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<https://doi.org/10.1057/s41599-025-05858-w>

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Inflation, food insecurity, and mental health: Generation Z's burden in emerging Europe

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Inflation does not just raise prices; it reshapes daily life. For Generation Z (Gen Z), rising food costs and financial instability are not abstract economic shifts but lived realities carrying serious emotional and psychological weight. This study explores how perceived inflation relates to food insecurity and depressive symptoms among university students in Hungary, one of the EU's hardest-hit economies during recent inflation surges. As an emerging EU economy with limited student welfare support, Hungary offers a critical lens for understanding how inflation, food insecurity, and mental health intersect across vulnerable populations in similar contexts. Using validated measures (FIES, PHQ-9) and survey data from 517 Gen Z students, we examine how students' personal experiences of inflation affect both their access to basic needs and their mental health. Our findings show that perceived inflation is not only an economic burden but a psychological amplifier capable of intensifying insecurity and emotional distress, especially among emotionally sensitive students and young women. Nearly half of our sample reported food insecurity, and more than three-quarters indicated signs of moderate to severe depression. These results point to a deeper truth: when basic needs become harder to attain, mental health suffers. Inflation, food insecurity, and emotional well-being are deeply interconnected and properly addressing them requires more than financial aid alone. To truly support Gen Z and future generations, universities and policymakers must work together to offer holistic solutions that safeguard both economic stability and mental well-being.

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Introduction

Economic instability has become one of the most pressing and personal challenges facing young adults today, especially those navigating financial precarity (Woodman & Wyn, 2013). Since the onset of the COVID-19 pandemic, the pressures facing Generation Z (Gen Z) have only intensified, fuelled by ongoing global disruptions, supply chain shocks, and geopolitical conflict. For many, the rising cost of everyday essentials, especially food, has become not just a budgeting concern, but a source of deep uncertainty and emotional strain (Lawrence & Schäfer, 2023). While inflation is a global phenomenon, its impact is far from equal. In Central and Eastern Europe, where public services are too often fragmented and social safety nets remain thin, the burden is felt more acutely (Eurostat, 2023; IMF, 2024). Research shows that food price inflation disproportionately affects lower-income households, forcing difficult choices that often mean sacrificing nutritional quality in favour of cheaper, ultra-processed foods (Causa et al., 2022; Gundersen & Ziliak, 2018; Wolfson, Leung 2020; Skotnicka et al. 2021; Laborde et al. 2021). These trade-offs can have consequences not only for physical health, but for mental and emotional well-being as well. Yet despite growing recognition of the economic aspects of food insecurity, its psychological toll, particularly on young people, remains underexplored in many parts of the world (Jones et al., 2022). Hungary offers a vivid case of this. As one of the EU's most inflation-affected countries, food prices there surged by nearly 45% between 2021 and 2022 alone, well beyond wage growth and well beyond what many young people can absorb (KSH-Hungarian Central Statistical Office 2023). Recent research confirms that this inflationary spike has been among the steepest in the region, influencing not only how people shop and eat, but how they cope, plan, and live (Balogh & Sárvári, 2024; Grunert et al., 2023).

Food insecurity is far more than an economic issue; it is a major social determinant of health. A wide body of research has identified strong links between food insecurity and elevated levels of stress, anxiety, and depression (FAO, 2018; Nagata et al., 2019). A recent review by De Bail et al. (2023) further reinforced that these mental health risks become even more pronounced during economic crises, during which university students are especially vulnerable. Caught in the transition between dependence and financial independence, many young adults face precarious living conditions and mounting financial strain (Hattangadi et al. 2019; Pourmotabbed et al. 2020). As Bruening et al. (2017) and Burruss et al. (2021) emphasize, these pressures leave students especially vulnerable to the emotional and psychological toll of food insecurity. While some research has addressed food insecurity in Eastern Europe (Grimaccia & Naccarato, 2020), much of the existing research still centres on Western, high-income countries, thereby leaving a critical knowledge gap. Emerging EU economies in the region continue to battle stubborn inflation, coupled with limited welfare protections (Eurostat, 2024). For young people, especially university students, the stakes are too often high. As the cost-of-living climbs, the risk of food insecurity and its related mental health consequences continues to escalate as a concern (Gundersen & Ziliak, 2018; Gurova, 2024). To better understand these dynamics, we draw on financial stress theory (Conger et al., 1994) and economic precarity theory (Standing, 2011), both of which explain how material deprivation and uncertainty fuel psychological distress, particularly in low-protection contexts like Hungary.

There is also a clear gendered side to this crisis. Research consistently shows that women tend to be more vulnerable to the psychological impacts of economic downturns. This vulnerability is often rooted in socially constructed caregiving roles and the ongoing demands of unpaid domestic labour, which leave many

women with fewer buffers when financial strain hits (Mussida & Patimo, 2020). When food insecurity enters the picture, these challenges often intensify, leading to heightened mental health risks such as anxiety and depression (Talamonti et al., 2023; Thibaut, 2023). Young women are especially at risk, yet their emotional struggles around food insecurity remain under-represented in research, especially outside of high-income, Western contexts (Maynard et al. 2018; Wattick et al. 2018).

Some scholars have noted that while the health behaviours of university students in Eastern Europe are often labelled as “unhealthy lifestyles,” they are rarely the result of individual choice alone. Instead, these behaviours reflect deeper structural constraints. Many students in the region care deeply about their health and are eager to make good choices, yet often face barriers such as limited access to trustworthy health information or affordable support services (Steptoe & Wardle, 2001; Ilić et al., 2022; Dadaczynski et al., 2021). Research from Southeastern Europe has similarly shown that most of what we currently know about food insecurity and its mental health effects is drawn from wealthier countries. This leaves the specific challenges faced by students and families in Central and Eastern Europe understudied and poorly understood (Jansen et al., 2020; Dudek & Myszkowska-Ryciak, 2022). This lack of context-specific knowledge has real-world consequences. Without a clearer picture of local realities, it is difficult to design meaningful mental health interventions. In response, scholars have increasingly called for greater investment in regional research and more cross-border collaboration to help shape mental health policies that are both evidence-based and locally relevant (Winkler et al., 2017; Hook & Bogdanov, 2021).

