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The Impact of Women's Empowerment on Infant and Young Child Feeding Practices: Key Dimensions and Mediating Channel in Nepal

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The Impact of Women's Empowerment on Infant and Young Child Feeding Practices: Key Dimensions and Mediating Channel in Nepal*

Sana Khan† Lucia Ferrone ‡

Abstract

The concept of women's empowerment has received a lot of recognition in the past few years and is considered an important factor in determining the nutritional outcomes of children. Nevertheless, there is a lack of evidence regarding the impact of women's empowerment on infant and young child feeding (IYCF) practices. This study examined the causal relationship between women's empowerment and IYCF outcomes by utilizing the most recent data from the Demographic and Health Survey (2022) conducted in Nepal. Women's empowerment is measured using a composite index that encompasses five domains: information access, healthcare access, asset ownership, decision-making autonomy, and attitude towards domestic abuse. Each of these dimensions was also analyzed separately to assess its impact on IYCF practices. The empirical strategy encompassed the Lewbel two-stage least squares method (I+E) as the primary methodology. The findings indicate a positive relationship between the overall women's empowerment score and minimum meal frequency, minimum acceptable diet, and iron-rich foods. Specifically, the information access dimension has a positive relationship with the minimum acceptable diet and iron-rich foods. The decision making autonomy dimension is positively related to the minimum meal frequency, vitamin-A rich foods, and iron-rich foods. The attitude toward domestic violence dimension indicates a positive relationship with minimum dietary diversity, minimum acceptable diet, and vitamin-A rich foods. Further analysis also suggests that women's empowerment has an indirect effect on IYCF practices, specifically through mother's education. It has a substantial positive impact on minimal dietary diversity, a minimum acceptable diet, and vitamin A rich foods. Interventions aimed at enhancing IYCF practices in Nepal should prioritize women's empowerment strategies. In particular, focus on key areas such as decision-making autonomy, access to information, and shaping women's attitudes towards domestic violence. Likewise, it is also necessary to comprehend the indirect impact of a mother's education on these child nutritional outcomes.

Keywords: infant and child feeding practices, women's empowerment, Lewbel estimation method, mediation analysis
JEL classification: I15, I25, O15

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1. Introduction

Infant and young child feeding (IYCF) is recognized as a crucial aspect in enhancing child survival and fostering optimal growth and development (Prudhon, Benelli, Maclaine, Harrigan, & Frize, 2018; Marriott, White, Hadden, Davies, & Wallingford, 2012; Menon, 2012; Sinhababu, Mukhopadhyay, Panja, Saren, Mandal, & Biswas, 2010; UNICEF, 2009). There is a significant relationship between the nutritional quality of food and the overall wellness and health of children, particularly in the first two years of life[1] (Black et al., 2008) when require adequate nourishment to reach their maximum potential in terms of both their physical and mental capabilities (Benjamin Neelon, Briley, & American Dietetic Association, 2011). During the crucial age of 6-23 months, when complementary food is introduced and the child begins to consume home food, childhood malnutrition[2] becomes a concern (Mitchodigni et al., 2017). On the other hand, inadequate complementary feeding practices in the first two years of life can have serious consequences. These include gastrointestinal infections, stunted physical growth, impaired cognitive development, delayed milestones, decreased productivity, and a higher chance of illness and death related to malnutrition, accounting for over two-thirds of cases (Jones et al., 2014; Black et al., 2013; Khanal, Sauer, & Zhao, 2013; Martins et al., 2011)[3]. Thus, implementing proper infant and young child feeding practices is important.

In light of this, the Convention on the Rights of the Child acknowledges that every infant and child possesses the right to get adequate nutrition (Jonsson, 1996). This fundamental right has also been articulated in the Sustainable Development Goals (SDGs)[4]. In order to achieve the SDGs, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) suggest the incorporation of nutritionally sufficient and safe complementary (solid, semi-solid, or soft) foods for children starting from six months of age, while also continuing breastfeeding until the child reaches two years of age or beyond (UNICEF, 2016). Therefore, the World Health Organization developed the infant and young child feeding

[1]Effective IYCF practices have a direct impact on improving child nutrition outcomes.

[2]Malnutrition can occur when a child's nutritional intake and needs are not properly balanced (Maleta, 2006).

[3] Complementary feeding practices can significantly reduce the number of under-five deaths by almost 19% (UNICEF, 2009).

[4]One of the objectives of SDGs developed by United Nations is to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture (Goal #2), while ensuring healthy lives and promoting wellbeing for all at all ages is another objective of Sustainable Development Goal (Goal # 3).

practices indicators[5] along with their measurement methods with the goal of enhancing and safeguarding, advocating for, and providing assistance for the best possible feeding practices for infants and young children (UNICEF, 2016).

It is also worth noting that in many low- and middle-income countries (LMIC), only a small number of children have access to nutritionally adequate and safe complementary food. It is frequently provided with insufficient nutritional value, either too early or too late in inadequate amounts, or not given in an optimal manner (Olatona, Adenihun, Aderibigbe , & Adeniyi , 2017). Further, children at a young age continue to rely on elderly people for the intake of their food. Women are the primary caregivers for younger children in the majority of households and societies, and are therefore responsible for the complementary practices of infants and young children (Elliott & Bowen, 2018; Moreira et al., 2016; Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). Nevertheless, women with fewer privileges face greater challenges in obtaining the knowledge and abilities necessary to adhere to the highest standards of care (Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). The status of women is interconnected with their autonomy, authority, and health both inside their households and society (Fielding & Lepine, 2017; Herforth, Anna, & Harris, 2014). Empowerment is the capacity to exercise agency, enabling individuals to exercise autonomy in decision-making and to establish objectives and actively pursue them, particularly in the face of opposition (Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). Women's empowerment (WE) is exemplified by their ability to make decisions and is reinforced by their control over various resources[6], including economic, human, social, and legal resources (Na, Jennings, Talegawkar, & Ahmed, 2015). Access to these resources enables individuals to make informed decisions regarding purchasing, healthcare, family planning, and other related matters (Heckert, Olney, & Ruel, 2019). Prior studies have demonstrated a significant association between women's empowerment and the nutritional status of children (Santoso, Kerr, Hoddinott, Garigipati, Olmos, & Young, 2019; Siddhanta & Chattopadhyay, 2017; Cunningham et al., 2015), as well as the importance of appropriate infant and young child feeding practices for children's nutritional well-being (Santoso, Kerr, Hoddinott, Garigipati, Olmos, & Young, 2019) and highlighted its role in promoting effective nutritional practices (Jones, Haardörfer, Ramakrishnan, Yount, Miedema , & Girard, 2019). However, there is a limited amount of research that has examined the impact of women's empowerment on IYCF practices. Thus, it

5Details of infant and young child feeding practices can be obtained from World Health Organization website. It is accessible online at https://iris.who.int/handle/10665/340706

6A caregivers require particular resources to ensure optimal care for her children, including appropriate knowledge and expertise, independence, sufficient time, and social assistance (Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003).

raises the need for additional research to determine if empowered women will lead to better IYCF practices. The current research seeks to investigate this knowledge gap using the context of Nepal.

Despite the fact that Nepal[7] has experienced significant progress in reducing child undernutrition in recent years, the country still faces a considerable challenge due to poor infant and young child feeding practices. Various previous studies have highlighted this issue[8] (Cunningham, Headey, Singh, Karmacharya, & Rana, 2017; Headey & Hoddinott, 2015). According to the Nepal Demographic Health Survey (NDHS) conducted in 2022, the prevalence of minimum dietary diversity, minimum meal frequency, minimum acceptable diet, vitamin-A rich food, and iron rich food was 48%, 82%, 43%, 59%, and 36% among the children under the age of 6 to 23 months (Ministry of Health and Population, 2023). Additionally, Nepal's position was 96th out of 146 countries on the Global Gender Gap Index in 2022, indicating a significant gap in gender equality (Pal, Piaget, Baller, Ratcheva, & Zahidi, 2022). Finally, previous studies conducted in this country have primarily examined the relationship between women's empowerment and various factors such as their health and reproductive outcomes, child wellbeing (including education, vaccination rates, and anemia), socioeconomic status, and nutrition information related to child feeding (ROSSI, 2023; Panday, 2020; Kulkarni, Frongillo, Cunningham, Moore, & Blake, 2020; Ghimire, 2019; Tuladhar, Khanal, K.C., Ghimire, & Onta, 2013). However, the relationship between women's empowerment and specific IYCF practices is still not well-defined. Thus, this study will analyze the causal relationship between the empowerment of women and IYCF practices in Nepal, addressing the following questions:

1. Does the empowerment of women have an impact on infant and young child feeding practices?
2. If yes, what dimensions of women's empowerment matter for infant and young child feeding practices?
3. Does women's empowerment have a differential impact on infant and young child feeding practices depending on the type of household head and area of residence ?
4. Does maternal education play a mediating role in the relationship between women's empowerment and infant and young child feeding practices?

[7]The Nepalese government has formulated and executed various legislation, policies, initiatives, and programs with the aim of enhancing infant feeding practices (Karn, Devkota, Uddin , & Thow , 2017).

[8]The Ministry of Health and Population considers IYCF a top priority plan. Although the program was expanded to all districts of Nepal, the practices related to infant and young child feeding continue to be inadequate (Hanley-Cook, Argaw, Dahal, Chitekwe, & Kolsteren, 2022).

This study contributes to the existing research by employing several methodologies to address the previously mentioned questions. Primarily, the majority of previous research focuses on analyzing the correlation between women's empowerment and child nutritional outcomes. However, these studies do not identify the factors that contribute to childhood malnutrition, specifically the inappropriate feeding practices among infants and young children. It is important to note that proper feeding is essential in reducing the prevalence of stunting, wasting, and overweight among children under the age of 2 years (Matvienko-Sikar et al., 2018; Hunsberger et al., 2013; Marriott, White, Hadden, Davies, & Wallingford, 2012). Therefore, this study adds to the existing body of research by utilizing a rigorous approach and investigating the causal impact of women's empowerment on the practices of feeding infants and young children. Secondly, prior studies mostly examined either the effects of a specific definition of women's empowerment on child nutritional outcomes or explored the connections between women's empowerment in agricultural settings (Cunningham, Ruel, Ferguson, & Uauy, 2015; Malapit & Quisumbing, 2015). Measuring women's empowerment in practice has been challenging due to the diverse definitions of empowerment, which span from employment and social networks to decision-making on various themes (Richardson, 2018; Yount, Peterman, & Cheong, 2018). Moreover, there have been inconsistencies found in the literature about the measurement of women's empowerment, mostly due to the diverse variations in the measurement of women's empowerment (Cunningham, Ruel, Ferguson, & Uauy, 2015). This study utilizes the various dimensions of women's empowerment as defined in the Demographic and Health survey (DHS) data and investigates the impact of such dimensions on complementary feeding practices among young children. Thirdly, previous research has not specifically examined the potential variations in the impact of women's empowerment on infant and young child feeding practices based on factors such as the type of household headship and the place of residence. We enhance the existing literature by conducting supplementary analysis on this aspect as well. Finally, prior research mostly concentrated on determining the direct impact of women's empowerment on supplemental feeding methods. Nevertheless, there are indirect effects that occur through diverse mechanisms. There is a scarcity in the existing literature about the identification of the specific mechanisms through which the empowerment of women influences the health outcomes of children. Therefore, we enhance the existing body of knowledge by conducting a causal mediation analysis to determine the influence of women's empowerment on infant and young child feeding practices through an indirect pathway.

