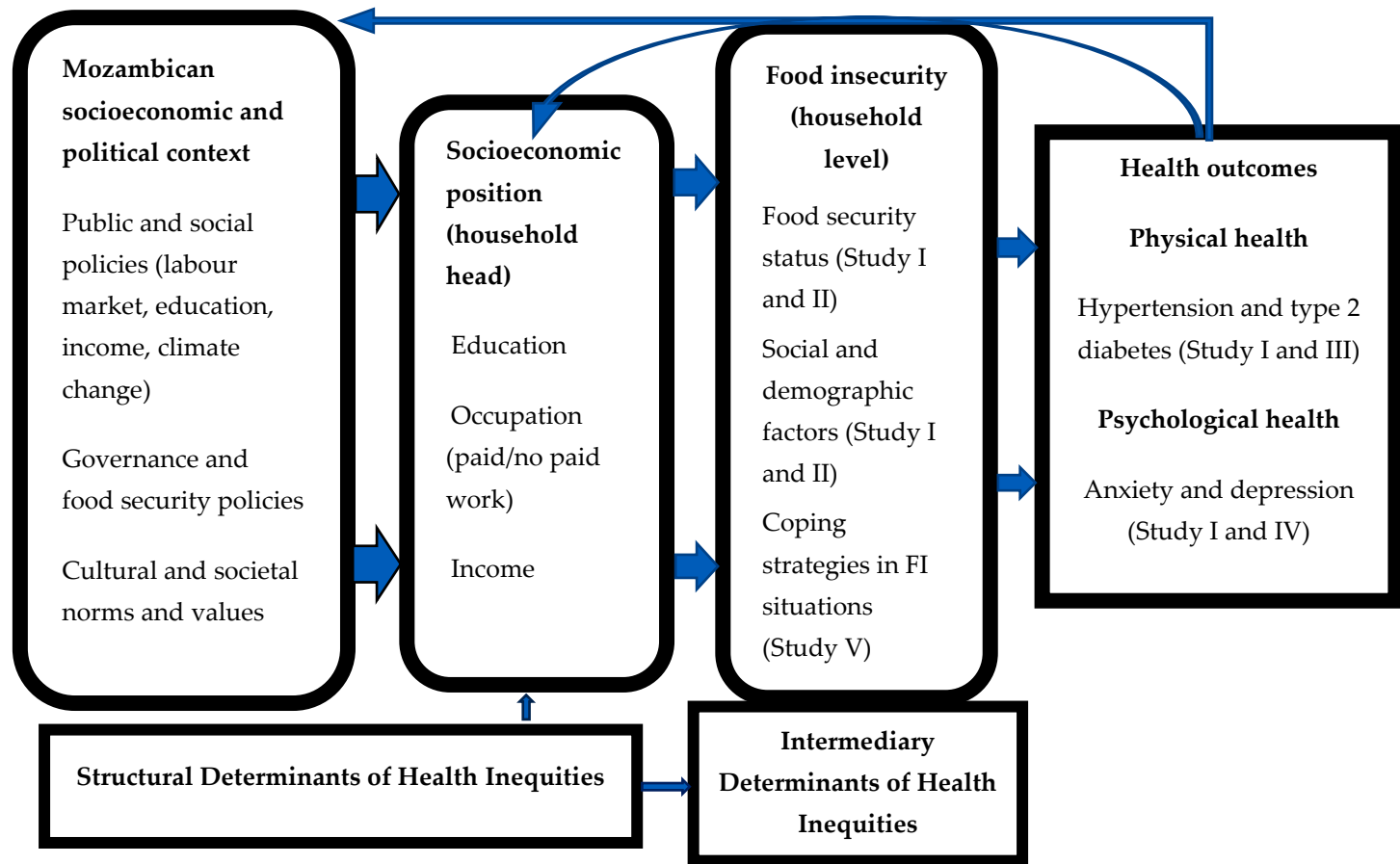
Figure 1. Conceptual framework of the relationship between socioeconomic position, household food insecurity and health outcomes in Mozambique. Source: Adapted from the CSDH conceptual framework.[116]

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2.6 Rationale for the thesis

Mozambique is a low-income, high-inequality and food-deficit country[123] that is prone to climate shocks, with regular droughts dominating the south, and floods occurring virtually every year in main river basins and inadequately drained urban settlements.[124,125] Official reports indicate that about 80% of the Mozambican population are unable to afford an adequate diet,[126] 68% live in extreme poverty[127] and about 80% are engaged in informal labour.[128] Approximately 70% of the rural population rely on rain-fed agriculture, which is unreliable today; also, the markets and infrastructures are deficient and poorly integrated, and post-harvest losses reach 30%, especially because of limitations in storage capacity, processing and handling.[124,129] Research evidence suggests that most households in Mozambique are at risk of FI and of adopting harmful coping strategies which, in turn, may undermine their health outcomes.[32] In addition, the burden of household FI and its associated factors are not well known, despite strong indications from other African countries that FI has a detrimental impact on health-related outcomes.[24,26]

In parallel, NCDs have taken the lead as the main causes of mortality and morbidity globally,[84] and studies in Mozambique report a prevalence of hypertension of 38.9% (95% CI:35.9–41.9)[130] and of type 2 diabetes of 7.4% (95% CI: 5.5–10.0).[131] A study by Jessen et al.[130] suggests that both the distribution of cardiovascular risk factors and the awareness of these factors in Mozambique depend on socioeconomic and demographic factors of the population. Similarly, Madede et al.[131] report that only 10% of the people with diabetes in Mozambique were aware of their condition and fewer than 50% were on medication. This highlights the severity of the current situation in Mozambique as the prevalence of NCDs has been progressively

increasing over the years. Despite this trend, a recent study by Madede et al.[132] found that there was a gap in human capital, funding and material resources to respond to the country's needs in relation to NCDs. Likewise, the burden of psychological health in Mozambique is unknown. Furthermore, the available resources for psychological health in terms of infrastructure, human capital, essential medicines, and funding are often very limited.[99] Another factor compounding this situation is the strong stigma historically attached to mental illness, as observed particularly in LMICs including Mozambique,[98,133] which leads to underestimation of the problem.[102,103]

At the same time, the government of Mozambique recognizes the need to develop research-based health programmes and policy strategies that can include FS and nutrition as an essential aspect of promoting resilience and healthy diets and alleviating FI to improve physical and mental health, particularly among the most sensitive groups.[134] Despite this situation, there are no studies examining the link between FI and health outcomes in Mozambique.[28] To fill this gap, through a health inequality perspective, this thesis will fill the knowledge gap by assessing how SEP (e.g. household income, paid work, and education) and FI affect the differential distribution of health outcomes among households. The thesis views FI in Mozambique and its potential impact on health as part of the imbalances of economic and social power in the food systems and structural barriers that are preventable and unfair, and that need to be addressed by positive state/government intervention.

3 Objectives

3.1 Main objective

To assess the effects of SEP on FI, and physical and psychological health outcomes among adults in Maputo City, southern Mozambique.