Our study is part of this effort. We explore how inflation-driven food insecurity relates to depressive symptoms among university students in Hungary, an often-overlooked group in a region that is facing some of Europe's highest inflation rates. Using validated tools like the Food Insecurity Experience Scale (FIES) and the PHQ-9, we examine how economic pressures are affecting young people's daily lives and mental well-being. In doing so, we hope to bring much-needed visibility to this intersection of food insecurity, emotional health, and gendered vulnerability. Our findings are intended to inform future policy decisions focused on student support, youth mental health, and gender-sensitive intervention. We test our hypotheses using Partial Least Squares Structural Equation Modelling (PLS-SEM) and multivariate statistical analysis. In our discussion, we connect these insights to wider literature, propose practical responses, and highlight the need for more long-term, cross-national studies that can deepen understanding across the broader Central and Eastern European context.

Literature review and hypothesis development

The psychological impact of economic downturns and financial shocks. Economic instability does not just rattle stock markets; it reshapes daily life. It affects what people eat, how they manage stress, and how safe they feel in the world around them. More and more research shows that it is not just the loss of income that causes distress, but the constant pressure of wondering what might happen next. Even the fear of financial trouble can lead to anxiety, depression, and a drop in life satisfaction, especially among young adults, women, and those working in insecure jobs (Clark et al. 2016; Deaton, 2012; Kahneman & Deaton 2010; Gili et al. 2013; Avdic et al. 2020; Matsubayashi et al. 2022; Zamanzadeh et al. 2024). Events like the COVID-19 pandemic and the war in Ukraine only added to this pressure, deepening existing cracks in household stability (Stuckler et al. 2009).

As food prices rose, many families found themselves forced to make difficult choices that often involve shifting away from fresh, nutritious meals and toward more affordable, calorie-dense options (Bogmans 2021; Toffolutti et al. 2020; Hoenink et al. 2024). This reaction is not new. During earlier downturns, researchers already noticed that people began trading nutrition for cost (Dave & Kelly, 2012). What once seemed temporary is now rapidly becoming the norm under ongoing inflation. These compromises hit hardest in households that already had little room to manoeuvre. While higher-income families can switch brands or stock up during sales, those with tighter budgets often have to stretch every bit of income while relying more and more on processed foods just to get by (Argente & Lee 2021; ECB 2022; Orhun & Palazzolo 2019; Molnár & Hajdu 2024; Senia et al. 2017; French 2003; Pancrazi et al. 2022). Over time, these patterns do more than harm physical health as they also wear people down emotionally. The stress of constant decision-making, the fatigue of having to weigh every purchase, and the guilt of cutting corners on food for loved ones all can significantly diminish well-being.

And this burden is not just falling on the poorest anymore. Middle-income families that were once able to weather financial storms are now also feeling the squeeze (Dudek 2022; Gundersen & Garasky 2012; Smith et al. 2017). In Hungary, the reality is striking: some households now spend more than 40% of their income just on groceries (Molnár & Hajdu 2024; Chua & Tsiaplias, 2024). Compared to the 2008 financial crisis, the current wave of inflation has lasted longer and hit harder, leaving less room for recovery (Clark et al. 2016). All of these point to a clear need for action. Temporary support can help in a pinch, but it is not enough for challenges that are now structural and ongoing. What is needed is a deeper, more coordinated response—one that sees financial resilience and mental health not as separate issues, but as parts of the same story. Without that, we risk letting everyday hardship become the new normal (Hymans 1975; Molnár & Hajdu 2024).

Gen Z and food insecurity. Gen Z, those born between the mid-1990s and early 2010s, has grown up in a world shaped by economic instability, digital saturation, and cultural flux (Abou-Khalil et al. 2021; Gurova 2024). From the 2008 crash to the climate crisis and COVID-19, they have inherited a world of overlapping disruptions. As digital natives, Gen Z relies heavily on online platforms for health information, which shapes how they shop, eat, and take care of themselves (Raeside et al. 2022). While many young people aspire to healthy living, inflation often forces them to make compromises. Health-consciousness gets overridden by financial necessity (Grunert et al. 2023; Lewis et al. 2023). Rising food costs push them toward cheaper, processed options, foods that are easier to afford but nutritionally lacking (Bogmans, 2021; Toffolutti et al., 2020). Fresh produce and whole grains become harder to access, and fast food or ready-to-eat meals take their place (Monsivais, Drewnowski 2007; Wongprawmas et al., 2022).

This shift does not just affect diet but also fuels food insecurity and broader well-being challenges, especially for students and early-career workers. Based on this, we propose the following hypothesis:

H1. High food inflation significantly exacerbates food insecurity among Gen Z individuals by limiting access to affordable, nutritious food options.

Food insecurity and mental well-being. There is strong evidence linking food insecurity to poor mental health. U.S. and Canadian studies show that students facing food insecurity are more likely to experience stress, anxiety, and depression (Raskind et al. 2018; Hattangadi et al. 2019). These findings are echoed in meta-

analyses, showing the psychological toll of food insecurity across different socioeconomic groups (Pourmotabbed et al. 2020). These effects, however, go beyond mere clinical symptoms. They affect how young people view their futures, their autonomy, and their sense of control. In Hungary, crippling inflation has made this worse. Our data show that 45.6% of surveyed students faced some level of food insecurity. Many report choosing between proper meals and other basic needs, while these decisions weighed heavily on their emotional well-being.

Food insecurity, in this context, becomes both a consequence of inflation and a source of psychological strain. We explore this relationship through the following hypotheses:

H2a. High food inflation causes elevated depression among Gen Z consumers, mediated by food insecurity. H2b. High food inflation has a significant positive effect on depression among Gen Z consumers. H2c. Food insecurity has a significant positive effect on depression among Gen Z consumers.

The gendered impact of food insecurity and mental well-being.

The effects of food insecurity are not gender neutral. Women tend to experience greater psychological distress during periods of economic disruption. Across cultures, research shows that women face higher rates of food insecurity and are more vulnerable to its emotional consequences (Jones 2017; Maynard et al. 2018; Mikolajczyk et al. 2008). These disparities are not just personal but rather structural. As outlined by the social determinants of health framework (WHO, 2008), women are more likely to face economic strain due to pay gaps, caregiving roles, and unpaid labour at home (Mussida & Patimo, 2020). These stressors intensify during crises.