2. Conceptual framework of the study

2.1. The notion of empowerment

Empowerment is a concept that encompasses various dimensions and is not easily defined. Individuals can experience varying levels of empowerment or disempowerment in various aspects of their lives, which we refer to as dimensions. It is defined as enabling individuals who have been deprived of the opportunity to make important life decisions to gain the capability to do so (Kabeer, 1999). The process entails a transition from a state of limited options to one where options are actively chosen. Significantly, it demonstrates agency, which refers to the capacity to establish one's objectives and take action towards achieving them, in significant aspects of life (Kabeer, 1999). Decisions pertaining to crucial life choices have enduring effects on an individual's life trajectory and welfare, encompassing areas such as education, reproductive health, and economic opportunities. Exercising authority over important decisions in an individual's life plays a crucial role in achieving and safeguarding one's own human rights. Further, having the capacity to make strategic life choices across different dimensions reflects a person's capabilities. The term capabilities refers to the various ways individuals may articulate themselves and engage in different aspects of their lives that hold significance to them (Nussbaum, 2003). In addition, the empowerment process relies heavily on an individual's capacity to access and exert control over resources. The study conducted by Kabeer (1999) stated that resources are considered essential prerequisites for the exercise of agency. The term "resources" is used in a broad sense to include various types of assets. These assets can range from economic or financial resources, such as income and ownership of assets, to human and social capital, time, and information. Individuals who are more empowered are more likely to have resources available to them. Access to these resources for an individual is influenced by the political, economic, legal, and socio-cultural environment in which they are situated. This concept is defined as an individual's supportive opportunity structure, which refers to the formal and informal institutions, such as laws, regulatory frameworks, and norms, that establish and shape people's behaviors (Alsop & Heinsohn, 2005). The existence and enforcement of both formal and informal regulations, laws, customs, and norms play a crucial role in determining the access of individuals and groups to assets, as well as their ability to utilize these assets to accomplish their objectives (Alsop & Heinsohn, 2005).

2.2. Women's empowerment and its dimensions

The concept of women's empowerment focuses on the objective of providing women with equal access to their rights and enabling them to exercise those rights to their fullest extent. For a country to achieve overall

development, it is essential to establish equal opportunities for both men and women. Enhancing women's access to social, economic, cultural, and political resources is necessary for achieving this goal. Empowerment necessitates granting individuals the autonomy and ability to govern their own lives and exercise their rights. Women's empowerment refers to the capacity of women to exercise agency and influence in matters that hold significance for them and their families (Tandon, 2016). Various stakeholders, including government agencies, development partner organizations, civil society, women's groups, and other voluntarily created organizations, support the achievement of gender equality in decision-making processes.

Although numerous definitions of women's empowerment have been proposed, there is no standardized definition. In fact, it is characterized as a multidimensional concept that varies by context. Measuring women's empowerment in practice presents challenges in terms of measurement (Lombardini, Bowman, & Garwood, 2017) and in determining the appropriate standard of aggregation for each domain of empowerment. According to Santoso et al., (2019), researchers need to make certain that their classification of a dimension takes into account all relevant indicators while avoiding disguising the differential contributions of specific indicators of empowerment. In addition, empowerment in one dimension does not necessarily guarantee empowerment in another dimension. As a result, it is possible that achieving empowerment in one dimension or indicator is simpler than achieving empowerment in another dimension or indicator altogether (Santoso et al., 2019).

The conceptual model[9] depicted in Figure 1 illustrates the various dimensions of women's empowerment. The model we have developed is based on previous literature[10] and proposes that women's empowerment, as measured across five dimensions, has an influence on infant and child feeding practices (see Figure 1). The indicators and dimensions that are chosen in this study are based on the criteria that they had to have been used in previous research as a measure of empowerment. Also, there had to be a theoretical justification. The dimensions of women's empowerment[11] that are explored in this study are as follows: (1) the ability to

[9]The model integrates the dimensions of empowerment discussed in Sub-Section 2.1., wherein agency, resources, and opportunity structure synergistically contribute to the development of women's capabilities.

[10]The women's empowerment dimensions are assessed as implicit concepts by utilizing observed indicators from the DHS. In order to model the relationship between women's empowerment and complementary feeding practices, we conducted a review of the previous empirical research and analyzed DHS data to identify relevant indicators and empowerment dimensions that would be included in our model. The study identified indicators and dimensions that assess both decision-making ability (a direct measure of agency) and women's access to resources that contribute to women's agency and empowerment.

[11]Table 1 provides further information on each indicator and dimension.

access information, (2) the ability to access healthcare, (3) the ability to own assets. (4) the ability to make household decisions, and (5) the refusal to domestic violence.

Dimension 1: Women require access to information in order to make well-informed decisions regarding the health, feeding practices, nutrition, and overall wellbeing of their children. Mass media campaigns have the ability to spread clearly defined messages to vast groups of people. Prior research indicates that the utilization of mass media, such as reading newspapers, watching television, and listening to the radio, plays a crucial role in changing the behavior of individuals. It has been demonstrated to have a positive impact on women's health-related knowledge and attitudes, and has the power to influence gender norms in conjunction with technological advances and social media (Chandra-Mouli et al., 2017; Peltzer & Promtussananon, 2003). Previous literature shows that mass media campaigns have the ability to generate favorable modifications or hinder unfavorable modifications in behaviors associated with health in large numbers of people (Wakefield , Loken, & Hornik, 2010).

Dimension 2: Women in the reproductive age group may encounter many obstacles to accessing healthcare, sometimes as a result of gender norms and disparities (Riddle et al., 2023). Accessing healthcare facilities effectively enhances adherence to appropriate childcare practices (Jones et al., 2020).

Dimension 3: Access to assets empowers women to achieve financial autonomy and gain control over their financial resources. Legal ownership involves the recognition and protection of individuals' property rights, including assets like land and houses. Safeguarding women's property rights is widely recognized as a means to enhance the welfare and well-being of their children (Na, Jennings, Talegawkar, & Ahmed, 2015).

Dimension 4: Decision-making power is commonly employed as a metric to assess agency. Women who possess a significant level of influence in determining how household income is allocated or in accessing healthcare services have the potential to be more capable of providing sufficient care for their children. The hypothesis is that by enhancing women's ability to negotiate for household resources, under a traditional division of labor, there will be positive effects on children's well-being (Kabeer, 1999). The increased influence of mothers allows them to allocate a greater portion of household resources towards enhancing child human capital outcomes, such as health and education. There is significant evidence to support the notion that increased control of income or wealth by women is linked to, and potentially responsible for, better outcomes for children in various developing regions (Posso, Smith, & Ferrone, 2019; Bonilla et al., 2017). The observed phenomenon may be attributed to variations in preferences between males and females

regarding the allocation of resources towards offspring. In addition, women may possess a higher level of proficiency in utilizing any allocated family resources to enhance child outcomes.

Dimension 5: Women's perspectives on domestic abuse are indicative of the extent to which they have assimilated detrimental gender norms. Previous research has utilized these markers to assess women's inherent ability to act (Jones et al., 2019; Miedema, Haardörfer, Girard, & Yount, 2018). Prior research has demonstrated a strong positive correlation between a wife's attitude towards domestic violence and the health outcomes of children (Singh, Haney, & Olorunsaiye, 2012).

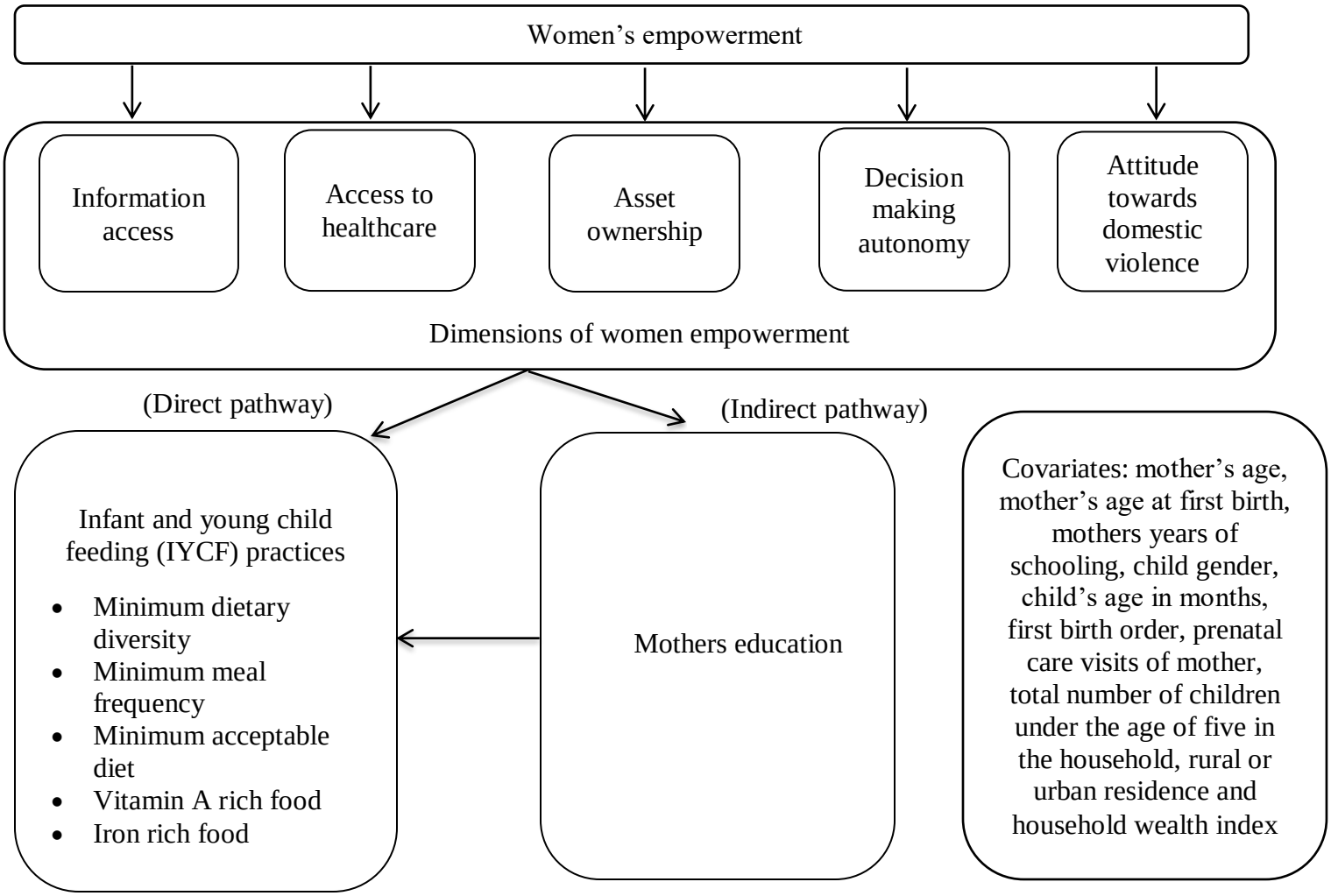
2.3. Link between women's empowerment and infant and young child feeding practices --- direct and indirect pathways