3.2 Specific objectives

a) To systematically review empirical studies exploring the relationship between FI and health outcomes among adults in southern Africa (including Mozambique) (Study I).

b) To estimate the prevalence of household FI and evaluate factors associated with FI in Maputo City (Study II).

c) To examine the association between SEP, household FI and physical health outcomes (hypertension and type 2 diabetes) (Study III).

d) To examine the association between SEP, household FI and psychological health outcomes (anxiety and depression) (Study IV).

e) To understand the perceptions and coping strategies applied by household heads in situations of FI (Study V).

4 Materials and methods

4.1 Study design, setting and sampling

Study I was a descriptive systematic review study. The study reviewed a total of 14 studies that met the inclusion criteria, namely, being peer-reviewed journal articles published in English in databases, and being empirical studies carried out in a member state of the Southern African Development Community (SADC). This is a regional economic community composed of 16 member states, namely, Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho,

Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe.[135] The study examined the relationship between household FI and health outcomes among adults in the region. The screening and evaluation of articles in the review were carried out by the first and last authors (E.M. and G.M.). The quality assessment of the included articles was evaluated using the adapted Critical Appraisal Skills Programme (CASP) guidelines, where all articles were scored on nine items[136,137] (Table 1 in the Appendix).

For Studies II, III and IV, a cross-sectional design was conducted in Maputo City, southern Mozambique. Maputo is the capital city of Mozambique and the largest urban agglomeration in the country. Administratively, it is divided into seven municipal districts, including KaNyaka island and KaTembe (Figure 2).[138] Underemployment is widespread in the city, with most people engaged in informal labour.[139] As the city is entirely urban, its landscape is ordinarily divided into three areas. The first, the KaMpfumu district, is the wealthiest area of the city, and was excluded from the sampling. The second, which was part of the sampling, consists of the poorer residential suburbs and covers Nlhamankulu and KaMaxaqueni. The third, which was also part of the sampling, covers the peri-urban districts of KaMavota and KaMubukwana.[138] According to the most recent general census, Maputo City has about 1,080,280 inhabitants (52% female and 48% male) and 235,750 households.[140] About 71% of the households in Maputo City as a whole are considered food-insecure.[56]
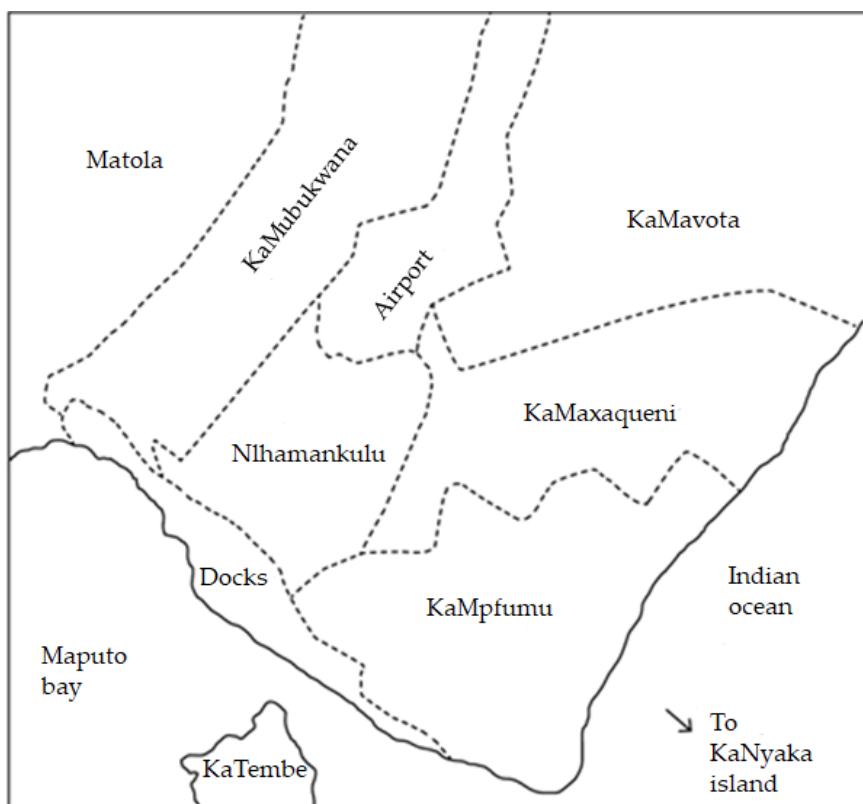
Figure 2. Municipal districts of Maputo City. Source: Raimundo et al.[138]

The selection of households relied on a two-phase design inspired by the National Institute of Statistics platform which was used by the Mozambique Technical Secretariat for Food Security and Nutrition (SETSAN) in their 2013 Baseline Study.[125] SETSAN is an inter-ministerial government unit whose mandate is to coordinate FS and nutrition interventions and monitor the implementation of the Food Security and Nutrition Strategy and Action Plan (ESAN).[125]

Accordingly, enumeration areas were randomly selected in the first phase. A total of 96 enumeration areas in four municipal districts (Nlhamankulu, KaMaxaqueni, KaMavota and KaMubukwana) were selected, and each area provided a maximum of 20 households. Next,

within each enumeration area households were selected using a systematic random sampling strategy, which was to sample every 15th household.

Households whose heads (or their member representatives) did not meet the age criterion (18–60 years), did not agree to participate, or decided to drop out were excluded from the research. Member representatives were allowed to respond exclusively to questions related to the FS status, food consumption patterns, food production and remittance. The information provided by member representatives was then confirmed by the heads of households. All other questions included in the questionnaire were reserved for the heads of households.

At the same time, the research interest was to capture the active workforce (those who were still in paid work), as most people over the age of 60 retire: in Mozambique, female workers are entitled to retire at the age of 55 years while male workers can retire at 60 years, or after 35 working years.[141] In addition, as the data collection for Study V, the first of the five studies to be conducted, was done during the COVID-19 pandemic, it was necessary to exclude household heads over 60 years because of their greater vulnerability.

In collaboration (as required by law) with the municipality, eligible households were approached and informed both orally and in writing about the goals and voluntary nature of the study. Finally, they were invited to participate and were given a maximum of 5 days to respond to our request. The total sample size was 1,842 households based on approximate proportional allocation.

Study V used a qualitative descriptive design. It is argued that this type of design is the most suitable for providing direct descriptions of experiences and perceptions, especially when little is known about the

topic under study. Moreover, it recognizes the subjective nature of a problem (in this case, the coping strategies in food-insecure households) as well as the participants' different experiences.[142–144]

In this study, households were selected using purposive sampling based on predetermined criteria relevant to the study objectives.[145,146] Eligibility criteria included being the head of a food-insecure household (confirmed by the first three questions from the United States Department of Agriculture (USDA) Household Food Security Survey Module (HFSSM) instrument used in Studies II, III and IV), being 18–60 years old, and residing in one of the four municipalities mentioned above. Food-secure households and food-insecure households whose heads did not meet the age criterion, disagreed to participate or chose to withdraw were excluded.