Studies consistently show that young women, particularly female university students, are more vulnerable to the psychological consequences of food insecurity. Higher rates of depression, anxiety, and sleep disturbances are common when food access becomes uncertain (Arenas et al. 2019; Wattick et al. 2018; Spaid, Duff 2009). These patterns hold across various regions. A Europe-wide study using the FIES framework found that women consistently reported higher levels of food insecurity than men (Grimaccia & Naccarato, 2020), and similar findings have been reported in China (Sze et al., 2021). Our own data clearly align with these trends: female students in Hungary were significantly more likely to report both food insecurity and depressive symptoms than their male peers. These disparities point to the urgent need for gender-sensitive policy measures, including expanded financial assistance, subsidized meal programmes, and mental health services tailored to the needs of young women.

H3. There is a higher prevalence of food insecurity and depression among female Gen Z consumers than among male Gen Z consumers, particularly those displaying severe FIES and PHQ-9 scores.

Methods and research design

The following theoretical framework (Fig. 1) served as the basis for carrying out the study and illustrates the relationship between inflation and food insecurity, as well as between food insecurity and depression. Previous studies within social science have made use of structural equation modelling (SEM) or regression analysis to examine the effects and interrelations of various constructs. This research leverages the PLS-SEM method and analyses the model with the software ADANCO (version 2.4). Furthermore, the relationships and proposed hypotheses will be assessed by means of multivariate statistical analysis.

Survey design: The Food Insecurity Experience Scale (FIES). FIES addresses food insecurity at both household and individual

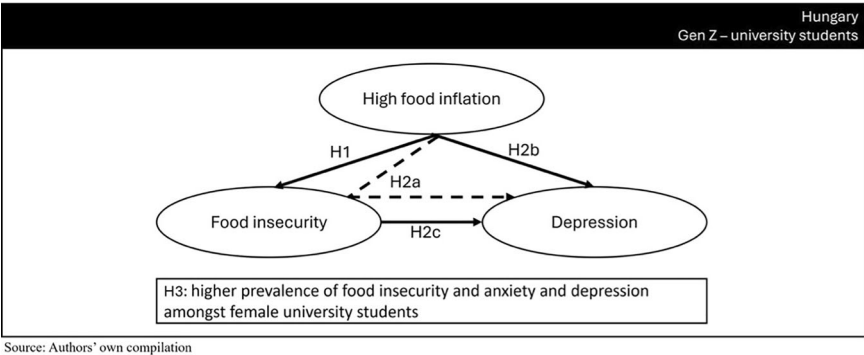


Fig. 1 Inflation, food insecurity, depression conceptual model.

Table 1 Participants' demographic characteristics (n = 517).		
Variables	n	%
(Age n (%))		
18	14	2.7
19	114	22.1
20	245	47.4
21	95	18.4
22	34	6.6
Older than 22	15	3
Home Country n (%)		
Hungarian	511	98.8
Other	6	1.2
Gender n (%)		
Men	270	52.4
Women	245	47.6
Non-Binary	0	0
Other	0	0
University n (%)		
	517	100

Source: Own data.

levels by utilizing experience-based measures through an eight-question survey (Ballard et al. 2013; FAO, 2018). This tool has been applied in over 140 countries across diverse contexts to assess moderate and severe food insecurity. It is particularly valuable in capturing nuanced experiences of food insecurity, allowing for a comprehensive understanding of its prevalence and impact across different populations (Saint Ville et al. 2019; Sheikomar et al. 2021; Pereira et al. 2021). The survey questions begin with assessing concerns about access to sufficient food, followed by questions related to compromises in the quality and variety of food consumed, and concluding with questions on reductions in the quantity of food intake. Each affirmative response earns the respondent one point, which is summed to produce a raw score that determines an individual's food security status. To ensure cross-country comparability of food insecurity severity, the Food and Agriculture Organization (FAO) standardized these scales to a global benchmark, establishing country-specific thresholds derived from the global severity scale (Broussard, 2018).

The Patient Health Questionnaire (PHQ-9). PHQ-9 (Kroenke et al. 2001, Spitzer et al. 1999) provides a robust measure of mental health, specifically depression, which is crucial for assessing the psychological effects of food insecurity (Itani et al., 2022, Buruss et al. 2021, Fang et al. 2021). These tools have been validated across a wide range of contexts, further reinforcing their reliability and applicability in diverse research environments.

Recent studies have demonstrated their effectiveness in identifying the multifaceted impacts of food insecurity on mental health during the COVID-19 pandemic (Lingén-Huamén et al., 2023) and in different cultural and socioeconomic contexts (Stocker et al. 2021, Markovic et al. 2022, Conceição et al. 2021). The PHQ-9 includes nine questions, escalating from mild to severe, where participants are asked to consider their experiences over the previous two weeks. The questionnaire consists of nine items using a three-point scale, with higher scores indicating more depressive symptoms within the previous four weeks (Kroenke et al. 2001). The reliability and validity of the PHQ-9 is high in clinical healthcare settings (Sun et al. 2020; Sun et al. 2022, Itani et al. 2022) and well established among university students all over the world (Monteiro et al. 2013, Du et al. 2017), Makhubela, Khumalo (2023), Rahman et al. (2022).

Data collection and sample. This study focused on undergraduate students in Hungary, who were invited to participate in an online survey conducted during their lecture periods from November 9th to November 27th, 2023. Due to rapidly changing economic conditions, a tighter survey window was deemed to be more prudent. University students represent a vital demographic for Gen Z research and typically display greater autonomy in making lifestyle choices. The health behaviours that they adopt during young adulthood can have long-term implications for their overall health (Von Ah et al. 2004; Mikolajczyk et al. 2008). The survey was originally developed in English but was also administered in Hungarian to ensure greater accessibility. Prior to the survey distribution, all professors involved were thoroughly briefed on the content and objectives of the study and all surveys were conducted during supervised lectures. The participants were fully informed about the study's purpose, its intended usage and storage of the data collected, and were required to provide informed consent before beginning the questionnaire. Participation was entirely voluntary and anonymous, with the option to withdraw from the study at any point. The survey initially collected responses from a total of 554 participants. After a thorough data cleaning, however, the final sample size was reduced to 517 legitimate responses. This reduction occurred because some participants did not provide complete answers to all the items on the Food Insecurity Experience Scale (FIES) or the Patient Health Questionnaire (PHQ-9). Missing data on any of these key measures led to the exclusion of 37 respondents to ensure the accuracy and reliability of the analyses. The final dataset, therefore, consists of 517 fully completed surveys that were used in subsequent analyses. The study was approved by the Research Ethics Committee, Office of the Vice-Rector for Research.