There is emerging evidence that suggests a mixed effect of women's autonomy on infant and young child feeding in various settings. The studies conducted in Ethiopia have indicated that mothers who participate in the decision-making process within the household are more likely to adhere to the recommended meal frequency (1.5 times) and dietary diversity (1.27 times) for their children, compared to children whose mothers do not participate (Kuche et al., 2020; Beyene, Worku, & Wassie, 2015). Additionally, a study in Uganda found that women who had more freedom in their movements were 1.69 times more likely to provide their children with the recommended dietary diversity (Ickes, Hurst, & Flax, 2015). The likelihood of improvement in children's dietary diversity score (DDS) and acceptable diet score is positively correlated with women's greater independence and financial capacity in certain sub-Saharan African regions (Ickes, Heymsfield, Wright, & Baguma, 2016; Na, Jennings, Talegawkar, & Ahmed, 2015). Other studies conducted in the same region have demonstrated a negative correlation between sociofamilial empowerment, which encompasses factors such as freedom of mobility, control over one's own health, attitudes towards domestic violence, and adherence to optimal infant and young child feeding practices.

Furthermore, it has been observed that there are indirect factors, such as the mother's education level, that are commonly linked to the improvement of IYCF practices in sub-Saharan Africa (Dagne et al., 2019; Biks, Tariku, Wassie, & Derso, 2018). Several studies have indicated a positive correlation between a mother's level of education and the adoption of minimum dietary diversity practices and appropriate complementary feeding practices (Dagne et al., 2019; Solomon, Aderaw, & Tegegne, 2017). Additional research conducted in South Asian countries has demonstrated that women with little to no education are significantly more likely to have poor dietary diversity, failure to meet the minimum meal frequency, and inadequate consumption of an acceptable diet according to the World Health Organization's recommendations (Senarath

et al., 2012; Ng, Dibley, & Agho, 2012; Patel, Pusdekar, Badhoniya, Borkar, Agho, & Dibley, 2012). The existing literature does not provide a definitive conclusion regarding the impact of women's empowerment on infant and young child feeding. Specifically, it remains unclear which dimensions of women's empowerment are most relevant in addressing inadequate feeding practices in infants and children.

Figure 1: Conceptual framework linking different dimensions of women's empowerment with infant and young child feeding (IYCF) practices



3. Data & methods

3.1. Data

We use data from the Nepal Demographic and Health Survey of 2022[12]. The DHS is a comprehensive survey, representative of the total country's population as well as the higher level of administrative division which is carried out in low- and middle-income countries once every five years. It is a cross-sectional data that gathers information on a vast array of health indicators and other subjects related mostly to women's and child health and well-being. The main sample is formed by women in reproductive age (15-19) and children under 5, but basic information is collected for all household members and at household level. The DHS data is appropriate for this analysis due to its extensive nature and its consistent inclusion of information regarding the demographic attributes of women, their household characteristics, factors related to women's empowerment, and the nutritional feeding practices of infants and young children. The analysis utilizes data from the children-recode data file (KR), which is combined with the individual women's recode data file (IR) and household member's recode data file (PR). This combination allows for the inclusion of information at both the mother and child levels. We focus on children aged 6 to 23 months because this is the age group which is recommended by the WHO to calculate the IYCF indicators. Our sample consists of 1,451 children between this age group. Further, the study sample exclusively consist of women aged 15 to 49 years who are either married or in consensual relationships (unions), as the questions regarding women's empowerment in the DHS were specifically directed towards these individuals. Unmarried women were excluded from questions regarding empowerment.

3.2. Measurement of variables

3.2.1. Women's empowerment

Numerous research studies have shown that women's empowerment is linked to the ability to access information, the ability to access health care, the ability to make household decisions, the refusal to domestic violence, and the ability to own assets (Riddle et al., 2023; Christian, Atiglo, Okyere, Obeng-Dwamena, Marquis, & Jones, 2023; Kulkarni, Frongillo, Cunningham, Moore, & Blake, 2020). In this study, we employed the standard DHS questionnaire to measure women's empowerment by focusing on five important dimensions:

[12]The study data is obtained from the DHS website, which is accessible online at http://www.dhsprogram.com/. A registration form has been completed, and a concise study proposal, specifying the intended use of the data set, has been submitted. Subsequently, authorization is granted to obtain the dataset.

1. The information access dimension explores factors that determine whether women have frequent exposure to media such as newspapers, television, and radio.
2. The access to health care dimension, which focuses on indicators that assess whether women have the autonomy to seek medical care and access financial resources for health care.
3. The asset ownership dimension measures women's capacity to access financial resources.
4. The decision-making autonomy dimension refers to the measurement of women's power in making decisions inside the household.
5. The attitude towards domestic violence dimension measures the extent to which women disagree with scenarios that justify hitting or beating a wife in cases of domestic violence.

Each dimension comprises various indicators that are combined to form a composite variable for each dimension. Next, a binary variable is created for each dimension of women's empowerment. This variable takes the value of 1 if the woman is empowered in that specific dimension, and 0 otherwise. Table 1 provides a comprehensive presentation of the specific dimensions and indicators of women's empowerment.

The analysis employs the five distinct dimensions of women's empowerment to evaluate their varying impact on infant and young child feeding behaviors in most of the models. Whereas, a composite variable that measures women's empowerment is also made by adding up the scores from each of the five domains of empowerment (information access, access to health care, asset ownership, decision-making autonomy, and attitude towards domestic violence) to get a score that goes from 0 to 19. This score is then also used to evaluate the impact of women's empowerment levels on infant and young child feeding practices. Higher scores indicate greater levels of empowerment.

Table 1: Description on dimensions of women's empowerment

Dimensions	Indicators included in each dimension	Description of each indicator	Description of each dimension
1. Information access	Media exposure: ➢ newspaper ➢ TV ➢ Radio	Dummy variable is equal to 1 if the women says that she regularly reads newspaper, watches television and listens to radio, or 0 otherwise for each indicator	Composite variable was obtained by summing women's responses and then dummy variable was generated, which was equal to 1 if women is empowered from media exposure (1-3) and 0 if women is not empowered (0)

2. Access to healthcare	No problem of: ➢ permission to go ➢ getting money ➢ distance to facility ➢ wanting to go alone	Dummy variable is equal to 1 if she responds that she has no big problem of permission to go, getting money, distance to facility, or wanting to go alone or, 0 otherwise for having a big problem for each indicator	Composite variable was obtained by summing women's responses and then dummy variable was generated, which was equal to 1 if women is empowered from having access to healthcare (1-4) and 0 if women is not empowered (0)
3. Asset ownership	Ownership of asset alone or jointly: ➢ Own a house ➢ Own land	Dummy variable is equal to 1 if she responds that she owns a house and land alone or jointly or 0 otherwise for each indicator	Composite variable was obtained by summing women's responses and then dummy variable was generated, which was equal to 1 if women is empowered from having asset ownership (1-2) and 0 if women is not empowered (0)
4. Decision making autonomy	Decision making either own or jointly with partner on: ➢ own health ➢ household purchases ➢ visits to family or relatives ➢ wife's cash earning ➢ husband's cash earning	Dummy variable equals 1 if she responds that she has decision making power either alone or jointly with partner on own health, household purchases, visits to family or relatives, wife's cash earnings, and husband's cash earnings, or 0 otherwise for each indicator	Composite variable was obtained by summing women's responses and then dummy variable was generated, which was equal to 1 if women is empowered by their participation in household decision making (1-5) and 0 if women is not empowered (0)
5. Attitude towards domestic violence	Not justified in hitting or beating his wife if she: ➢ burns food ➢ argues with him ➢ goes out without telling him ➢ neglects the children ➢ refuses to have sexual intercourse with him	Dummy variable equal to 1 if she responds that she does not agree that husband is justified in hitting or beating his wife if she burns food, argues with him, goes out without telling him, neglects the children and refuses to have sexual intercourse with him, or 0 otherwise for each indicator	Composite variable was obtained by summing women's responses and then dummy variable was generated, which was equal to 1 if women is empowered by disagreeing to the domestic violence scenarios (1-5) and 0 if women is not empowered (0)

Source: Each dimension is generated using the data from the Nepal Demographic and Health Survey 2022 (NDHS).

3.2.2. Infant and young child feeding (IYCF) practices

Five indicators of infant and young child feeding practices have been developed according to WHO guidelines: (1) minimum dietary diversity; (2) minimum meal frequency; (3) minimum acceptable diet; (4) vitamin A-rich food; and (5) iron-rich food. Indicators are detailed as follows:

1. The minimum dietary diversity serves as an indicator of the optimal amount of micronutrients in foods. Consuming food from a minimum of five[13] out of the eight food groups enhances the likelihood that the child will consume at least one food derived from animals and at least one fruit or vegetable, along with staple foods such as grains, roots, or tubers. The IYCF module in the DHS urged the respondent to indicate if the child consumed each specific food or beverage from a predetermined list within the past 24 hours before the time of survey. The dietary diversity score is calculated by adding positive responses for each food type.
2. The minimum meal frequency serves as a proxy for fulfilling energy needs. It is characterized by consumption of solid, semi-solid, or soft foods a minimum number of times in the preceding day. The minimum meal frequency differed depending on the age of the child and whether they had been breastfed. The particular details are provided in Table 2. In the DHS, a specific question was asked of the respondent on the frequency at which the child consumed solid, semi-solid, or soft food throughout the previous 24-hour period. The feeding frequency of infant formula, milk, and yogurt is evaluated using three questions. These frequencies are utilized to compute the total number of milk feedings.
3. The minimum acceptable diet is a comprehensive measure that takes into account both the minimum dietary diversity and the minimum meal frequency. It is defined variously for breast-fed and non-breast-fed children. It is necessary to provide infants and young children with a diet that meets their energy and nutritional needs. This diet should be provided at a reasonable interval and consist of a variety of foods. The details of this indicator are outlined in Table 2.
4. Consuming food that is rich in vitamin A is an important indicator of having sufficient micronutrients and is a significant factor in determining the quality of one's diet. Vitamin A deficiency of a severe nature can result in eye damage, exacerbate infections such as measles, and impede the process of

[13]The selection of the five dietary groups is made from a list of eight options, which include breast milk, cereals, roots, and tubers; legumes and nuts; dairy products (milk, yogurt, and cheese), flesh foods (meat, fish, poultry, and organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables.

recovery from illness. Foods rich in vitamin A support the prevention of vitamin A deficiency and reduce mortality rates in young individuals.