As in Study II, III and IV, eligible households were contacted and informed about the goals and voluntary nature of the study in collaboration with the municipality. After being invited to participate they had a maximum of 5 days to respond to our request. Based on the data saturation criterion,[147] a total of 16 in-depth interviews were performed using a semi-structured interview guide.[145] This instrument ensures that all key elements are captured while still allowing flexibility to look at other issues and points of view that may emerge during the interview.[148] At the same time, although the data collection took place during COVID-19 pandemic, because of the sensitive nature of the phenomenon under study and also because of practical limitations of the study population, face-to-face individual interviews seemed to be the most appropriate approach, as they are the most direct method for gathering data.[148]

4.2 Data collection and procedures

Study I relied on research data available on Web of Science, PubMed, and Google Scholar.

For Studies II, III and IV, structured interviews were conducted at each participant's home, starting from November 2021 and continuing to June 2022. Overall, each interview took about 45–60 minutes to be completed, particularly in cases where there was no obligation to call off the interview and finish it on another day convenient to the head of household. Data about each household were collected using a questionnaire previously validated in Portugal[149,150] but contextually adapted to the Mozambican population during a pilot study conducted by authors E.M. and E.S. in Manhiça district (a region outside the study setting, N=79) to test its accuracy and effectiveness.

The questionnaire consisted of various measurement instruments with focus on the USDA HFSSM envisioned to measure FI in the last 3 months, and the Hospital Anxiety and Depression Scale (HADS) to measure anxiety and depression in the past week. Moreover, the questionnaire included sociodemographic questions (education, work, income) and questions about: (a) physical health (diagnosed hypertension, type 2 diabetes and other chronic diseases); (b) mental/psychiatric illness; (c) medication and health care utilization; (d) dietary patterns (food items, from staple foods and oils, vegetables, fish, meat, and beverages to dairy products); (e) barriers to food access; (f) food costs and purchasing habits; (g) own food production and remittance; (h) physical activity (walking, jogging, cycling, swimming); and (i) behavioural factors affecting health (smoking and alcohol consumption).

In Study V, semi-structured interviews were conducted at the participants' homes between August and September 2021 by the first

author (E.M.) accompanied by a collaborator trained for this purpose. The interview guide was first piloted for use on food-insecure households by the authors (E.M. and E.S.) to test its suitability and effectiveness, and to ensure that the interviews would be performed in accordance with appropriate interview procedures (e.g. to build rapport and trust with the interviewees). The original interview guide was crafted in English; thereafter it was translated into Portuguese and back-translated into English to verify its accuracy. The guide included sociodemographic questions, followed by questions on multiple domains, about: participants' experiences and perceptions of FI, coping strategies, regularly consumed foods, effects of climate change, and perceived health. Each full interview lasted approximately 50 minutes. All interviews were conducted in Portuguese and were audio-recorded, then transcribed verbatim and verified for accuracy.

4.3 Measurement of variables

4.3.1 Outcome variables

The outcome variables were physical health (e.g. hypertension, type 2 diabetes, CVD, HIV acquisition risk) in Studies I and III; FI in Study II; and psychological health (e.g. anxiety and depression) and self-reported health (SRH) in Studies I and IV.

Regarding physical health (Studies I and III), the measurements relied on self-reporting by participants or household heads based on actual diagnoses performed at hospitals or medical clinics.

Regarding psychological health (study I), a wide range of instruments were used with focus on the Self-Reporting Questionnaire (SRQ)[151–153] to measure anxiety and depression.

In Study IV, psychological health (anxiety and depression) was measured using the HADS. This scale has been developed primarily as

a screening tool for identifying and quantifying anxiety and depression among hospital patients, but it has also been successfully used in the general population.[154–156] According to some scholars, the HADS is best used as a measure of general psychological distress.[154,155] In Study IV, Cronbach's coefficient alpha was 0.83 for the anxiety subscale (HADS-A) and 0.78 for the depression subscale (HADS-D). Qualitatively, a household head was assumed to have anxiety if they scored 8 or higher on the anxiety sub-scale (HADS-A). Similarly, they were assumed to have depressive symptoms if they scored 8 or higher on the depression sub-scale (HADS-D). For our study purposes, a composite variable consisting of symptoms of anxiety (individuals who scored 8 or higher on the anxiety sub-scale) and/or depression (individuals who scored 8 or higher on the depression sub-scale) was created to increase the sample size and enhance data interpretation during the data analysis.

4.3.2 Explanatory variables

4.3.2.1 Main explanatory variable (main exposure)

Food insecurity was the main explanatory variable for Study III and IV. Food insecurity was measured using the eight items from the USDA HFSSM. The original, 14-item HFSSM was modified by excluding the six items related to children. The HFSSM is a standard instrument used to measure FI at the household level. A "yes/no" response format was applied to make the scale easier to use. All "positive responses" had a follow-up question, "How often did it occur?", with three response alternatives ("often", "sometimes", "rarely"). The options "often" and "sometimes" were coded as 1, while "rarely" was coded as 0. The scale has a maximum of 8 points, and Cronbach's alpha was 0.87. Households were deemed food-secure if they scored ≤1 and food-insecure if they scored ≥2. Among food-insecure households, scores of 2 or 3 indicated mild FI, while scores

ranging from 4 to 6 indicated moderate FI, and scores of 7 or 8 indicated severe FI.

4.3.2.2 Other explanatory variables (covariates)

Other explanatory variables (covariates) included household size, number of children, marital status, education, type of work, household income, remittance, dietary diversity, and number of meals per day. The variable head of household was also included, which was defined in terms of sex in its strict sense (male or female-headed). Additionally, it should be noted that the term "head of household" was used in a broader sense (in Studies III and IV) as synonymous with "the couple" or "parents".

Household size was defined as the number of household members who live and have meals together. For our study purposes, it was dichotomized into households with up to four members, and households with five or more members.

Household members aged <18 years were considered children, and two groups were created, households with no or up to two children, and households with three or more children.

Marital status was defined as being single, being married or in marital union, or being divorced or separated; however, for the purposes of this study, this category was dichotomized into married/in marital union vs single/separated/divorced.

Four educational categories were considered (up to primary, secondary, high school and university). For the purposes of this study, the categories primary and secondary education were merged into one, and high school and university were also merged into one, resulting in three or just two categories, respectively.

When it came to occupation (type of work), the term "unpaid work" was used to classify household heads engaged in informal labour (insecure employment mainly self-employment), while "paid work" was used to classify those engaged in formal labour (secure employment mainly from government and the private sector).

Household income was determined by asking how much (in Mozambican metical) the household earned in a month, and accordingly household income was categorized into two or three groups.

Remittance included both food transfers and money transfers from relatives (mostly from South Africa), and households were dichotomized into those who often or usually received remittance and those who rarely or never did.

Regarding dietary diversity, three categories were created (low, medium and high dietary diversity) based on the variety of food items consumed in the last 7 days and how often they were consumed (at least in two meals).[157]

For number of meals per day, two groups were created, one consisting of households consuming up to two meals a day and the other consisting of those consuming three or more meals a day.