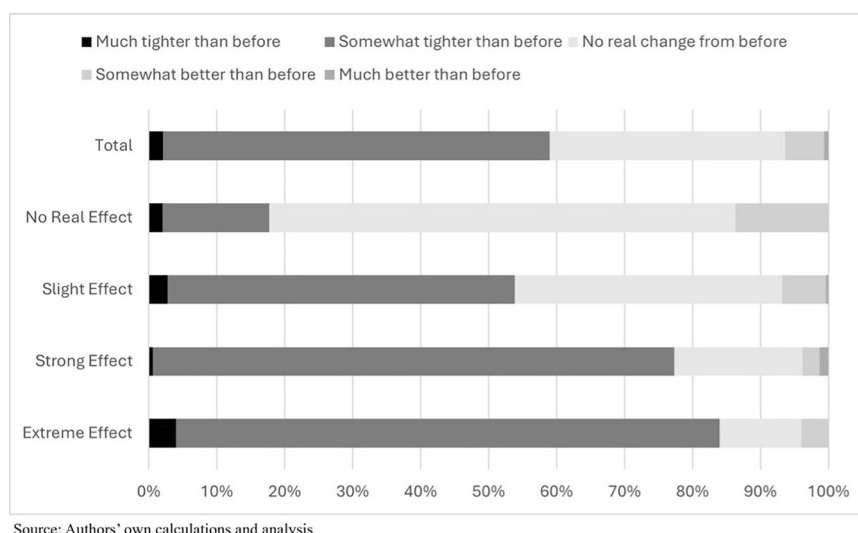


Fig. 2 Cross tabulation between the impact of inflation and household budgets.

Participant characteristics. The demographic characteristics are presented in Table 1. The median age of the sample was twenty years old and 98.8% of the respondents are Hungarian. The split between men and women is nearly even (52.4% vs. 47.6%) and the participants are all university undergraduate students.

Results

The Impact of Inflation on Food Insecurity. Our results indicate that more than 90% of the students were affected to some degree by inflation, while 30.8% reported a strong effect and 4.8% an extreme effect. Regarding household budgets, 56.9% of the respondents indicated budgets that were somewhat tighter than before while only 2.1% found their household budgets to be much tighter. Figure 2 (above) shows a significant positive relationship ($\chi^2 = 77.710$; $p < 0.001$; Cramer's $V = 0.224$) between the inflation effect and household budgetary changes. Among the students who felt inflation had a strong effect on their food purchases, 76% reported a slight effect in their overall household budgets. During periods of high inflation, however, it is common to see that while overall household budgets remain relatively static, the percentage of food purchases in the overall budget can become significantly larger particularly (Hymans 1975, Chua & Tsiaplias, 2024, Molnar et al. 2024). Evidence of the impact of inflation on emerging European economies can be further seen in the EU in 2022 where 13.6% household expenditures were spent on “food and non-alcoholic beverages” compared to Latvia (20.6%), Bulgaria (20.2%), and Slovakia (19.6%) (Eurostat, 2024).

Food insecurity and Rasch reliability. Overall, 45.6% of the students in our sample expressed some form of food insecurity. The level of moderate or severe food insecurity (FI_{mod+sev}) is 15.269% and the proportion experiencing severe food insecurity (FI_{sev}) is 0.9%. When looking at the distribution of affirmative answers to each FIES question (Fig. 3), the item “ATELESS” was reported most often in our sample (30.6%), followed by the items “FEWFOOD” (24.8%), “HEALTHY” (18.4%), “WORRIED” (15.7%), and “RUNOUT” (14.5%). Not eating for a whole day, “WHLDAY” (7.5%), and “SKIPPED: (4.4%) were chosen the least.

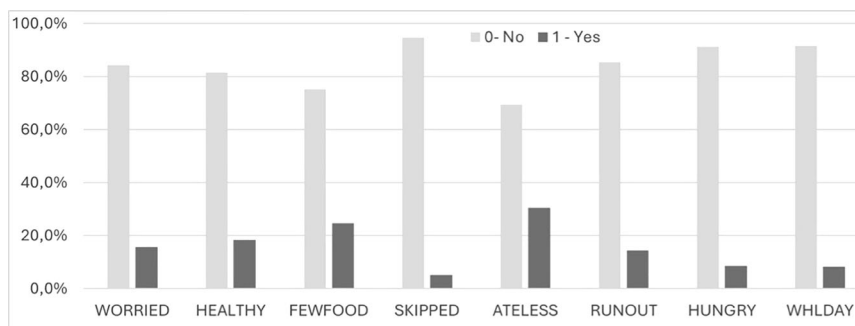
We used the open-source software RStudio Version 2024.04.02 for calculating prevalence rates of food insecurity and applied the Rasch model with the RM.weights package by the Statistics Division at the Food and Agriculture Organization (FAO).

During this process, the cases with extreme raw scores (0 or 8) were excluded; in our case, it meant (281 + 4) altogether total of 285 respondents. Item severity scores show that eating less (“ATELESS”) is the most severe, while skipping a meal because of a lack of money or other resources (“SKIPPED”) has the lowest severity. According to the infit statistics of all items, we can accept the solution as the infits are within the acceptable range of 0.7–1. This means that all items are associated to the latent trait (FI) and discriminate equally well among the respondents (Kötzsche et al., 2023). Outfit statistics can indicate the presence of outliers and an outfit of higher than 2 can be considered to be “high”. In the current sample, all the outfits are lower than the threshold. The Rasch reliability value of 0.7172 confirms a good discriminatory power of the overall scale and can be acceptable in the case of the 8-item scale. The residual correlation for a pair of items is also below the threshold ($<|0.4|$) (Table 2).

Patient Health Questionnaire (PHQ-9) Results. Figure 4 shows that “feeling tired and having little energy” was the most answered question and one that has the highest number of severe responses (“nearly every day”). “Trouble concentrating or on things” and “Trouble falling or staying asleep” are among the ones with the highest number of overall responses and highest severity responses. The consequences of high inflation on food insecurity are also reflected in the PHQ-9 scores, where only 22.8% of the students were classified as mild, 43.3% as moderate, 21.1% as moderately severe, and 12.76% as severe.