5. Iron-rich food is a reliable measure of having sufficient micronutrients and is a significant indicator of the overall quality of one's diet. Iron is a vital micronutrient that plays a crucial role in numerous biological processes. Iron deficiency is the main cause of anemia and a well-established factor that increases the risk of child mortality.

All five indicators are categorized as binary variables, which are considered as 1 if the child's feeding practice aligns with the WHO standard or 0 if the feeding practice does not satisfy the WHO recommendation.

Table 2: Definition of infant and young child feeding practices (IYCFP) indicators by WHO guidelines

Outcome variables	Age group		
	6-8 months	9-23 months	6-23 months
1. Minimum dietary diversity			food group score† ≥5
2. Minimum meal frequency • Breast-fed	No. of solid, semi-solid or soft foods ≥ 2		No. of solid, semi-solid or soft foods ≥ 3
• Non-breast-fed			No. of solid, semi-solid or soft foods or milk feeds‡ ≥4 and at least one of the feeds is a solid, semi-solid or soft food
3. Minimum acceptable diet • Breast-fed	No. of solid, semi-solid or soft foods ≥2	No. of solid, semi-solid or soft foods ≥3	food group score† ≥ 5
• Non-breast-fed			food group score§≥ 4, and No. of milk feeds‡ ≥2, and No. of solid, semi-solid or soft foods and milk feeds ≥4
4. Vitamin A rich food			Food group = food items rich in vitamin A (eggs, meat, pumpkin, carrots, squash, dark green leafy

		vegetables, vitamin A rich fruits, liver, heart, other organs, fish and shellfish)
5. Iron rich food		Food group = food items rich in iron (eggs, meat, liver, heart, other organs, fish and shellfish)

Source: Each outcome variable is generated using the data from Nepal Demographic and Health Survey 2022 (NDHS). All outcome variables are measured for the children, whose age range between 6 to 23 months.

†Food group score is calculated based on consumption of five out of eight food groups: breast milk; cereals, roots, and tubers; legumes and nuts; dairy products (milk yogurt, cheese); flesh foods (meat, fish, poultry, and organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables

‡Milk feeds are consumption of infant formula, milk, such as tinned, powdered or fresh animal milk, and yoghurt.

§Food group score is calculated based on consumption of four out of seven food groups, excluding dairy products, to avoid double counting of this food group in non-breast-fed children.

3.3. Empirical framework and strategy

This study uses a basic Probit regression model initially to evaluate the relationship between women's empowerment, including its various dimensions, and infant and young child feeding practices. The model's estimation is presented below:

$$IYCF_{ij} = \alpha + \beta_1 WE_{kj} + \sum_i \beta_2 \mathrm{K}_{ij} + \sum_k \beta_3 \mathrm{M}_{kj} + \sum_j \beta_4 \mathrm{H}_j + \sum_j \beta_5 \mathrm{P} + \varepsilon_{ij} \quad (1)$$

Where $IYCF_{ij}$ represents the infant and young child feeding practices of child *i* in household *j*, including minimum dietary diversity, minimum meal frequency, minimum acceptable diet, consumption of vitamin A rich and iron rich foods. Each of these indicators is examined separately in this study. The variable is assigned a value of 1 if the child meets the criteria for a given indicator and 0 otherwise. The variable WE_{kj} is the women's empowerment score and its dimensions for women *k* in household *j*. The variables *K*, *M*, and *H* denote the vector of characteristics for child *i*, mother *k,* and household *j*. These characteristics include the child's gender, child's age in months, first birth order, mother's years of schooling, mother's age, mother's age at first birth, prenatal care visits of the mother, the total number of children under the age of five in the

household, and the household wealth index[14]. The variable P represents the area of residence (rural or urban residence). ε_{ij} is a random disturbance error term. $\beta's$ denotes the coefficients of regressors and α represents the constant term. In addition, we utilized a clustering technique to group the standard errors at the enumeration area level, effectively accounting for any potential within-group error correlations. The estimates obtained from Equation (1) are potentially susceptible to omitted variable bias, which results in our estimate being endogenous. Hence, it is probable that there are unobservable factors that may be associated with both women's empowerment and infant and young child feeding practices. This correlation has the potential to introduce bias into our estimations and impact the generalization of the study findings.

In order to address the problem of endogeneity, we employed a variety of econometric methods. First, we adopt the main analysis specification recommended by Lewbel (2012), which proposes the implementation of a two-stage-least squares (2SLS) technique (Lewbel, 2012). According to Lewbel (2012), the instruments are created by taking into account the heteroskedasticity in the error terms. These instruments can be utilized when there are no valid instrumental variables (IVs) available, or they can be used in conjunction with valid external IVs (Lewbel, 2012). The Lewbel (2012) approach is described below:

$$Y_1 = X'\beta + Y_2\gamma + \varepsilon_1 \quad (2a)$$

$$Y_2 = X'\alpha + \varepsilon_2 \quad (2b)$$

Where Y_1 signifies our outcome variable (infant and young child feeding practices); Y_2 represents the endogenous variable, women's empowerment; X' is the vector of control variables that are exogenous whereas ε_1 and ε_2 represents the error terms that may be correlated. Conventional instrumental-variables estimation relies on the presence of a variable X in the Y_2 equation but not in the Y_1 equation and utilizes that excluded regressor as an instrument for Y_2. The problem at this point is that possibly no element of X is omitted from the Y_1 equation, or, in other words, we cannot be certain that any element of β is zero. Thus, Lewbel (2012), provides a method for identification and an equivalent simple linear two-stage least-squares estimator for β and γ in the above mentioned Equation (2a), where no element of X can be used as an excluded instrument for Y_2. The approach involves constructing valid instruments for Y_2 by using the information present in heteroskedasticity of ε_2 (Baum & Lewbel, 2019; Lewbel, 2018; Lewbel, 2012; Lewbel, 1997).

[14]In order to prevent collinearity with some indicators of women's empowerment, such as owning house and land, the wealth index is recalculated by excluding these variables and using principal component analysis. The wealth index is divided into terciles- low/poor, medium/middle and high/rich (Rutstein & Johnson, 2004).

Thus, the model is established by having some standard assumptions about the regression method. Initially, β and γ are considered as fixed constants, indicating that if Y_2 is a treatment measure, then treatment effects are considered homogenous. Additionally, we consider the standard exogenous assumption for X that E ($X\,\varepsilon_1$) = 0, E ($X\,\varepsilon_2$) = 0 and E(XX') is nonsingular. Then, in order to apply the Lewbel (2012), estimator, it is necessary to make the additional assumptions that Cov (**Z**, $\varepsilon_1\varepsilon_2$) = 0 and Cov (**Z**, ε_2^2) $\neq$ 0, where either **Z** = X or **Z** is a subset of an element of X. In this manner, the Lewbel (2012), estimator can be presented as a two-step process. First, obtain an estimate of $\hat{\alpha}$ by applying an ordinary least- squares linear regression of Y_2 on X. Then, calculate the estimated residuals $\widehat{\varepsilon_2}$ by subtracting $X'\hat{\alpha}$ from Y_2 ($\widehat{\varepsilon_2} = Y_2 - X'\hat{\alpha}$). Second, consider **Z** as some or all of the elements of X (excluding the constant term). Obtain estimates for β and γ by the standard linear two-stage least squares estimation method of Y_1 on X and Y_2, using X and (**Z** - $\overline{\mathbf{Z}}$) $\widehat{\varepsilon_2}$ as instruments, where $\overline{\mathbf{Z}}$ represents the sample mean of **Z**. The basic assumption of this method is that there must be no relationship between the regressors and heteroscedastic errors (Baum & Lewbel, 2019; Lewbel, 2018; Lewbel, 2012; Lewbel, 1997).

The Lewbel (2012), approach makes it possible to combine internal and external instrumental variables, resulting in three distinct estimating approaches: external instruments (E), internal instruments (I), and both internal and external (I+E). In this study, the external instrument is a binary variable that takes the value of one if the woman believes she is justified in declining to engage in sexual activity with her husband because she feels tired or is not in the mood (justification for not having sex). This variable is expected to explain women's empowerment in the household in a direct manner by emphasizing a key element of the couple's relationship, but it may not have the same direct effect on the mother-child relationship. Almost 90.1% of the women in the sample answered yes to this question.

The Lewbel (I+E) method is our preferred methodology as it provides over identification of the first stage equations and enables us to generate tests to verify the validity of instruments[15]. In order to ensure the

[15]Lewbel methods over identify the first stage equation, enabling us to estimate Hansen J tests for the validity of the instruments. The p-value for a Hansen J test of the instruments indicates the validity of the instrument set. If the p-value for a Hansen J test is greater than 0.10, it indicates that we do not accept the null hypothesis and that the instrument set is considered to be valid (Posso, Smith and Ferrone, 2019) and suggest a stronger case for the validity of the instruments. The results obtained from this empirical method are interpreted as causal if the coefficient estimate for a variable is statistically significant and the regression model also satisfies the Hansen J test.

robustness of our estimates, we additionally provide results[16] from Lewbel (I) method and propensity score matching technique (PSM). Every method has its own set of advantages and disadvantages[17].