4.4 Data analysis

Data analyses for Study II were performed in IBM SPSS Statistics version 27.0 and 29.0 (IBM Corp, Armonk, NY, USA). In descriptive statistics, frequencies and percentages were used for categorical variables, and means were used for continuous variables. Multiple regression was employed to investigate the predictive power of a set of variables to explain the outcome variable (FI score), and to evaluate the relative contribution of each variable in the final model. Similarly,

binary and multinomial logistic regressions were employed to investigate the predictive power of the mentioned set of variables (used on multiple regression) to explain the outcome variable (FI with two and more than two categories, respectively). A 95% confidence interval (CI) and a p-value ≤0.05 were used to assess the statistical significance between the explanatory variables and the outcome variable.

Data analyses for Studies III and IV were performed in Stata version 18.0 (StataCorp, College Station, TX, USA) and IBM SPSS Statistics version 29.0 (IBM Corp, Armonk, NY, USA). For Study III, multinomial logistic regression was used to explore the association between FI and hypertension and diabetes. Interaction terms were used to assess the moderation role of socioeconomic factors (income, education and work) on the relationship between FI and hypertension and diabetes. For Study IV, propensity score matching based on logistic regression models and the nearest neighbour technique (1:5 ratio)[158] was employed to investigate the impact of FI on psychological ill health (anxiety and depression). Moreover, an interaction effects analysis was conducted to examine the modifying effects of SEP of the household head on the relationship between FI and psychological ill health.

In Study V, qualitative content analysis was employed. This is a common method for data analysis in the social and health sciences, and is used to methodically condense and translate a large amount of text into a highly sorted and concise summary of main findings or themes.[146] This also allows for the presentation of discrepant information. Moreover, as pointed out by Graneheim et al.[159] it allows for multiple approaches (i.e. inductive, deductive and abductive) to be applied during different stages of the analysis. As the aim was to understand FI from the standpoint of our interviewees, an inductive approach was applied as described by Schulz.[160] Briefly, this included

data familiarization, creating units of analysis, open coding, closed coding, examining the ideas making up the themes, and writing up the storylines based on themes and subthemes. The development of codes and themes was an interactive process conducted by three of the authors (E.M., J.S. and G.M.) and included discussing and revisiting data until consensus was reached. During this process, several techniques were used to ensure scientific rigour with focus on triangulation, peer debriefing, reflexivity[161,162] and constant comparison.[147,163]

4.5 Summary of designs and methods

Table 1 below illustrates the main designs and methods employed in the studies included in this thesis. A wide range of instruments were used to collect data. Similarly, various statistical methods were used to analyse quantitative data. Qualitative content analysis and thematic analysis were among the approaches used to explore qualitative data.

Table 1. Overview of designs and methods used in the thesis.

Study	I	II	III	IV	V
Outcome	Health related outcomes (hypertension, diabetes, CVDs, HIV, anxiety and depression)	Food insecurity	Hypertension and diabetes	Anxiety and depression	Coping strategies, perceived causes of FI, and perceived health
Design	Cross-sectional, longitudinal, prospective cohort, qualitative descriptive	Cross-sectional	Cross-sectional	Cross-sectional	Qualitative descriptive

Data collection	Questionnaire, HFSSM, HFIAS, self-reports of actual diagnoses	Questionnaire, HFSSM	Questionnaire, self-reports of actual diagnoses	Questionnaire, HADS	Semi-structured interviews
Sample	Varied from 53 to 8,790 participants	1,842 heads of households	1,842 heads of households	1,842 heads of households	16 heads of food-insecure households
Data analysis	Logistic regression, multilevel regression, Poisson regression, thematic analysis	Multiple linear regression, binary and multinomial logistic regression	Multinomial logistic regression, interaction effects analysis	Propensity score matching, interaction effects analysis	Qualitative content analysis

CVD = cardiovascular disease; FI = food insecurity; HADS = Hospital Anxiety and Depression Scale; HFIAS = Household Food Insecurity Access Scale; HFSSM = Household Food Security Survey Module; HIV = human immunodeficiency virus.

4.6 Ethical considerations

This research was conducted in accordance with the guidelines established in the Declaration of Helsinki and the research protocol, which included all measurement instruments needed for Studies II, III, IV and V. Approval was obtained from the Institutional Committee of Bioethics in Health of the Faculty of Medicine, Eduardo Mondlane University, Maputo (registration No. CIBS FM&HCM/036/2019). Thereafter, informed consent was obtained from each household prior to the data collection. All ethical requirements (e.g. voluntariness, confidentiality, anonymity) were strictly followed.

5 Results

5.1 Study I

In this systematic review, 14 studies met the inclusion criteria. Of these, five were carried out in South Africa, two in Zimbabwe, and one each in Zambia, Malawi, Tanzania, Botswana, Namibia and Madagascar. One study was conducted in both Botswana and Eswatini. Most of these studies relied on cross-sectional designs and measured FI using modified versions of the USDA HFSSM or the Household Food Insecurity Access Scale (HFIAS). The prevalence of FI in the region ranged from 18%, in Botswana and South Africa, to 91%, again in South Africa. Food insecurity was associated with several factors, the most common being poverty, high food prices, illness, unfavourable household size and structure, gender inequality, and seasonality. Lastly, FI was often linked to poor mental health, anxiety and depression, increased odds of hypertension, diabetes and CVD, and increased risk of HIV acquisition. Remarkably for Mozambique, no empirical study was found that examined the relationship between household FI and health outcomes.

5.2 Study II

Study II was based on a cross-sectional design that included 1,842 households. Most households were male-headed (71.6%); 66.6% were married or living in marital union. Most households had five members. Altogether, 45.4% of the heads of households had low educational attainment, while 41.4% had high school education (grade 11–12). A total of 48.5% of the sample had insecure employment and were working in the informal sector.

Cronbach's alpha for the FI scale was 0.87, suggesting very good internal consistency. In addition, there were no negative values in the

inter-item correlation matrix, indicating that all items measured the same underlying phenomenon. This result is further supported by the corrected-item total correlation values as not a single value was below 0.3. Of the 1,842 households included in the study, only a small proportion, 21%, were food-secure, while the remaining 79% were food-insecure. Regarding food-insecure households, 20.99% were suffering from mild FI, while 35.52% and 43.49% were suffering from moderate and severe FI, respectively.

In the multiple regression, FI was associated with various sociodemographic factors. The final model explained 75% of the variability (adjusted R square = 0.752) in FI. Eight variables out of ten reached statistical significance, with an emphasis on household income, educational attainment, dietary diversity, and number of meals per day. Similarly, both the binary and the multinomial logistic regression (Table 2 in the Appendix) corroborated the multiple regression results and revealed that household income, educational attainment, dietary diversity, and number of meals per day were consistently and significantly associated with FI.

5.3 Study III

Study III was based on a cross-sectional design that included 1,842 households, but in the study, only 1,820 households were included in the final analyses. Overall, 74.4% of participants without metabolic diseases were categorized as food-insecure, and this figure significantly increased to 93.7% in the category of participants suffering from hypertension and 88.7% in the category of participants suffering from diabetes.

The findings from multinomial logistic regression revealed significant associations between FI (moderate and severe), SEP (particularly

education and income), and hypertension and diabetes. Interaction analyses showed that the impact of FI on hypertension risk was moderated by all socioeconomic factors; analyses consistently showed a nuanced influence on diabetes. Specifically, food-insecure heads of households with a higher position in terms of work, income and education appeared to have a higher probability of developing diabetes than their counterparts in a lower position.