These results are consistent with studies conducted in France and Canada that identified the relationship between food insecurity and depression relating to university students (Pryor et al. 2016, Martin et al. 2016), as well as numerous studies from the U.S. (Wattick et al. 2018), Raskind et al. (2018), Martinez et al. (2020), Oh et al. (2022). Finally, several U.S. studies found that food insecurity is associated with poorer mental health and sleep quality among university students (Hagedorn et al. 2020; Nagata et al. 2019).

PLS-SEM analysis. According to the conceptual research model, we have selected the perceived inflation effect as the exogenous variable. It was measured by a single item. Respondents had to indicate the degree to which inflation has affected their food purchases during the past 12 months on a scale from 1–5 where “1” meant deflationary effect, “2” no real effect, “3” a slight effect,



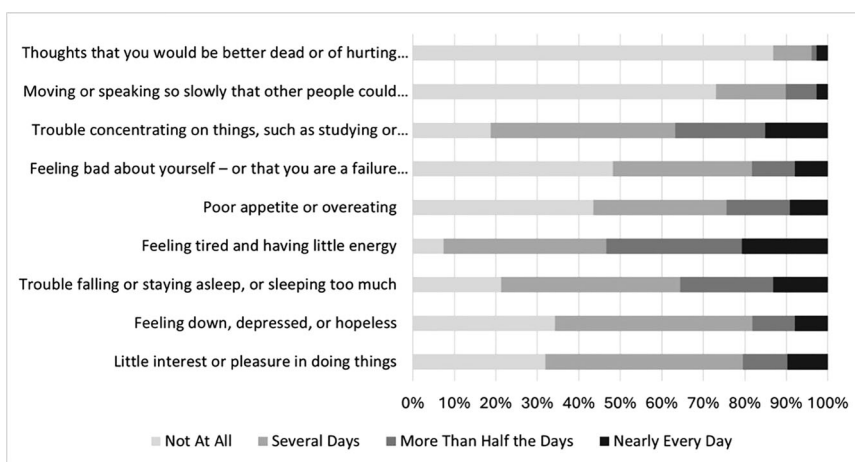
Source: Authors' own calculations and analysis

Fig. 3 Distribution of the raw scores from the eight FIES questions ($n = 517$).

Table 2 Rasch reliability results in the case of the 8-item scale.

Item	Item parameter	Standard error	Infit	Outfit	Proportion of affirmative responses	Number of affirmative responses
WORRIED	-0,17	0,17	1,0713	1,0564	33,19	77
HEALTHY	-0,49	0,16	0,8256	0,7070	39,22	91
FEWFOOD	-1,16	0,15	0,9008	0,8419	53,45	124
SKIPPED	1,68	0,25	0,9251	0,7566	9,91	23
ATELESS	-1,71	0,15	1,1199	1,1152	66,38	154
RANOUT	-0,02	0,17	1,2017	1,3483	30,60	71
HUNGRY	0,89	0,20	1,0384	0,9059	17,67	41
WHLDAY	0,97	0,21	0,9451	0,8714	16,81	39

Source: Authors' own calculations and analysis.



Source: Authors' own calculations and analysis

Fig. 4 Distribution of PHQ-9 raw scores ($n = 517$) based on the nine questions.

“4” a strong effect and “5” an extreme effect. Due to the binary variables as suggested measurement items in the FIES scale, the food insecurity level of respondents was included as an emergent variable in the model using the sum scores as a weighting scheme. In the case of depression, all nine measurement items were included and the consistent-PLS (PLSc) was applied to build the reflective measurement model. By using the PLSc, the reflective measurement models can avoid attenuation bias (Benitez et al. 2020) (Supplementary 2).

To assess the measurement model, we conducted a confirmatory composite factor analysis (CCFA). In terms of construct reliability values of the depression scale, the Dijkstra-Henseler's rho (Dijkstra-Henseler, 2015) (0.8434) and composite reliability (0.8269) and Cronbach's alpha (0.8363) are all above the threshold (higher than 0.7). There is no need to calculate the reliability value in the case of a single item (perceived inflation) or

emergent variable (FIES score) measured with a sum score weighting scheme. The AVE value of the latent variable depression ($AVE = 0.3554$), however, is below the suggested threshold of 0.5. This does not imply that convergent validity is not adequate as the composite reliability scores are well above the threshold and the AVE is “a more conservative estimate of the validity of the measurement model, and based on composite reliability alone, the researcher may conclude that the convergent validity of the construct is adequate” (Lam, 2012). According to the Fornell-Larcker criterion, a construct's squared correlations with all other constructs in the model must be smaller than its average variance retrieved. Furthermore, discriminant validity can be assessed based on the HTMT and HTMT2 values, which are also acceptable ($HTMT = 0.2728$ and $HTMT2 = 0.2663$) in the case of depression. The loadings of the items were used to measure the different constructs that demonstrate fit, and the

Table 3 Direct and indirect effects from PLS-SEM analysis.

Direct effects	Orig. Coeff	Standard bootstrap results					Percentile bootstrap quantiles			
		Mean value	Standard error	t-value	p-value (2-sided)	p-value (1-sided)	2.5%	97.5%		
PERCEIVED INFLATION ->FIES	0.443	0.445	0.0345	12,558	0.0000	0.0000	0.3707	0.512		
PERCEIVED INFLATION ->DEPRESSION	0.172	0.175	0.0497	3.3851	0.0006	0.0003	0.0732	0.272		
FIES ->DEPRESSION	0.251	0.256	0.0532	4.6122	0.0000	0.0000	0.1505	0.366		
Indirect effects										
PERCEIVED INFLATION ->FIES ->DEPRESSION	0.111	0.114	0.0260	4.268	0.0000	0.0000	0.0652	0.169	VAF 39.34%	Mediation Comp. partial mediation
Perceived inflation and food insecurity levels effects on depression										
Effect	Beta	Indirect effects			Total effect		Cohen's f²			
PERCEIVED INFLATION ->FIES	0.4428				0.4428		0.2439			
PERCEIVED INFLATION ->DEPRESSION	0.1715	0.1112			0.2826		0.0272			
FIES ->DEPRESSION	0.2511				0.2511		0.0583			

Source: Authors' own calculations and analysis.

loadings and t-values calculated from the 5000 bootstrap samples are appropriate. In terms of the item “SELFHARM,” however, we can see a lower loading since this item is measuring an extreme behaviour and was only answered positively by a few respondents. According to these considerations, we finally conclude that the measurement model is acceptable (Table 3).