The main Lewbel 2sls (I+E) model also takes into account possible heterogeneity in the impact of women's empowerment on infants and young child feeding practices based on the area of residence (urban/rural) and household headship structure (female /male headed household). In addition, women's empowerment has a significant impact on infant and young child feeding practices through various channels, as previously mentioned (Section 1). The estimate is often biased if the indirect effect is ignored (MacKinnon, Coxe, & Baraldi, 2012). To account for this, we conducted a causal mediation analysis to calculate the total effect, direct effect, and indirect effect. In order to establish a formal approach, we have used the notation M_{ij} which denotes the potential mediating variable. This variable represents the value of the mediator for an individual i who is affected by the treatment (i.e., women's empowerment in this case). Then, $IYCF_{ij}(WE, M_{ij})$ denote the potential outcome for the individual i if the treatment and mediator are set to WE and M_{ij}, respectively. The causal mediation effect for individual i is precisely defined as follows:

$$\delta_i(WE) = IYCF_{ij}\{WE, M_{ij}(1)\} - IYCF_{ij}\{WE, M_{ij}(0)\} \quad (3)$$

The causal mediation analysis[18] identifies the indirect effect of women's empowerment on infant and young child feeding practices through the mediating variable M_{ij} (Keele, Tingley, & Yamamoto, 2015). In its basic form, $\delta_i(WE)$ in Equation (3) is determined by estimating two equations indicated for the mediator and outcome variables. These equations are stated as follows:

$$M_{ij} = \varphi_0 + \varphi_1 WE_{kj} + \sum_i \beta_2 \mathrm{K}_{ij} + \sum_k \beta_3 \mathrm{M}_{kj} + \sum_j \beta_4 \mathrm{H}_j + \sum_j \beta_5 \mathrm{P} + \varepsilon_{ij} \quad (4)$$

$$IYCF_{ij} = \Omega_0 + \Omega_1 WE_{kj} + \Omega_2 \mathrm{M}_{ij} + \sum_i \beta_2 \mathrm{K}_{ij} + \sum_k \beta_3 \mathrm{M}_{kj} + \sum_j \beta_4 \mathrm{H}_j + \sum_j \beta_5 \mathrm{P} + \varepsilon_{ij} \quad (5)$$

[16]The results obtained from Lewbel (I) specification and PSM tend to be more accurate compared to the alternative strategy - conventional 2sls - which we used as an additional robustness check in our study. The details are provided in Section 4.4.

[17]PSM provides several advantages compared to other techniques, like probit estimators. One of its main advantages is that while the calculation of propensity scores is parametric, the use of propensity scores to determine causal effects is nonparametric. Therefore, utilizing the PSM to calculate causal effects is more resistant to the violation of model assumptions (Li, 2013).

[18]Mediation analysis is conducted using *mediate* command in Stata (Hicks & Tingley, 2011).

Equations (4) and Equation (5) are used to determine the direct ($\widehat{\Omega_1}$) effect of women's empowerment on infant and young child feeding practices and indirect ($\hat{\delta}_\iota = \widehat{\Omega_2} \times \widehat{\varphi_1}$) effects through the mediating variable. In accordance with the conceptual framework, the mother's education is employed as a mediator in this analysis.

4. Results

4.1. Descriptive statistics

Table 3 displays the summary statistics of the selected variables pertaining to women's empowerment, infant and young child feeding practices, and socio-demographic characteristics of the study group. The initial section of the table shows different dimensions of women's empowerment. The analysis indicates that 45% of women have access to information through media, television, and radio. The majority (84%) of women have access to healthcare and have the ability to make decisions within the household (82%). Only 7% of women have ownership of assets. Almost all women (99%) have a positive attitude towards domestic violence. Overall, the mean score for women's empowerment is 10.

The middle section of Table 3 provides a description of the feeding practices for infants and young children. Approximately 46% of the children in the sample demonstrated a minimum dietary diversity within the past 24 hours of the survey. The majority of children (81%) had a minimum meal frequency. Only 42% of the children met the minimum acceptable diet criteria. However, more than half of the children (60%) consumed vitamin-A rich food, while only 36% consumed iron-rich food.

The final panel of this table illustrates the socio-demographic attributes, encompassing the variables that were selected at the mother-level, child-level, and household-level. The mean duration of maternal education is approximately 6.4 years. About one third of households are headed by females, with the average age of mothers being around 26.4 years, regardless of their headship status. Women are equally distributed between urban and rural areas. Regarding the economic condition of women, the descriptive statistics indicate that the average group of women is positioned in the middle of the wealth distribution. In addition, the average age of the mother at her first childbirth was approximately 20 years. Among the total of 5,148 children, 47% of them are female children, and their average age is 29.5 months. 41% of the children in the sample are classified as the mother's first-born child. Approximately 46% of mothers attend four or more prenatal care visits. The average number of children is approximately 1.5 per household.

Table 3: Descriptive Statistics of the selected variables in the analysis

Variable	Obs	Mean	SD	Min	Max
Dimensions of women empowerment					
Information access	5148	0.45	0.50	0	1
Access to healthcare	5148	0.84	0.36	0	1
Asset ownership	5148	0.07	0.26	0	1
Decision making autonomy	5148	0.82	0.38	0	1
Attitude towards domestic violence	5148	0.99	0.10	0	1
Overall women empowerment score	5148	10.23	2.71	0	19
Outcome variables					
Minimum dietary diversity	1451	0.46	0.49	0	1
Minimum meal frequency	1451	0.81	0.39	0	1
Minimum acceptable diet	1451	0.42	0.49	0	1
Vitamin A rich food	1451	0.60	0.49	0	1
Iron rich food	1451	0.36	0.48	0	1
Socio-demographic characteristics					
Mother years of schooling	5148	6.41	4.39	0	13
Mother's age	5148	26.41	5.39	15	49
Mother's age at first birth	5148	20.17	3.51	11	43
Child is female	5148	0.47	0.50	0	1
Child age in months	5148	29.50	17.13	0	59
First birth order	5148	0.41	0.49	0	1
Prenatal care visits	5148	0.46	0.50	0	1
Wealth index	5148	2.00	0.90	1	3
Total number of children under 5	5148	1.49	0.72	1	5
Female headed household	5148	0.33	0.47	0	1
Urban resident	5148	0.50	0.50	0	1

Notes: All data is extracted from the children's recode data file (KR) and merged with the individual women's recode data file (IR) and household member's recode data file (PR) of the Nepal Demographic Health Survey (NDHS) 2022. Obs = observations, SD = standard deviation, Min = minimum value, and Max = maximum value. Descriptive statistics are weighted to be nationally representative of the Nepalese general population.

4.2. Probit model estimates

Table 4 presents the Probit model findings for the estimation of Equation (1). The model examines the correlation between women's empowerment (measured by the overall score and dimensions) and infant and early child feeding practices. The dependent variable in Table 4 consists of five distinct indicators of infant and young child feeding practices, as previously explained in Section 3.3.2. The primary independent variable is women's empowerment, which is measured using an overall empowerment score and five significant dimensions. The study also incorporates control variables that were previously described in Section 3.3.3.

The upper panel of Table 4 indicates a positive relationship between the overall empowerment score and the minimum acceptable diet, but no such correlation is observed with other indicators of infant and young child feeding practices. The coefficient indicates that there is a 0.9 percentage point improvement in the likelihood of a minimum acceptable diet for every one-unit increase in the overall women's empowerment score. The score has statistical significance at a significance level of 10%. The lower panel of Table 4 depicts the correlation between several dimensions of women's empowerment and the outcome variables. The findings indicate that there is a positive association between the information access dimension and the minimum acceptable diet, vitamin-A rich foods, and iron rich foods. Specifically, women who have access to information is associated with a 4.7 percentage point increase in the probability of a minimum acceptable diet and a 4.6 percentage point increase in the probability of the consumption of vitamin-A rich foods and iron-rich foods as compared to women who do not have such access to information. These three coefficients have statistical significance at a significance level of 10%. Moreover, there is a positive correlation between the decision-making autonomy dimension and the consumption of vitamin-A rich foods and iron-rich foods. In particular, being involved in the household decision-making is associated with a 7.5 percentage point increase in the probability of consuming vitamin-A rich foods and an 11 percentage point increase in the probability of consuming iron-rich foods, compared to those women who are not involved in decision-making. Both estimated coefficients exhibit statistical significance at the 1% and 5% significance levels. Also, there is no substantial link between other dimensions of women's empowerment and the five indicators of infant and young child feeding practices.

Table 4: Effect of the women empowerment (overall score + dimensions) on infant and young child feeding practices (Probit model)

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Overall women empowerment score					
Empowerment score	0.009	0.003	0.009*	0.007	0.008
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Dimensions of women empowerment					
Information access	0.029	0.018	0.047*	0.046*	0.046*
	(0.025)	(0.022)	(0.025)	(0.026)	(0.026)
Access to healthcare	0.020	0.008	0.004	0.000	0.015
	(0.032)	(0.029)	(0.032)	(0.036)	(0.034)

Asset ownership	0.039 (0.057)	0.082 (0.058)	0.089 (0.057)	0.028 (0.057)	0.005 (0.053)
Decision making autonomy	0.044 (0.032)	0.041 (0.027)	0.049 (0.032)	0.075** (0.031)	0.110*** (0.034)
Attitude towards domestic violence	0.074 (0.152)	0.008 (0.111)	0.136 (0.151)	0.121 (0.127)	0.017 (0.115)
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,451	1,451	1,451	1,451	1,451
Pseudo R-squared	0.12	0.04	0.10	0.09	0.06
Chi-squared p-value	0	0	0	0	0

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence).

4.3. Main specification using Lewbel (I+E) method

The upper part of Table 5 demonstrates the evidence of the overall empowerment score. The results indicate a positive relationship between the women empowerment score and minimum meal frequency, minimum acceptable diet, and iron-rich food. It indicates a causal interpretation since the Hansen J p-value is greater than 0.10 and the coefficients are statistically significant at a 10% significance level. The overall women's empowerment score has a significant impact on the probability of meeting the minimum meal frequency, the minimum acceptable diet, and iron-rich food. A one-unit increase in the empowerment score results in a 4.0 percentage point increase in the probability of meeting the minimum meal frequency, and a 4.6 percentage point increase in the likelihood of achieving a minimum acceptable diet and consuming iron-rich foods, holding other factors constant.

The lower part of Table 5 shows the findings of each dimension of women's empowerment and its impact on infant and young child feeding practices[19]. The information access dimension shows a positive causal

[19]The results of each indicator utilized in each dimension are displayed in Appendix B Tables B1 to B5 for the purpose of simplifying the identification of significant indicators in each dimension and determining the primary drivers of each dimension's outcome.

relationship between the minimum acceptable diet and iron-rich foods. Both variables are statistically significant at a 5% significance level and also pass the Hansen J-test. Having access to information is associated with a 58.3 percentage point higher probability of women achieving a minimum acceptable diet for their children, and a 63.7 percentage point higher probability of women feeding their children iron-rich foods. In addition, there is a positive causal relationship between the decision making autonomy dimension and the probability of meeting the minimum meal frequency, and consuming vitamin-A rich food, and iron-rich food. The three coefficients exhibit statistical significance at both the 1% and 5% levels, and they also satisfy the criteria of the Hansen J tests. These results suggest that having decision-making autonomy in the household increases the probability of meeting the minimum meal frequency and of feeding children vitamin-A rich and iron-rich foods. Finally, the attitude towards domestic violence dimension indicates a positive causal relationship with minimum dietary diversity, minimum acceptable diet, and vitamin-A rich food. This relationship is consistent with the previous causal interpretation. Specifically, a refusal to accept domestic violence increases the probability of achieving the minimum dietary diversity and a minimum acceptable diet by 7.8 percentage points. Additionally, it increases the probability of consuming vitamin-A rich foods by 30.9 percentage points. The remaining two variables, minimum meal frequency and iron-rich food, only show a positive correlation.