5.4 Study IV

Study IV was based on a cross-sectional design that included 1,842 households. In this study, both HADS subscales were found to be internally consistent, with Cronbach's coefficient alpha 0.83 (HADS-A) and 0.78 (HADS-D). Of the 1,842 households included in Study IV, 1,174 participants were randomly assigned for propensity score matching, where 787 participants constituted the exposed (food-insecure) group while 387 constituted the reference (food-secure) group.

Propensity score matching showed stark disparities in psychological health outcomes associated with FI. The risk of poor psychological health among household heads exposed to FI was 25.79%, which was significantly higher than the 0.26% observed in the reference group (unexposed participants), giving a risk ratio of 99.82. The assessment of population attributable fractions revealed that virtually all the risk for poor psychological health in the exposed group could be attributed to FI, specifically moderate and severe FI. This trend was apparent in the descriptive analysis, as those experiencing moderate and severe FI displayed higher scores on both the anxiety and the depression subscales (7.83 [95% CI: 7.75–7.91] and 6.94 [95% CI: 6.82–7.07]) compared with their food-secure and mildly food-insecure

counterparts (4.65 [95% CI: 4.56–4.74] and 4.59 [95% CI: 4.51–4.68]). In addition, the interaction effects analysis showed that the SEP of the household head greatly modifies the association between FI and psychological health outcomes. In fact, household heads from food-secure households with paid work, higher income levels and better education tended to report more favourable mental health compared with their counterparts from food-insecure households with unpaid work, and with lower income and education.

5.5 Study V

The findings of Study V can be summarized in five themes: (a) experiences and perceptions of FI; (b) coping strategies applied in situations of FI; (c) food choices; (d) effects of climate change on FS; and (e) effects of FI on perceived health. Overall, the FI experienced by heads of households varied in severity depending on their SEP. They applied various strategies to acquire food, as well as to manage and reduce their exposure to FI. The most common coping strategies included cooking any food available, skipping meals, receiving remittance from relatives and friends, consuming unsafe foods, taking on occasional work, cooking least favourite foods, having a repetitive and less-nutritious diet, and reducing meal preparation costs. Likewise, the participants identified many factors that may have caused their FI, especially extreme poverty, lower incomes, high food prices, the COVID-19 pandemic, other illnesses, unfavourable household size and structure, low educational attainment, habitation problems, pregnancy, and corruption. The heads of households also reported poor general health themselves, as well as emotional suffering, hopelessness, anxiety and depression, substance use, diarrhoea, and other adverse health outcomes as consequences of FI. Some had been diagnosed with

hypertension, diabetes, or HIV/AIDS, or had a household member who had been diagnosed with epilepsy or had suffered a stroke.

6 Discussion

This thesis aimed to examine the association between the SEP of heads of households, and FI and health outcomes in Maputo City, Mozambique. To this end, five studies were carried out. In Study I, FI was found to be prevalent in southern African countries and was associated with various adverse health outcomes. Remarkably, no study was found that examined the relationship between FI and health outcomes in Mozambique which per se emphasizes the need for the other studies included in the thesis. In Study II, FI was found to be widespread in Maputo City. Household FI was associated with various socioeconomic and demographic factors. In Study III, FI was positively and significantly associated with hypertension and type 2 diabetes, and SEP seemed to greatly moderate this relationship. This trend was also observed in Study IV, where moderate and severe FI was positively and significantly associated with higher scores of symptoms of anxiety and depression, and SEP, particularly income and education appeared to greatly moderate this relationship. Finally, in Study V, the heads of households suffering from moderate and severe FI used various strategies, some of which are considered risky for health, to acquire and manage food.

6.1 Food insecurity and health outcomes in Southern Africa

Food insecurity in the southern African region, where Mozambique is located, ranged from 18%, in Botswana and South Africa, to 91% again in South Africa. The main factors associated with FI included poverty, illnesses (mostly HIV and tuberculosis), high food prices,

unfavourable household size and structure, gender inequality and seasonality. These findings illustrate the extent and severity of FI in the region and also its multidimensional nature, which requires especial attention and consideration when it comes to developing and implementing suitable programmes to alleviate FI.

Overall, FI was frequently linked to poor mental health, anxiety and depression, increased odds of hypertension, diabetes, and CVDs, and increased risk of HIV acquisition. However, no study was found that examined the relationship between FI and health outcomes in Mozambique even though many Mozambican households suffer daily from FI.[164–166] The studies from Mozambique looked at the effects of food assistance programmes on ART,[167,168] and revealed that approaches aiming to enhance FS for PLHIV on ART may be effective for reducing loss to follow-up, and therefore, strengthening the HIV care cascade in Africa.[168–170]

Regarding psychological health, the findings pointed out a positive and significant correlation between household FI and poor mental health, anxiety and depression in the region. Unfortunately, a similar conclusion could not be made for physical health, as most studies included in the systematic review were qualitative in nature. Still, these findings suggest that FI increases the probability of developing chronic illnesses such as hypertension, diabetes, and CVDs. Moreover, it can make food-insecure households apply risky coping strategies which could be translated as increased odds of HIV acquisition and other sexually transmitted diseases. This trend was evident in various studies on coping strategies used in situations of FI.[171–173] One case–control study from Luanda, Angola, by Robbiati et al.[174] found a positive and significant association between severe FI and diabetes. Therefore, to some extent the findings illustrate the behavioural and

psychological mechanisms linking moderate and severe FI to adverse psychological[20,151,153] and physical health.[172,175,176]

6.2 Factors associated with food insecurity in Maputo City

The prevalence of household FI in Maputo City was 79%, which highlights the challenges that the country faces regarding FI and malnutrition. In addition, this proportion may be modest considering, first, that about 68% of the Mozambican population live below the poverty line,[127] and second, the effects of COVID-19 pandemic, since the data collection happened just after the pandemic. At any rate, FI is an issue of great concern for most households not only in Mozambique as observed in Study II (and Study V), but across SSA and other LMICs.[56,177]

Indeed, recent reports indicate that the UN SDGs, particularly those targeting elimination of extreme poverty and hunger, FI and all forms of malnutrition by 2030, are practically out of reach for many LMICs including Mozambique.[39,178] This being a decade of informed actions, there is a pressing need to implement both short-term solutions, especially for the most sensitive groups, and medium- and long-term solutions to combat household FI and malnutrition, and eventually achieve the SDGs.[177,179]

Another factor compounding FI is rapid population growth together with soil degradation. This is a grave challenge that urgently requires consideration when addressing global FS and nutrition, as overpopulation is projected to be the main cause of FI worldwide by 2050, and food quality and diversity in the world has been shrinking at greater pace over the last decades as a result of soil degradation.[9,180]

In Study II, FI was associated with a combination of socioeconomic and demographic factors – poverty, lower incomes, low educational attainment, unfavourable household size and structure, non-diversified diet, and a limited number of meals per day being the most important. Food insecurity in Mozambique, and in African countries in general, is largely related to poverty.[181,182] Hence, there is an urgent need to address all the factors that are contributing significantly to the increase in poverty in the region.