The model fit of the estimated model is also acceptable ($SRMR_{estimated} = 0.0591$ HI95 value = 0.0631), and less than 0.08. To assess the structural model, we can examine the explanatory power (R^2) of the endogenous variables. While the $R^2_{FIES} = 19.45\%$ and the $R^2_{DEPRESSION} = 12.72\%$ implies a rather small explanatory power, explaining a smaller proportion of the variance within these constructs by perceived inflation affect is still an important and significant finding (Supplementary 3).

The significance of the sub hypotheses (H2a, H2b, H2c) is examined by a bootstrapping approach with 5000 resamples and all assumed direct relationships are supported. The perceived inflation affect has a significant and positive direct effect on the food insecurity ($\beta_{PERCEIVED\ INFLATION - FIES} = 0.4428, p < 0.0000$) and on the depression level of participants ($\beta_{PERCEIVED\ INFLATION - DEPRESSION} = 0.1715, p < 0.0006$). Furthermore, we also found that food insecurity has a direct positive effect on the depression level ($\beta_{FOOD\ INSECURITY - DEPRESSION} = 0.2511, p < 0.0000$). There is also a significant positive and indirect effect ($\beta_{PERCEIVED\ INFLATION - FOOD\ INSECURITY - DEPRESSION} = 0.1112, p < 0.0000$). Accordingly, there is a complementary partial mediation because the direct and indirect effects are both significant and positive. The VAF value (which is the extent to which the mediation process explains the dependent variable's variance) shows the ratio of the indirect effect to the total effect in the case of complementary mediation. According to the results, it is 39.34%, and this means that food insecurity mediates the relationship between high inflation effect and depression and this mediation can be considered as an important aspect of causing higher depression levels. The effect sizes (f^2) of perceived inflations and food insecurity levels effect on depression can both be considered rather weak effects (< 0.02). While the effect of perceived inflation on food insecurity is stronger ($f^2 = 0.24$).

To perform a robustness test, we have also used a covariance-based SEM approach in SmartPLS. We first performed a confirmatory factor analysis (CFA) to test the measurement model. As part of this analysis, the factor loadings were assessed

for each item. While we found three items with levels lower than 0.5 (“SLOWORFAST” item (DEP8), “SELFHARM” item (DEP9) and “SKIPPED” item (FIES)), all other loadings exceeded our criteria. The scales used for food insecurity and depression are validated scales and all items are needed to calculate the results when using them. The overall goodness of model-fit was measured, and we could accept the model based on the common acceptance levels of $CMIN/df = 2.246$; $GFI = 0.938$; $CFI = 0.935$; $TLI = 0.925$; $SRMR = 0.045$ and $RMSEA = 0.049$ values (Dash & Paul, 2021). The construct reliability was assessed using Cronbach Alpha and Composite Reliability (ρ_c). For each construct, these were above 0.7 (Cronbach's $\alpha_{FIES} = 0.836$ and Cronbach's $\alpha_{DEP} = 0.817$; $CR_{FIES} = 0.840$ and $CR_{DEP} = 0.823$). Discriminant validity was also established according to the Fornell and Larcker Criterion and the HTMT ratio.

The results of the structural model in a CB-SEM approach are similar to the PLS-SEM results. The squared multiple correlation was 0.118 for food insecurity and 0.237 for the depression level. This shows that 11.8% variance in food insecurity is accounted by perceived inflation effect. Furthermore, 23.7% of variance in the depression level of Gen Z students is accounted by perceived inflation affect and food insecurity. The impact of perceived inflation on food insecurity ($b = 0.487$; $t = 12.882$; $p < 0.000$) and depression ($b = 0.127$; $t = 2.239$; $p = 0.025$) was positive and significant. In addition, the direct relationship between food insecurity and depression level was also positive and significant ($b = 0.264$; $t = 4.148$; $p < 0.000$). Finally, the indirect effect of perceived inflation on depression mediated by food insecurity was also positive and significant ($b = 0.129$; $t = 3.836$; $p < 0.000$).

Contrasting food insecurity among genders. Our results confirm that there is a difference between men and women in terms of most of the FIES items such as “HEALTHY”, “FEWFOOD”, “ATELESS”, “RUNOUT”, “HUNGRY” and “WHLDAY”. The results also highlight that worrying about not having enough food to eat (“WORRIED”) and skipping a meal (“SKIPPED”) were not significant. To compare the proportional differences in terms of food insecurity between men and women, we have applied an Independent-Samples Proportions Wald (H_0) Test (Table 4).

To assess and compare the effect of inflation on food insecurity among men and women, we created the categorical variable to differentiate food secure (all 8 items are answered with a NO),

Table 4 Independent samples proportions Wald (H_0) Test between men and women.

Independent-Samples Proportions Tests								
	Man		Woman			Z	Significance	
	N	Percent	N	Percent			One-Sided p	Two-Sided p
WORRIED	38	14.00%	43	17.50%	not significant	−1.08	0.14	0.28
HEALTHY	38	14.00%	57	23.20%	Significant	−2.682	0.004	0.007
FEWFOOD	54	19.90%	74	30.10%	Significant	−2.672	0.004	0.008
SKIPPED	12	4.40%	15	6.10%	not significant	−0.852	0.197	0.394
ATELESS	71	26.20%	87	55.10%	Significant	−2.26	0.012	0.024
RUNOUT	29	10.70%	46	18.70%	significant	−2.579	0.005	0.01
HUNGRY	17	6.30%	28	11.40%	Significant	−2.058	0.02	0.04
WHLDAY	16	5.90%	27	11.00%	Significant	−2.086	0.019	0.037

Source: Authors' own calculations and analysis.

moderate (maximum 3 YES answers) and severe (4 or more YES answers) food insecurity. The Chi-squared test showed significant results in both cases ($\chi^2_{\text{MAN}} = 40.902$; $p < 0.001$ and $\chi^2_{\text{WOMEN}} = 81.920$; $p < 0.001$). By comparing the Cramer's V values, we found, in the case of women, that there is a stronger positive relationship (Cramer's $V_{\text{MEN}} = 0.275$ and Cramer's $V_{\text{WOMEN}} = 0.275$).