Table 5: Effect of the women empowerment (overall score + dimensions) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Overall women empowerment score					
Empowerment score	0.042	0.040*	0.046*	0.028	0.046*
	(0.026)	(0.024)	(0.025)	(0.026)	(0.024)
Hansen J p-value	0.727	0.675	0.756	0.643	0.353
Dimensions of women empowerment					
Information access	0.375	0.232	0.583**	0.290	0.637**
	(0.239)	(0.192)	(0.266)	(0.239)	(0.275)
Hansen J p-value	0.020	0.252	0.377	0.763	0.972
Access to healthcare	0.053	0.010	0.071	0.068	0.032
	(0.064)	(0.067)	(0.063)	(0.077)	(0.069)
Hansen J p-value	0.907	0.004	0.821	0.715	0.761

Asset ownership	0.089 (0.079)	0.034 (0.050)	0.122 (0.080)	0.044 (0.072)	0.019 (0.082)
Hansen J p-value	0.617	0.541	0.684	0.676	0.552
Decision making autonomy	0.087 (0.078)	0.208*** (0.076)	0.076 (0.077)	0.218*** (0.083)	0.189** (0.076)
Hansen J p-value	0.673	0.622	0.734	0.980	0.885
Attitude towards domestic violence	0.078* (0.041)	0.284*** (0.047)	0.078* (0.040)	0.309*** (0.046)	0.168*** (0.044)
Hansen J p-value	0.200	0.012	0.234	0.182	0.009
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.

4.4. Robustness checks

Several robustness checks[20] are presented in Table 6 and Table 7. The first approach relies on an internally constructed instrument Lewbel (I). Next, we applied the propensity score matching method, utilizing the regression adjustment through the probit outcome model, for the main robustness check of PSM[21]. A binary indicator is created for women's empowerment (empowered or not) by using the median value of 10 to estimate the average treatment effect.

[20]Conventional 2sls estimation method also applied as a part of our robustness check. While applying this strategy, F-tests for overall women's empowerment score indicate that the external instrument is strong. However, there is variability in F-statistics among various dimensions. This variation indicates that the instruments exhibit differing levels of predictive capability for different dimensions of women's empowerment. The heterogeneity seen can result from variations in the measurement methods employed for a particular dimension or the fundamental relationship between the instruments and each individual dimension. This may suggest the potential bias and inconsistency in our estimates of 2SLS for the individual dimensions and thus we have not included this strategy in our main robustness checks. The results can be obtained upon request.

[21]An additional exercise is carried out by implementing various matching techniques, such as four nearest neighbors and propensity score matching. The results align with our main estimation method, regression adjustment, and can be obtained upon request.

Table 6 demonstrates the impact of the overall empowerment score on infant and young child feeding practices. Table 7 shows the effect of various dimensions of women's empowerment on infant and young child feeding practices through the utilization of separate regression methods. Overall, the results obtained from these robustness checks present mixed evidence about a positive, causal, and statistically significant relationship between the overall empowerment score, different dimensions of women's empowerment, and our outcome variables. There is no evidence to suggest that any of the indicators consistently show positive and significant results in every specification.

In accordance with Table 6, it indicates that with the Lewbel (I) approach, there is a positive relationship between the overall empowerment score and the consumption of vitamin-A rich food and iron-rich food. The estimates derived from this method indicate a causal relationship between women's empowerment and infant and young child feeding practices. This is supported by the Hansen p-value, which is greater than 0.10, and statistical significance at a 10% significance level. The evidence derived from the propensity score technique indicates that women's empowerment has a beneficial impact on the increase of minimum dietary diversity, minimum acceptable diet, and consumption of iron-rich food. We can infer that only iron-rich food demonstrates a consistent, positive, causal, and statistically significant relationship with the overall empowerment score from both the robustness checks.

Table 6: Effect of the women empowerment (overall score) on infant and young child feeding practices (Robustness check)

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Overall women empowerment score - Lewbel 2SLS (I) model					
Empowerment score	0.045 (0.036)	0.004 (0.031)	0.049 (0.036)	0.064* (0.038)	0.061* (0.036)
Hansen J p-value	0.619	0.565	0.681	0.861	0.296
Observations	1,440	1,440	1,440	1,440	1,440
Overall women empowerment - Propensity score matching (PSM)					
Empowerment	0.084*** (0.028)	0.007 (0.021)	0.078*** (0.029)	0.030 (0.027)	0.058** (0.029)
Observations	1,451	1,451	1,451	1,451	1,451
Covariates included	Yes	Yes	Yes	Yes	Yes

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust

standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Propensity score matching is calculated using the regression adjustment- probit outcome model. A binary indicator for women's empowerment is generated for PSM by using the median value (10). Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I: internal; PSM: propensity score matching.

The upper panel of Table 7 indicates that, utilizing the Lewbel (I) method, the information access dimension has a positive causal impact on the minimum acceptable diet and consumption of iron-rich food. While decision making autonomy dimension shows a positive effect on minimum meal frequency, vitamin-A rich food, and iron-rich food.

The lower panel of Table 7 shows the results of PSM analysis. Findings suggest that the information access dimension is positively affecting the children's minimum dietary diversity, minimum acceptable diet, vitamin-A rich food, and iron-rich food of empowered women as compared to those women who are not empowered. There is also evidence of a positive relationship between the asset ownership dimension and the minimum meal frequency and minimum acceptable diet. Women who have decision-making autonomy in the household are more likely to ensure their children have a minimum acceptable diet and consume iron-rich food than those who lack decision-making autonomy in the household. Finally, women who are empowered against domestic violence have a significant positive causal relationship with all five variables of infant and young child feeding practices. We can infer from both the strategies that only iron-rich food exhibits a consistent, positive, causal, and statistically significant relationship with different dimensions of women's empowerment.

Table 7: Effect of the women empowerment (dimensions) on infant and young child feeding practices (Robustness check)

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Dimensions of women empowerment - Lewbel 2SLS (I) model					
Information access	0.305 (0.242)	0.091 (0.193)	0.515* (0.268)	0.259 (0.247)	0.586** (0.282)
Hansen J p-value	0.012	0.343	0.273	0.653	0.940

Access to healthcare	0.041 (0.064)	0.039 (0.068)	0.055 (0.063)	0.074 (0.077)	0.045 (0.069)
Hansen J p-value	0.968	0.021	0.895	0.766	0.833
Asset ownership	0.083 (0.079)	0.038 (0.050)	0.117 (0.080)	0.041 (0.072)	0.020 (0.082)
Hansen J p-value	0.618	0.935	0.852	0.610	0.736
Decision making autonomy	0.062 (0.080)	0.180** (0.079)	0.055 (0.080)	0.242*** (0.089)	0.177** (0.081)
Hansen J p-value	0.692	0.587	0.783	0.970	0.848
Attitude towards domestic violence	0.058 (0.132)	0.015 (0.131)	0.135 (0.105)	0.112 (0.130)	0.015 (0.109)
Hansen J p-value	0.547	0.699	0.704	0.131	0.354
Observations	1,440	1,440	1,440	1,440	1,440
Dimensions of women empowerment - Propensity score matching (PSM)					
Information access	0.059** (0.028)	0.011 (0.021)	0.080*** (0.028)	0.050* (0.027)	0.067** (0.028)
Access to healthcare	0.050 (0.039)	0.004 (0.030)	0.030 (0.040)	0.022 (0.038)	0.027 (0.039)
Asset ownership	0.085 (0.053)	0.060* (0.035)	0.135** (0.054)	0.061 (0.055)	0.032 (0.059)
Decision making autonomy	0.058 (0.036)	0.031 (0.029)	0.075** (0.037)	0.044 (0.037)	0.087** (0.037)
Attitude towards domestic violence	0.122*** (0.019)	0.149*** (0.016)	0.108*** (0.019)	0.117*** (0.017)	0.067*** (0.020)
Observations	1,451	1,451	1,451	1,451	1,451
Covariates included	Yes	Yes	Yes	Yes	Yes

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Propensity score matching is calculated using the regression adjustment- probit outcome model. A binary indicator for women's empowerment is generated for PSM by using the median value (10). Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I: internal; PSM: propensity score matching.

4.5. Heterogeneous analysis

Table 8 displays the potential variability in the impact of the overall women's empowerment score on infant and early child feeding practices using the Lewbel (I+E) model. There are substantial and significant disparities for some outcome variables depending on the geographical location and the type of household head[22]. The findings indicate a positive relationship between the overall women's empowerment score and the consumption of iron-rich food among the children in rural areas. Further, this relationship also significantly pertains to female-headed households (FHH). An increase of one unit in the overall women's empowerment score leads to a 8.1 percentage point increase in the likelihood of children in rural regions consuming iron-rich food. For children in female-headed households, the increase is 4.3 percentage points. Both estimates successfully pass the Hansen J test and are also statistically significant at the 5% and 10% significance levels.

Table 8: Heterogeneity in the effect of the women empowerment (overall score) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Overall women empowerment score- Urban sample					
Empowerment score	0.004	0.016	0.006	0.017	0.007
	(0.028)	(0.023)	(0.028)	(0.030)	(0.028)
Hansen J p-value	0.349	0.270	0.356	0.143	0.104
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	724	724	724	724	724
Overall women empowerment score- Rural sample					
Empowerment score	0.029	0.036	0.030	0.037	0.081**
	(0.035)	(0.036)	(0.035)	(0.036)	(0.035)
Hansen J p-value	0.317	0.089	0.264	0.813	0.755
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	716	716	716	716	716
Overall women empowerment score- Female-headed households					
Empowerment score	0.056	0.026	0.050	0.061	0.043*
	(0.043)	(0.035)	(0.041)	(0.045)	(0.025)

[22]The result of each dimension for heterogeneity analysis is presented in Appendix A (Tables A1 and A2).

Hansen J p-value	0.657	0.862	0.800	0.662	0.693
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	435	435	435	435	435
Overall women empowerment score- Male-headed households					
Empowerment score	0.031 (0.027)	0.025 (0.024)	0.032 (0.026)	0.021 (0.027)	0.041 (0.040)
Hansen J p-value	0.859	0.735	0.927	0.563	0.324
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,005	1,005	1,005	1,005	1,005

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), and the total number of children under the age of five in the household. Abbreviations: SLS: stage least square; I+E: internal + external.