Along these lines, research evidence from Africa shows that flawed economic policies, corruption, poor governance and political conflicts[183,184] as well as poor land utilization are recognized as primary causes of poverty.[183] Likewise, poor governance and political conflicts[78,185] have been emphasized as significant determinants of FI in Africa. Specifically, good quality governance (e.g. government effectiveness, rule of law, accountability) and targeted policies are crucial to promoting a stable environment that is conducive to economic investments, especially those aimed at improving FS and nutrition, social protection and the pace of economic growth.[185] In this regard, effective interventions from governments, the private sector, and international institutions (e.g. the World Bank and International Monetary Fund) are needed to promote decent work and build a more inclusive economy for Africa.[28]

In parallel, household income and food prices are undoubtedly crucial determinants of FI in African cities including Maputo as most urban households purchase most of their food rather than producing it themselves.[181] Urban FI tends to get worse with high food prices in cities. Recently, the COVID-19 pandemic has caused an additional rise in FI because of food shortages and high food prices, job losses and a decrease in livelihoods.[32] A study by Rosenberg et al.[135] in 16 southern

African countries found a correlation between the pandemic and increased risk of job loss. In this sense, the COVID-19 has underlined the weaknesses of food systems and health systems in the world.[186,187] In rural areas, climate change and seasonality can have a massive impact on household FI. Most rural households in Africa depend on their own food production, which is heavily dependent on rainfall, but because of climate change, this is becoming increasingly unreliable.[74,188] Similarly, climate change can impact food systems and FI in several ways, starting from its direct impacts on food production to changes in markets, food prices and the food supply chain.[73]

In conclusion, it is of paramount importance to consider various factors together to obtain a comprehensive view of household FI, as one single element will not fully capture and explain the burden of FI in a particular setting. The studies on the issue reinforce not only the need for social protection, especially for the most sensitive groups,[189,190] but also the need to rethink future actions aimed at achieving global, regional, national and local FS and nutrition targets.[186,189]

6.3 Association between food insecurity, socioeconomic position, hypertension, diabetes, anxiety and depression

Based on the findings of Study III and IV, it is evident that there is an association between FI and adverse health outcomes, and the SEP of the household head seems to have a significant influence on the direction and strength of this relationship. Moreover, the mechanisms (especially the psychological and behavioural, and to some degree biological pathways) linking FI to ill health are consistent and insightful. It has been well documented that people's health is influenced by various factors, which may display synergetic or

antagonistic effects on each other. These include age, sex, genetics, behaviour and lifestyles, social networks, environmental conditions, and health systems and services available to people.[116] These factors can be categorized into intermediary and structural determinants of health outcomes, which in this thesis, meant household FI and SEP of the household head, respectively.

Food insecurity as a social determinant of health is often linked to compromised diet, as observed particularly in Study V, and this has been associated with higher risk of developing hypertension and diabetes.[32] Similarly, depending on the severity of FI, individuals and households may find themselves in situations of employing risky coping strategies to acquire and manage food, which may induce feelings of alienation, helplessness, shame, and guilt associated with depression.[19,95] On the other hand, various studies suggest that a diet rich in vegetables, fruit and complex carbohydrates and low in processed meat and refined carbohydrates may have a protective effect against hypertension, type 2 diabetes, CVDs and other NCDs.[150,191] Surprisingly, Kazembe et al.[176] report from Namibia that a diet rich in "starch–oil–sugars" and "meat–fish–dairy" was associated with hypertension, diabetes and CVDs, but these foods were consumed more by food-secure households than by their food-insecure counterparts, which reinforces the need for education on health and nutrition.

On this matter, several studies have proposed that food-insecure households are more likely to purchase cheap and unhealthy food (e.g. highly processed foods containing large amounts of sugar, sodium and oils) and therefore have increased risk for NCDs.[17,192] Findings from Madagascar and Cameroon reinforce the need for education on the nutritional value and benefits of eating leafy green vegetables[193] and

other neglected foods such as soybean, Bambara bean and cowpea for prevention of cardiometabolic diseases.[194] A study by Farris and her colleagues[193] revealed that despite the fact that heads of households consistently reported health concerns as important considerations when purchasing food, these concerns were not translated into actual food choices.

Food insecurity as a source of chronic stress can lead to increased levels of cortisol and cause hypothalamic–pituitary–adrenal dysfunction,[195] which plays a significant role in the development of affective disorders and depression.[196,197] Likewise, increased cortisol levels due to stress can lead to increased blood glucose and insulin resistance, which play crucial roles in the development of type 2 diabetes.[198] Food insecurity can also be connected to poor mental health via micronutrient deficits,[199] as poor diet is associated with increased risk of cognitive decline.[200,201] At the same time, chronic stress and worry can cause maladaptive responses, leading to suicidal ideation and behaviour. This along with other mental illnesses can lead to increased health expenses, unemployment, social withdrawal, and other effects which exacerbate each of these conditions.[202]

Socioeconomic inequalities are the primary causes of health inequalities both within and between societies[107] and the underlying cause of poverty and household FI, especially in LMICs.[182] Each socioeconomic component (i.e. education, occupation, and income) has direct effect on household FS status[182] as well as physical[203] and psychological health outcomes,[113] as observed in Study III and IV, respectively. Remarkably, the interaction effects revealed that food-insecure individuals with a higher SEP were more likely to develop diabetes than their counterparts with a lower SEP.

Considering that the findings are based on self-reporting of actual diagnoses by household heads, these results suggest that individuals at the top in education, income and work are more aware of their health status, especially regarding diabetes. The results also provide an explanation for the impact of medical conditions (including competing expenses for medication and treatment) on FI. Similarly, these findings reinforce the need for education on health and nutrition even among individuals with a higher SEP. Education can contribute to households and individuals translating food concerns into appropriate food choices, and promote healthy eating.

Finally, the findings are also indicative of the need for health services for the majority of the population who cannot afford health care. This is in agreement with Madede et al.[131] who reported that only 10% of people with diabetes in Mozambique were aware of their condition. Moreover, inequalities in SEP and FS status among diabetic individuals emphasize the need for policy intervention to address financial and nutritional gaps in society in conjunction with appropriate education.

Education, the most basic SEP component, can shape individuals' careers, and provide knowledge and skills that allow well-educated individuals to have access to critical information and the resources required to promote their health.[111] Furthermore, education can have a critical impact on food access and utilization among households and individuals.[30] Additionally, educational attainment is a proxy for better employment,[30] social prestige and networks in modern societies.[113] Low educational attainment along with household FI can greatly contribute to increased risk of developing metabolic diseases, emphasizing the importance and magnitude of resources and knowledge in health management.

Household heads with a lower occupation are more likely to experience additional psychological distress, which can further worsen their physical health.[203] Lack of employment and job uncertainty can be detrimental to a person's health. Similarly, disadvantaged workers are more likely to be exposed to severe forms of FI,[32] as well as physical (labour injuries and exposure to toxic substances) and psychosocial risks (job strain and lack of control)[113] and, therefore, have increased risk of developing cardiometabolic diseases.