In terms of the adjusted standardized residual comparison, we can see that the extreme inflation perceptions for both women and men are overrepresented with a higher difference in case of women. In the case of moderate food insecurity, however, women are overrepresented while displaying a strong perceived inflation affect (Supplementary 4). It is also evident that women in our sample were more adversely affected by food insecurity than their male counterparts. Women answered “Yes” more than men in all the eight questions. This disparity is the most pronounced in the severe questions such as “RANOUT”, “HUNGRY”, and “WHLDAY”.

Contrasting PHQ-9 results among genders. To compare the proportional differences in terms of depression scale items between men and women, we have applied an Independent-Samples Proportions Wald (H_0) Test (Supplementary 5) The results confirm that there is a significant difference between men and women regarding the questions about poor appetite, feeling bad about yourself, letting yourself or your family down, and trouble concentrating (particularly studying). We can state, therefore, that women, more often than men, feel bad about themselves, think that they are a failure or have let their family down and experience difficulties concentrating on activities such as studying or performing daily activities.

In the case of women, we find more significant differences due to the impact of inflation on depression. In particular, the items “DEPRESSED”, “SLEEPLESS”, “POORAPPETITE”, “FAILURE” and “SLOWORFAST” are all more positively influenced by inflation when looking only at women within the sample. Men, on the other hand, show significant differences due to inflation regarding feeling depressed or feeling like a failure. It is also important to mention that the Cramer's V values in the cases of significant differences are always higher in the women's subsamples.

Discussion

This study explores the impact of inflation-induced food insecurity on the mental well-being of Gen Z university students in Hungary, offering important insights into the challenges faced by youth in emerging European economies in Central Eastern Europe (CEE). Our findings confirm that high inflation exacerbates

food insecurity, leading to significant mental health distress, with female students disproportionately affected. This research contributes to understanding the complex intersection between economic instability, food insecurity, and mental health outcomes in high-inflation, low-social-protection contexts. While the relationship between food insecurity and mental health has been well-documented in Western economies, this study provides one of the first empirical assessments of its psychological consequences in emerging European economies in Central Eastern Europe (Jones, 2017; Maynard et al. 2018).

Inflation's Impact on Food Insecurity. Our results indicate that over 90% of students reported being affected by inflation to some degree, with 30.8% experiencing a strong effect and 4.8% reporting an extreme effect. Although overall household budgets remained relatively stable, the proportion allocated to food purchases increased significantly. This aligns with previous research showing that perceived inflation pressure among Gen Z students can trigger depressive symptoms even in students whose absolute income did not change (Zamanzadeh et al., 2024). It is also the case that during inflationary periods, food expenditures take up a larger share of household budgets, particularly in emerging economies (Hymans, 1975; Chua & Tsiaplias, 2024; Molnár & Hajdu, 2024). The high prevalence of food insecurity (45.6%) among Hungarian students is comparable to a similar study in Turkey and notably higher than recent studies conducted in Spain, Germany, and Portugal (Table 5). These comparisons underscore the severity of inflation-driven food insecurity in Hungary, where price shocks have drastically altered food access patterns in a short time frame. These findings suggest that emerging European economies in Central Eastern Europe experience intensified food insecurity due to weaker economic protections, reinforcing the economic precarity theory (Standing, 2011) and clearly confirm Hypothesis 1. This trend aligns with studies indicating the disproportionate impact of inflation on low-income populations (Causa et al. 2022; Grunert et al. 2023).

Food insecurity and mental health outcomes. We found a significant link between inflation, food insecurity, and depression, with 22.8% of students experiencing mild depression, 43.3% moderate depression, and 12.76% severe depression (Supplementary 6). These results align with existing literature linking food insecurity to mental health distress (Pryor et al., 2016; Raskind et al., 2018), but this study highlights that economic instability, particularly in emerging economies, intensifies these mental health risks. This emphasizes the need for targeted interventions in countries like Hungary, where inflation intensifies food insecurity and mental health challenges. Studies have

Table 5 FIES Score Comparisons with Similar and Recent University Studies.

Article	Country	Date	n	Overall ^a	Moderate	Severe
<i>Inflation, food insecurity, and mental health: Generation Z's burden in emerging Europe</i>	Hungary	2024	517	45.6%	12.66%	2.6%
<i>Prevalence and Predictors of Food Insecurity among Students of a Spanish University during the COVID-19 Pandemic: FINESCOP Project at the UPV/EHU</i>	Spain	2023	422	22.9%	2.6%	0.7%
<i>Prevalence and predictors of food insecurity among university students – Results from the Justus Liebig University Giessen, Germany</i>	Germany	2023	626	27.5%	9.5%	0.9%
<i>Evaluation of food insecurity and its association with food consumption and some variables among college students</i>	Turkey	2023	1149	35.5%	13%	9.4%
<i>Food Insecurity Levels among University Students: A Cross-Sectional Study</i>	Portugal	2022	284	17.3%	2.1%	1.1%

^aOne of the eight FIES questions received a “Yes” answer.
Source: Own Data.

consistently shown that inflation and food insecurity exacerbate psychological distress, leading to higher rates of anxiety, depression, and stress-related disorders (Giorgi et al., 2020; Hossain, 2020).

Mediation effects of food insecurity. The PLS-SEM analysis provides strong statistical support for food insecurity as a mediator in the relationship between inflation and depression. Perceived inflation has a significant direct effect on food insecurity ($\beta = 0.443$, $p < 0.001$) and depression ($\beta = 0.172$, $p < 0.001$). Food insecurity also has a direct positive effect on depression ($\beta = 0.251$, $p < 0.001$). Furthermore, food insecurity mediates the relationship between inflation and depression, with an indirect effect of $\beta = 0.111$ ($p < 0.001$), accounting for 39.34% of the total effect. These findings contribute to financial stress theory by demonstrating that food insecurity acts as a crucial transmission mechanism linking inflation to psychological distress. The results also support economic precarity theory (Standing, 2011), highlighting how financial uncertainty increases chronic stress, which disproportionately impacts young adults transitioning to financial independence. The study's findings provide strong empirical support for these theoretical frameworks, showing that nearly 40% of the relationship between inflation and depression is explained by the mediating role of food insecurity.