4.6. Causal mediation analysis of mother's education

The methodology utilized in the analysis so far considered the direct influence of women's empowerment on the practices of feeding infants and young children. Nevertheless, the empowerment of women may have an indirect impact on the practices of feeding infants and young children through alternative channels. Table 9 displays the analysis of a potential pathway via which the empowerment of women could impact the infants and young children feeding practices. Table 9 shows the total effect, direct effect, and indirect effect. The total effect refers to the impact of women's empowerment on infant and small child feeding practices, also known as the treatment effect. The total effect is further divided into two categories: direct effect and indirect effect. The indirect effect, often referred to as the causal mediation effect (Imai, Keele, & Tingley, 2010), captures the influence of the mediator - mother's education - on the outcome variable. The direct effect represents the remaining impact of the treatment on the outcome variable. In addition, we have also calculated the proportion of the total effect explained by mediation.

The findings of the causal mediation analysis[23] indicate a significant correlation between the mother's level of education (indirect effect) and minimal dietary diversity, a minimum acceptable diet, vitamin-A rich foods, and iron-rich foods. Nevertheless, the proportion of the total effect of women's empowerment that is

[23]The result of each dimension for causal mediation analysis is presented in Appendix A (Table A3).

influenced by the education of mothers is only statistically significant for minimum dietary diversity, minimum acceptable diet, and vitamin-A rich food. Therefore, we solely comprehend these results. The mediating effect of maternal education explains 70.8% of the impact of women's empowerment on achieving minimal dietary diversity, 66.5% on attaining a minimum acceptable diet, and 44.5% on consuming vitamin-A rich foods. The remaining impact of 29.2% on minimal dietary diversity, 33.5% on a minimum acceptable diet, and 55.5% on vitamin-A rich food is attributed due to the other mechanisms.

Table 9: Causal mediation analysis with mother's education as a channel of influence of women empowerment (overall score) on infant and young child feeding practices

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Overall women empowerment score					
Indirect effect (mediating variable-mother's education)	0.083*** (0.013)	0.017 (0.013)	0.077*** (0.013)	0.032** (0.013)	0.027** (0.014)
Direct effect	0.034 (0.031)	0.022 (0.027)	0.039 (0.028)	0.040 (0.030)	0.050* (0.030)
Total effect	0.117*** (0.028)	0.039* (0.023)	0.116*** (0.027)	0.071*** (0.027)	0.077*** (0.027)
Proportion mediated	0.708*** (0.202)	0.436 (0.430)	0.665*** (0.179)	0.445* (0.244)	0.347 (0.215)
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,451	1,451	1,451	1,451	1,451

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence).

5. Discussion

The study aims to analyze the relationship between women's empowerment and infant and young child feeding practices in Nepal, using the DHS dataset of 2022. In this study, we utilize the Lewbel method, specifically the internal and external instruments (I+E), as the primary strategy for conducting causal analysis. This main findings shows a significant relationship between women's empowerment score and

essential dietary factors, including minimum meal frequency, minimum acceptable diet, and iron-rich food, after considering confounding variables.

However, not all dimensions of women's empowerment have a significant relationship with the IYCF outcomes: the indicators that have a substantial relationship with infant and young child feeding practices are access to information, decision making autonomy, and to a lesser degree, attitude against domestic violence. To be more explicit, the information access dimension demonstrates a positive relationship with the minimum acceptable diet and iron-rich food, while, the decision making autonomy score exhibits a positive relationship with the minimum meal frequency, vitamin-A rich food, and iron-rich food. In addition, the attitude toward domestic violence dimension suggests a positive causal relationship with minimum dietary diversity, minimum acceptable diet, and vitamin-A rich food, but only a positive association with minimum meal frequency and iron-rich food.

The results align with previous research that has demonstrated a positive correlation between women's empowerment and child feeding practices, particularly in terms of enhanced dietary diversity. This relationship has been observed in several regions like Vietnam, Ghana, South Asia, and Sub-Saharan Africa (Bhagowalia, Menon, Quisumbing, & Soundararajan, 2012; Bhagowalia, Menon, Quisumbing, & Soundararajan, 2010). More precisely, when women have the ability to make decisions regarding child feeding and childcare, they are more inclined to adhere to suggested feeding practices and give more suitable care (Shroff, 2007). The participation of women in the decision-making process within the household and their control over resources are indications of women's empowerment in relation to infant and young child feeding practices. The role of a mother in child feeding is crucial in the majority of families. The involvement of women in family matters is vital since they possess efficient and full access to household resources, enabling them to provide more frequent nourishment to their children in accordance with the recommendations of the World Health Organization (WHO). According to Na, Jennings, Talegawkar, & Ahmed (2015), there is a consistent and positive relationship between women's ability to influence decision-making and several IYCF practices in Mali, Rwanda, and Sierra Leone. Moreover, existing research also indicates that the attitude towards domestic violence plays a significant role in enhancing child nutrition (Jones et al., 2020). A study conducted in Ghana found a favorable correlation between women's perception of domestic violence and children's dietary diversity score (Amugsi, Mittelmark, & Oduro, 2015). The empowerment of women is considered crucial in low- and middle-income countries to enhance infant and young child feeding, leading to better diets and nutritional status (Jones et al., 2019). Nevertheless, some dimensions of women's empowerment did not seem to have an impact on the nutritional outcomes of

children. According to some studies, it is important to consider the context and dimensions of empowerment when discussing women's empowerment in relation to infant and young child feeding (IYCF) practices (Na, Jennings, Talegawkar, & Ahmed, 2015). However, alternative research indicates that women's empowerment should be viewed as a multidimensional notion rather than a one-dimensional concept (Christian et al., 2023).

The present study demonstrates that women's empowerment has a varied impact on ICYF practices depending on factors such as area of residence and being the head of the household. The results indicate a positive relationship between women's empowerment and the consumption of iron-rich food among children of mothers residing in rural areas of the country, as well as among female-headed families. The latter result differs with the findings from a study in Tanzania (Ochieng, Afari-Sefa, Lukumay, & Dubois, 2017), which reported that children in female-headed households tend to receive a less diversified diet in comparison to those in male-headed households. This discrepancy may be attributed to the economic constraints often faced by female-headed households such as widowed or divorced women (i.e. single-parent households) who may have decision-making power but often lack the financial resources to adequately feed their children. Thus, it highlights the crucial importance of contextual differences when examining the relationship between women's empowerment and child nutrition.

The educational attainment of mothers has a major effect on enhancing the health outcomes of their children. It has been shown that it plays a beneficial role in facilitating the impact of women's empowerment on infant and child feeding practices. The results of the current study also indicate a significant relationship between women's empowerment, influenced by maternal education, and minimal dietary diversity, a minimum acceptable diet, and the consumption of vitamin-A rich and iron-rich foods. However, the proportion of the total effect of women's empowerment through women's education is only statistically significant for minimal dietary diversity, a minimum acceptable diet, and vitamin-A rich foods. The findings indicate that maternal education serves as a mediating factor, accounting for 70.8% of the impact of women's empowerment on obtaining minimal dietary diversity, 66.5% on attaining a minimum acceptable diet, and 44.5% on consuming vitamin-A rich foods. Prior research has also demonstrated that the education of women is a key indicator for improving the nutritional outcomes of children. There is a strong correlation between women who lack education and their children having an inadequately acceptable diet, poor dietary diversity, and unmet meal frequency (Khan et al., 2017). An additional study conducted in different parts of Ethiopia found that there is a favorable correlation between a mother's level of education and her adherence to minimum dietary diversity and proper supplemental feeding practices for their children (Dagne et al.,

2019; Solomon, Aderaw, & Tegegne, 2017). Education is crucial for enhancing women's empowerment and, consequently, improving child feeding practices. Higher levels of education contribute to the development of women's self-assurance and their understanding of the importance of promoting optimal infant and young child feeding (IYCF) practices (Dagne et al., 2019). Thus, the study reinforces the significance of understanding the indirect pathway or mechanism via which women's empowerment impacts child feeding practices (Christian et al., 2023).

Despite the aforementioned findings, it is important to acknowledge that this study does have certain limitations. First, the DHS surveys are conducted in a cross-sectional manner, in which data is collected at a specific moment in time: this constraint restricts the capacity to analyze changes in variables over a period of time. Second, the data from the DHS regarding the various empowerment domains and infant and young child feeding practices is obtained through self-reported information provided by mothers. This information includes details about the specific foods consumed by their children during the 24-hour survey period. However, it's crucial to keep in mind that recall bias, social desirability bias, or other measurement errors could affect these data findings. Third, it is crucial to recognize that the measurement of women's empowerment is continuously growing. The use of the Women's Empowerment in Agriculture Index (WEAI) is an illustration of efforts to capture both intrinsic and collective agency. Nevertheless, the measures implemented by the DHS have undergone extensive research and are widely recognized for effectively addressing significant areas of maternal empowerment. Finally, it is important to identify that women's empowerment can have an influence on ICYF outcomes through various indirect pathways, apart from the one examined in this study. These indirect pathways may have different effects on ICYF outcomes. Hence, it is imperative to conduct a comprehensive investigation to ascertain the potential influence of women's empowerment on feeding practices, considering different indirect pathways as well.

6. Conclusion and recommendation

This study contributes to the existing scholarship on the relationship between women's empowerment and infant and young child feeding practices in the specific context of Nepal. The domain of women's empowerment and its impact on child nutritional outcomes is rapidly growing, offering numerous opportunities for analysis and a valuable means for supporting programs and actions related to improving child health and nutritional outcomes. Nevertheless, existing evidence has been somewhat limited and inconclusive. The present research study employs a range of econometric tools to investigate the causal relationship between women's empowerment and complementary feeding practices among infants and young

children. The study's findings indicate a significant relationship between the overall empowerment score and certain child feeding outcomes, such as minimum meal frequency, minimum acceptable diet, and iron-rich food. This finding highlights the significance of overall maternal empowerment in improving complementary feeding practices among young children in households. However, it is also important to consider various dimensions of women's empowerment that aim to enhance these child feeding outcomes. Further analysis of this study indicates that not all domains of women's empowerment are significantly related to these outcome variables. The research determined that certain dimensions, such as the information access, decision making autonomy, and attitude against domestic violence, have a significant impact on various aspects of infant and young child feeding practices. In particular, the information access dimension is positively related to the minimum acceptable diet and iron-rich foods. Similarly, the decision making autonomy dimension is positively associated with the minimum meal frequency, vitamin-A rich foods, and iron-rich foods. Additionally, the attitude against domestic violence has a positive causal relationship with minimum dietary diversity, a minimum acceptable diet, and vitamin-A rich food. Therefore, it is crucial for policymakers to prioritize interventions that are tailored to the unique aspects of women's empowerment in each country. By carrying out interventions in a particular context, they can effectively promote maternal empowerment in relation to the nutritional outcomes of their children. In addition, it is crucial to design programs, policies, and interventions that actively promote gender equality. This would empower women to make decisions for themselves and their children within the household, giving them access to resources and contributing to the achievement of various sustainable developmental goals (SDGs) focused on women and children.