Along the same lines, household heads with a higher income have the means for better housing, schooling, health care, nutrition, and recreation,[111,113] leading to better overall health outcomes. In Study III, the interaction effects observed revealed that paid work, high income, and education may have a protective effect against hypertension. This highlights their significance on health. Conversely, poverty and low income can hinder access to a quality diet and healthy eating,[39] adequate housing and quality education,[113] and therefore contribute to poor health outcomes. Lastly, daily financial difficulties that vulnerable groups face diminish their sense of agency, control and self-esteem, contributing to psychological and physical ill health.[204] In fact, research evidence indicates that people with a lower SEP are more likely to experience severe forms of FI[182] and health issues throughout their lives. In addition, they are likely to develop illnesses earlier, spend more years with disability and die at a younger age than those with a higher SEP.[111] Conversely, household heads with a higher SEP have advantages in accessing resources, information and conditions that can be translated into actual FS and better health outcomes.[111,114] Coordinated and joint efforts from the government, private sector and other relevant institutions to address each of these factors, as well as

the fundamental mechanisms through which they affect people's health, are needed to close the gap in SEP and household FI, especially among the most sensitive groups.

As observed in Studies III and IV, inequalities in education, work and income, where the risk for ill health increases with reductions in SEP, contribute heavily to the social gradient in health within and between societies.[111,120,121] This gradient, where the poorest suffer most, is viewed as an injustice, and the adverse health outcomes (e.g. anxiety, depression, hypertension, type 2 diabetes) caused by it are health inequities that are avoidable and unfair.[121] Accordingly, appropriate policies and interventions designed to provide equal access to better education and employment opportunities should be implemented. Similarly, targeted interventions[111,122] aimed to lift the most sensitive groups out of extreme poverty are required to close the gap in household FI and health outcomes. This thesis proposes a comprehensive approach to household FI and socioeconomic factors, which can impact on psychological health and shape the prevention and management of NCDs.

6.4 Perceptions and coping strategies among households experiencing food insecurity

Several elements were perceived as key causes of household FI in Study V. These included extreme poverty, lower incomes, high food prices, the COVID-19 pandemic, other illnesses, low educational attainment, habitation problems, pregnancy, and corruption. Household size and structure also played a significant role. These findings illustrate the multidimensional nature of household FI, and that joint and synchronized efforts are required from various agents

such as government, the private sector, civil society, and international bodies, specifically to promote decent work and build a more inclusive economy.[28,184] Moreover, they emphasize the pressing need to provide social assistance and economic aid to the most sensitive groups.[189,190]

Regarding coping strategies, the heads of households reported using a broad spectrum of strategies to acquire and manage food, including some considered risky for health. In agreement with our findings, Muderedzi et al.[172] in Zimbabwe illustrated the connection between household FI, gender roles and HIV acquisition as a vicious cycle. The authors found that, because of extreme poverty, women residing in Tonga communities often adopted sexual (as well as non-sexual) coping strategies to acquire food for their relatives, even though they were aware of the health risks. Furthermore, the authors believed that Tonga cultural factors (including polygamous marriage systems, widow inheritance and sexual cleansing) are critical determinants of the spread of HIV in Zimbabwe.[172] Another study, by Anater et al.[205] in the USA, found that individuals experiencing FI resorted to inadequate nutrient intake, consuming unsafe foods, and engaging in illegal activities and behaviours that are stigmatized and financially and physically risky (e.g. gambling, commercial sex, eating other people's leftovers).

Along the same lines, Nagata et al.[171] examining nationally representative data on US young adults aged 24–32 years found that young women experiencing FI were more likely to have multiple concurrent sex partners in the last 12 months, exchanging sex for money, and to report sexually transmitted infections (e.g. chlamydia and HIV) compared with their counterparts experiencing FS. In both sexes, FI was linked to greater odds of substance use. Therefore, coping strategies, in addition to serving as indicators of economic difficulties,

can pose financial, legal/regulatory, nutritional and safety risks, as well as physical risks to the person employing them, demanding significant public health attention.[205,206]

Virtually all households in Study V had compromised their food quality and safety as a consequence of FI. Similar findings have been reported among food-insecure households in several settings across SSA,[207] Malaysia,[208] Europe,[209] the USA,[210] Canada[211] and Australia.[212] On this matter, food-borne diseases (FBDs) and food adulteration are of great concern today, especially in LMICs. As pointed out by Grace,[213] most of the known burden of FBDs derives from eating fresh foods sold in informal markets. Furthermore, structural challenges such as the fragmentation of the food system and poor monitoring, together with the weak capacity of public institutions responsible for enforcing regulations, exacerbate this situation.[213,214]

Lastly, a systematic review by Gizaw[215] across the world found that food contamination, food adulteration, mislabelling, misuse of food additives, old food, and genetically modified foods were prevalent health risks associated with food safety. The author advocated the need for effective food control systems not only to protect the health and safety of the general public but also to ensure the safety and quality of imported foods.[215] Altogether, these findings underscore the clinical and public health implications for alleviating household FI and malnutrition to improve health outcomes, especially among the most vulnerable groups.[43]

6.5 Strengths and limitations

This thesis provides one of the first assessments of empirical studies that examined the relationship between household FI, SEP of the household head, and health outcomes in Maputo City, Mozambique.

Furthermore, the thesis employed both quantitative and qualitative methods. The studies used validated measures of household FI and psychological and physical health outcomes and applied advanced statistical methods for data analysis (i.e. propensity score matching and multinomial regression). In addition, the studies examined the interaction effects between variables, and generated interaction plots for clear visual representation of complex statistical data. The findings on FI and its associated factors can be generalized to the entire city of Maputo, and regarding transportability, can also be extended to other cities in Mozambique.[216] Similarly, with some caution (e.g. using the HADS scores rather than the cut-off value), the findings on the association between FI and psychological health can be generalized to the entire city of Maputo. Regarding cardiometabolic diseases, the findings provide valuable information about the associations with FI, and give insights into the severity of the situation in Mozambique in the context of multiple risk factors. Likewise, the qualitative study (Study V) provides rich information and valuable insights that explain to some extent the behavioural mechanisms linking FI and negative health outcomes. Nevertheless, the interpretation of the findings (especially in Study III and IV) requires some caution and some limitations need to be considered. The systematic review relied exclusively on peer-reviewed journal articles published in English in databases. The studies used a cross-sectional design and could not ascertain causality. In fact, research evidence indicates that the relationship between FI and negative health outcomes is complex and bidirectional. Many factors associated with FI are in themselves associated with negative health outcomes; and FI can cause negative health outcomes and vice versa,[43,217] hence the need for designs that consider temporal relationships (e.g. prospective cohort studies). Moreover, the measurements were based on self-report, and self-

reporting is susceptible to response bias. At the same time, considering the strong stigma traditionally associated with mental health in Mozambique[98,133] and recognizing that mental health exists in a complex continuum,[93] extra caution is needed to interpret the findings on the association between FI and psychological health. Similarly, there may be an underestimation of cardiometabolic disease prevalence, especially among vulnerable groups because of reliance on actual diagnoses. Furthermore, although household FI was measured and categorized into mild, moderate, and severe, the sample size was inadequate to explore this information through multilevel analysis. Finally, the qualitative study consisted largely of female participants. Therefore, the findings may not be generalizable to households headed by men given that FI coping strategies have been found to vary by gender.[218,219]