Gender disparities in food insecurity and depression. Our findings confirm significant gender disparities in both food insecurity and depression outcomes. Female students reported higher food insecurity levels than their male counterparts, particularly in severe FIES categories related to households running out of food (18.7% vs. 10.7%) and being hungry but not eating (11.4% vs. 6.3%) and not eating for a whole day (11% vs. 5.9%) (Supplementary 7). The Independent-Samples Proportions Wald test showed significant gender differences across most FIES indicators, corroborating previous research that women are disproportionately affected by food insecurity (Jones, 2017; Maynard et al., 2018; Wattick et al., 2018). In terms of mental health, female students scored significantly higher on PHQ-9 depression measures (Supplementary 6). Among those classified as having severe depression, 60.6% of the sample were women. The most pronounced gender differences were observed in symptoms such as poor appetite, low self-esteem, difficulty concentrating, and feelings of failure. These results align with earlier studies that highlight women's increased vulnerability to the psychological effects of food insecurity (Hilal et al., 2024; Wattick et al., 2018; Spaid, Duff, 2009). Broader economic research consistently shows that women in emerging economies often face greater financial precarity, lower earnings, and higher caregiving responsibilities, exacerbating their vulnerability to inflationary shocks (Jones, 2017; Maynard et al., 2018).

Conclusion and future research directions

This study sheds light on how rising food prices, driven by inflation, have become a major source of emotional and psychological strain for Gen Z university students in Hungary. Young women, in particular, are feeling the burden more intensely, as our findings confirm what others have already shown: food insecurity is not just about having too little to eat, it is also about the constant emotional toll of worrying about reliable food access (Arenas et al., 2019; Grimaccia & Naccarato, 2020; Sze et al., 2021). Using well-established tools like the FIES and PHQ-9, and applying a structural equation modelling approach, we demonstrate that economic hardship is deeply intertwined with how students feel, function, and plan their futures.

At the same time, it is important to acknowledge the limits of this research. Our sample was drawn from just one university, which may not fully reflect the broader experiences of students across Hungary or the Central and Eastern European region (Lambie-Mumford, 2019). Since our data are cross-sectional and self-reported, we are also unable to draw conclusions about long-term effects or eliminate potential reporting biases (Bruening et al., 2017). These are important areas that future research should address.

Looking ahead, there is a clear need for studies that explore the long-term impact of inflation and food insecurity on students and how these challenges shape their mental health and well-being (Hook & Bogdanov, 2021). Comparing different national responses within the CEE region could help identify and share best practices (Winkler et al., 2017). Perhaps even more importantly, qualitative research is essential to bring these experiences to life showing how students actually experience food insecurity, how they cope, and how much faith they place in the institutions that are supposed to support them (Henry, 2017; Pourmotabbed et al., 2020; Hattangadi et al., 2019).

The policy implications are equally urgent. Universities and governments must move beyond short-term fixes and commit to building lasting, integrated support systems. On-campus solutions like subsidized cafeterias, meal pantries, or emergency aid programmes, combined with accessible mental health support, can make a real difference (Lambie-Mumford, 2019; Mussida & Patimo, 2020; Thibaut, 2023). National programmes also offer encouraging examples: France's €1 meals for students (Arenas et al., 2019), Poland's income-based subsidies (Lambie-Mumford, 2019), and Slovakia's targeted post-pandemic food access reforms (Global Child Nutrition Foundation Slovakia, 2021) all show what is possible when policy is designed around student needs.

In the end, supporting students through this crisis is not about helping them get by—it is about giving them the platform to thrive. Investing in their resilience today means investing in both the present and the future of an entire generation.

Data availability

The datasets generated during and/or analysed during the current study are available through the Zenodo repository, which may be accessed at <https://doi.org/10.5281/zenodo.15474698>.

Received: 12 February 2025; Accepted: 30 August 2025;

Published online: 30 September 2025

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Acknowledgements

We would first like to thank Corvinus University and the University of Pécs for supporting our research. A special thanks also goes to Professor Stuart Durrant, Dr. Balázs Sárvari, Dr. Bálint Blaskovics, and Dr. Éva Mikáczó, who introduced and administered our survey to their students. Finally, we would also like to thank the students who participated in the survey for their valuable time and insights. The authors received no financial support for the research, authorship, and/or publication of this article.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Dr. Kevin Jackson, Dr. Zita Kelemen and Dr. Ákos Nagy. The first draft of the manuscript was written by Dr. Kevin Jackson and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This study was conducted in accordance with the ethical standards of Corvinus University of Budapest and the principles outlined in the Declaration of Helsinki. Ethical approval was formally granted by the Research Ethics Committee of Corvinus University on November 21, 2024 (Reference No.: KRH/331/2024). We acknowledge that participant data collection began earlier, in November 2023, while the project was under internal consideration and departmental oversight. At that time, the study followed all established university protocols for minimal-risk, anonymous behavioural research. While the procedures had already been reviewed informally and considered appropriate within the institutional framework, due to an administrative lapse, the documentation had not been submitted through the official system at the time of initial review. Consequently, the formal registration process was completed at a later stage. The full study protocol was subsequently submitted without modification and approved by the Research Ethics Committee. To address the timing and ensure transparency, a formal letter of clarification was issued and signed by the Chair of the Research Ethics Committee, Prof. Dr. Tamás Bartus, on July 29, 2025. The letter confirms that the procedures used during data collection, including recruitment, consent, and data handling, were identical to those described in the final approved protocol (Supplementary 7). It also affirms that the data collected prior to final approval was retrospectively reviewed and deemed ethically consistent, and that the research project is considered fully ethically compliant and valid for publication.

Informed consent

All participants provided informed consent prior to beginning the survey. The consent process was delivered in both oral form (during in-class presentations by faculty) and written form on the first page of the anonymous online questionnaire. Participants were informed about the purpose of the study, the voluntary nature of participation, the absence of any risks, and the right to withdraw at any time without consequence. Informed consent was collected as part of the electronic survey, which was active between November 9th and November 27th, 2023. The study did not collect any personally identifying or sensitive information, and responses were stored securely and accessed only by the lead researchers. The procedures used for participant consent and data protection were fully aligned with the final approved protocol and were explicitly confirmed in the statement issued by the Corvinus University Research Ethics Committee.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-025-05858-w>.

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