6.6 Implications for policy and future research

Food insecurity is a global concern and a key determinant of malnutrition and negative health outcomes, especially in LMICs. The present studies highlight the complexity of the relationship between household FI, SEP of the household head, and cardiometabolic diseases and psychological health in the capital city of Mozambique. The findings suggest the need to jointly consider key socioeconomic and demographic factors when developing public health policies and intervention programmes to combat household FI and improve physical and psychological health outcomes. Furthermore, these studies significantly contribute to the ongoing scientific debate on the relationship between household FI, SEP of the household head, and cardiometabolic diseases and psychological health. At the same time, these findings can inform governments, policy makers and institutions

about which interventions may be most suitable for implementation to improve local, regional and global FS and nutrition, as well as to improve physical and psychological health outcomes among vulnerable populations. Simultaneously, the studies suggest that it is of paramount importance to provide social assistance and economic aid to the most sensitive groups (including household heads with a low SEP).

Finally, future research should longitudinally assess the abovementioned relationships and explore in-depth the mechanisms behind them. In the context of the widespread prevalence of household FI and a multitude of other risk factors and adverse health outcomes, future studies that examine the role of structural and institutional policies to address FI and health outcomes are also needed. In addition, future research should test interventions to mitigate inequalities, especially in nutrition and the SEP of household heads. In this regard, collaboration agreements among researchers, health care providers, policy makers and community institutions appear to be critical for strategy development and implementation of programmes to alleviate household FI, promote decent work and quality education, and improve physical and psychological health among vulnerable populations.

7 Conclusions

Food insecurity is a major concern in southern African countries including Mozambique, and is associated with negative health outcomes. In Mozambique's capital city of Maputo, practically four out of every five households were, at the time these studies were conducted, living in FI. Of these four, three households were suffering from moderate or severe FI. This proportion of FI underscores the

pressing challenges the country faces in relation to FS and nutrition. Several factors were associated with household FI, but the following were the most prevalent: poverty, low income, insecure employment, habitation problems, low educational attainment, unfavourable household size and structure, a non-diversified diet, high food prices, illness, gender inequality, and corruption. This demonstrates the complexity and multidimensional nature of the FI situation in the country (and across the region).

The presented research provides evidence for a significant relationship between FI, and anxiety, depression, hypertension, and type 2 diabetes. Furthermore, the results indicate that the SEP of heads of households significantly modifies the relationship between household FI and their psychological and physical ill health. Moreover, the heads from food-insecure households reported a broad spectrum of experiences and coping strategies that they used to acquire and manage food, highlighting their hardships and vulnerability and how they attempted to curtail exposure to FI. Furthermore, there is a need for the country to create more employment opportunities and promote decent work and improve livelihoods among the most vulnerable groups. Therefore, within the context of multiple risk factors, these findings point to the need for longitudinal studies to gain a deeper understanding of the mechanisms linking socioeconomic and demographic factors to household FI and negative health outcomes, and to establish causal inferences. Moreover, these findings demand urgent informed actions from government, the private sector, and international bodies, not only to provide social assistance and economic aid to the most sensitive groups (including the heads of households with a lower SEP), but also to implement multifaceted programmes to be included alongside educational initiatives. With

these measures in place, the government of Mozambique may successfully alleviate household FI and malnutrition and improve physical and mental health outcomes in the general population.

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Appendices

Table 1. Quality assessment of the articles included in the review.

Criteria	Totally met	Partially met	Not met
Was there a clear statement of the aims of the research?	14		
Is a qualitative/quantitative methodology appropriate?	14		
Was the research design appropriate to address the aims of the research?	14		
Was the recruitment strategy appropriate to the aims of the research?	13	1	
Were the data collected in a way that addressed the research issue?	14		
Was the data analysis appropriate for the aims of the research?	13	1	
Have ethical issues been taken into consideration	13	1	
Is there a clear statement of findings/results?	14		
Available Open Access	10		4

Table 2. Multinomial logistic regression of food insecurity by socio-demographic characteristics, Maputo City Household Survey, 2022.

Food Insecurity Scale[a]		B	Std. Error	Wald	df	p-value	OR	[95% Conf. Interval]	
Mild FI	Intercept	9.053	2.205	16.852	1	<,001			
	Household head	-.440	.740	.353	1	.552	.644	.151	2.745
	Type of work	-.039	.133	.087	1	.768	.962	.741	1.247
	Education	-.641	.229	7.805	1	.005	.527	.336	.826
	Marital status	-1.355	.722	3.521	1	.061	.258	.063	1.062
	Remittance	-.040	.215	.035	1	852	.961	.631	1.464
	Household income	-.502	.145	12.009	1	<,001	.605	.456	.804
	Number of meals	-.131	.248	.281	1	.596	.877	.540	1.425

	Household size	-.162	.223	.532	1	.466	.850	.550	1.315
	Number of children	.310	.238	1.702	1	.192	1.363	.856	2.172
	Food diversity	-.887	.208	18.234	1	<,001	.412	.274	.619
Moderate FI	Intercept	14.323	2.297	38.873	1	<,001			
	Household head	-.551	.762	.523	1	.470	.576	.129	2.567
	Type of work	.217	.149	2.121	1	.145	1.242	.928	1.662
	Education	-.980	.250	15.333	1	<,001	.375	.230	.613
	Marital status	-1.649	.739	4.976	1	.026	.192	.045	.819
	Remittance	-.734	.247	8.870	1	.003	.480	.296	.778
	Household income	-1.388	.152	83.824	1	<,001	.250	.185	.336

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	Number of meals	-.636	.296	4.624	1	.032	.529	.296	.945
	Household size	.127	.248	.261	1	.610	1.135	.698	1.847
	Number of children	.326	.273	1.425	1	.233	1.385	.811	2.365
	Food diversity	-1.232	.236	27.259	1	<,001	.292	.184	.463
Severe FI	Intercept	36.114	2.605	192.18	1	<,001			
	Household head	-.947	.831	1.299	1	.254	.388	.076	1.977
	Type of work	.082	.180	.206	1	.650	1.085	.763	1.543
	Education	-1.558	.297	27.531	1	<,001	.211	.118	.377
	Marital status	-1.945	.805	5.844	1	.016	.143	.030	.692
	Remittance	-1.011	.299	11.448	1	<,001	.364	.203	.654

	Household income	-3.003	.198	230.62	1	<,001	.050	.034	.073
	Number of meals	-14.731	.000	.	1	.	4.0E-7	4.0E-7	4.0E-7
	Household size	1.271	.317	16.083	1	<,001	3.564	1.915	6.633
	Number of children	.695	.345	4.062	1	.044	2.003	1.019	3.936
	Food diversity	-5.152	.639	65.090	1	<,001	.006	.002	.020

a. The reference category is: Food Secure.