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Appendix A

Table A1: Heterogeneity in the effect of the women empowerment (dimensions) on infant and young child feeding practices (Lewbel 2SLS (I+E) model)) - Area of residence

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Dimensions of women empowerment – Urban residence					
Information access	0.162	0.014	0.180	0.369	0.071
	(0.338)	(0.263)	(0.345)	(0.355)	(0.333)
Hansen J p-value	0.222	0.332	0.327	0.641	0.341
Access to healthcare	0.063	0.028	0.115	0.113	0.029
	(0.096)	(0.081)	(0.097)	(0.104)	(0.099)
Hansen J p-value	0.763	0.287	0.925	0.645	0.946
Asset ownership	0.059	0.025	0.056	0.093	0.037
	(0.093)	(0.064)	(0.093)	(0.083)	(0.095)
Hansen J p-value	0.706	0.816	0.752	0.531	0.712
Decision making autonomy	0.121	0.172*	0.155	0.270**	0.199*
	(0.120)	(0.100)	(0.118)	(0.122)	(0.114)
Hansen J p-value	0.788	0.101	0.868	0.837	0.704
Attitude towards domestic violence	0.007	0.023	0.120	0.056	0.077
	(0.263)	(0.167)	(0.220)	(0.213)	(0.168)
Hansen J p-value	0.237	0.590	0.484	0.142	0.004
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	724	724	724	724	724
Dimensions of women empowerment – Rural residence					
Information access	0.360*	0.198	0.421*	0.206	0.273
	(0.215)	(0.189)	(0.222)	(0.220)	(0.203)
Hansen J p-value	0.022	0.118	0.171	0.190	0.052
Access to healthcare	0.057	0.013	0.050	0.125	0.004
	(0.098)	(0.114)	(0.096)	(0.129)	(0.109)
Hansen J p-value	0.734	0.002	0.442	0.763	0.305
Asset ownership	0.174	0.117	0.255*	0.180	0.217
	(0.139)	(0.087)	(0.142)	(0.142)	(0.170)
Hansen J p-value	0.228	0.119	0.058	0.297	0.276
Decision making autonomy	0.122	0.211**	0.088	0.158	0.182**
	(0.087)	(0.095)	(0.087)	(0.097)	(0.083)

Hansen J p-value	0.604	0.038	0.222	0.865	0.737
Attitude towards domestic violence	0.031 (0.056)	0.300*** (0.070)	0.034 (0.048)	0.257*** (0.063)	0.108** (0.052)
Hansen J p-value	0.223	0.013	0.258	0.393	0.001
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	716	716	716	716	716

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), and the total number of children under the age of five in the household. Abbreviations: SLS: stage least square; I+E: internal + external.

Table A2: Heterogeneity in the effect of the women empowerment (dimensions) on infant and young child feeding practices (Lewbel 2SLS (I+E) model)) – Sex of household head

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Dimensions of women empowerment – Female-headed Households					
Information access	0.375 (0.242)	0.154 (0.176)	0.327 (0.228)	0.121 (0.238)	0.289 (0.227)
Hansen J p-value	0.074	0.407	0.288	0.234	0.062
Access to healthcare	0.064 (0.118)	0.014 (0.106)	0.146 (0.120)	0.149 (0.151)	0.041 (0.122)
Hansen J p-value	0.333	0.973	0.209	0.096	0.341
Asset ownership	0.148 (0.111)	0.016 (0.081)	0.182* (0.110)	0.254*** (0.088)	0.134 (0.124)
Hansen J p-value	0.204	0.540	0.413	0.299	0.456
Decision making autonomy	0.028 (0.118)	0.114 (0.123)	0.022 (0.118)	0.271** (0.129)	0.162 (0.109)
Hansen J p-value	0.399	0.273	0.092	0.169	0.278
Attitude towards domestic violence	0.293*** (0.087)	0.138** (0.062)	0.304*** (0.077)	0.230 (0.322)	0.036 (0.345)
Hansen J p-value	0.247	0.297	0.616	0.307	0.069
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	435	435	435	435	435

Dimensions of women empowerment – Male-headed Households					
Information access	0.133 (0.205)	0.182 (0.178)	0.261 (0.211)	0.123 (0.200)	0.316 (0.212)
Hansen J p-value	0.300	0.612	0.532	0.930	0.952
Access to healthcare	0.048 (0.074)	0.001 (0.080)	0.031 (0.072)	-0.043 (0.087)	-0.056 (0.078)
Hansen J p-value	0.985	0.001	0.929	0.763	0.706
Asset ownership	0.060 (0.090)	0.045 (0.056)	0.091 (0.096)	-0.102 (0.096)	-0.101 (0.092)
Hansen J p-value	0.857	0.700	0.949	0.852	0.645
Decision making autonomy	0.125 (0.100)	0.256*** (0.094)	0.111 (0.099)	0.164 (0.102)	0.201** (0.096)
Hansen J p-value	0.467	0.675	0.756	0.977	0.799
Attitude towards domestic violence	0.073 (0.049)	-0.287*** (0.052)	0.081* (0.047)	0.313*** (0.055)	0.191*** (0.050)
Hansen J p-value	0.135	0.036	0.153	0.100	0.011
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,005	1,005	1,005	1,005	1,005

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), and the total number of children under the age of five in the household. Abbreviations: SLS: stage least square; I+E: internal + external.

Table A3: Causal mediation analysis of mother's education as a channel of influence of women empowerment (dimensions) on infant and young child feeding practices

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Dimensions of women empowerment					
Information access					
Indirect effect (mediating variable)	0.100*** (0.014)	0.014 (0.012)	0.095*** (0.014)	0.037*** (0.014)	0.047*** (0.014)
Direct effect	0.002 (0.028)	0.026 (0.024)	0.020 (0.028)	0.044 (0.028)	0.031 (0.028)

Total effect	0.103*** (0.026)	0.039* (0.022)	0.115*** (0.026)	0.081*** (0.025)	0.078*** (0.025)
Proportion mediated	0.976*** (0.271)	0.347 (0..337)	0.825*** (0.209)	0.455** (0..221)	0.602** (0.254)
Access to healthcare					
Indirect effect (mediating variable)	0.050*** (0.010)	0.015** (0.006)	0.047*** (0.010)	0.028*** (0.008)	0.023*** (0.007)
Direct effect	0.020 (0.032)	-0.008 (0.030)	0.004 (0.032)	-0.002 (0.037)	-0.014 (0.034)
Total effect	0.070** (0.033)	0.008 (0.030)	0.051 (0.033)	0.026 (0.036)	0.009 (0.034)
Proportion mediated	0.714** (0.331)	2.010 (7.797)	0.921 (0.571)	1.069 (1.503)	2.517 (9.091)
Asset ownership					
Indirect effect (mediating variable)	0.047** (0.022)	0.010 (0.017)	0.042* (0.022)	-0.018 (0.022)	-0.020 (0.023)
Direct effect	0.043 (0.063)	0.073 (0.047)	0.096 (0.064)	0.071 (0.058)	0.049 (0.061)
Total effect	0.089 (0.059)	0.083** (0.041)	0.139** (0.060)	0.052 (0.054)	0.029 (0.053)
Proportion mediated	0.521 (0 .424)	0.118 (0.221)	0.306 (0.209)	-0.351 (0.567)	-0.698 (1.378)
Decision making autonomy					
Indirect effect (mediating variable)	0.043*** (0.010)	0.014** (0.007)	0.042*** (0.010)	0.019** (0.007)	0.018** (0.007)
Direct effect	0.046 (0.032)	0.041 (0.031)	0.047 (0.031)	0.080** (0.033)	0.105*** (0.031)
Total effect	0.089*** (0.033)	0.055* (0.029)	0.089*** (0.032)	0.098*** (0.033)	0.124*** (0.030)
Proportion mediated	0.483** (0.193)	0.253 (0.192)	0.468*** (0.181)	0.188** (0.093)	0.149** (0.070)
Attitude towards domestic violence					
Indirect effect (mediating variable)	0.020 (0.030)	0.006 (0.009)	0.018 (0.028)	0.010 (0.016)	0.009 (0.014)

Direct effect	0.067 (0.139)	0.035 (0.099)	0.127 (0.130)	0.125 (0.127)	0.015 (0.118)
Total effect	0.086 (0.126)	0.040 (0.105)	0.145 (0.129)	0.135 (0.123)	0.024 (0.119)
Proportion mediated	0.226 (0.555)	0.137 (0.268)	0.125 (0.214)	0.074 (0.147)	0.375 (0.250)
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,451	1,451	1,451	1,451	1,451

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence).

Appendix B

Table B1: Effect of the information access dimension (each indicator) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Indicators of information access					
Media exposure- newspaper	0.087	0.021	0.178***	0.048	0.108
	(0.066)	(0.053)	(0.066)	(0.067)	(0.074)
Hansen J p-value	0.159	0.343	0.231	0.202	0.465
Media exposure- TV	0.019	0.035	0.077	0.000	0.002
	(0.053)	(0.047)	(0.056)	(0.053)	(0.056)
Hansen J p-value	0.311	0.541	0.501	0.970	0.642
Media exposure- radio	0.028	0.100	0.030	0.110	0.020
	(0.092)	(0.072)	(0.092)	(0.094)	(0.091)
Hansen J p-value	0.0104	0.123	0.0130	0.220	0.115
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.

Table B2: Effect of the access to healthcare dimension (each indicator) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Indicators of access to healthcare					
No problem of: permission to go	0.064	0.013	0.088	0.019	0.019
	(0.079)	(0.077)	(0.079)	(0.089)	(0.082)
Hansen J p-value	0.894	0.015	0.770	0.252	0.862

No problem of: getting money	0.014 (0.163)	0.085 (0.153)	0.108 (0.158)	0.136 (0.171)	0.032 (0.163)
Hansen J p-value	0.398	0.181	0.351	0.040	0.057
No problem of: distance to facility	0.031 (0.166)	0.072 (0.153)	0.009 (0.159)	0.097 (0.174)	0.109 (0.167)
Hansen J p-value	0.781	0.666	0.597	0.731	0.820
No problem of: wanting to go alone	0.477 (0.291)	0.435 (0.272)	0.579* (0.300)	0.371 (0.294)	0.318 (0.271)
Hansen J p-value	0.961	0.660	0.911	0.144	0.668
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.

Table B3: Effect of the asset ownership dimension (each indicator) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Indicators of asset ownership					
Own a house alone or jointly	0.034 (0.105)	0.003 (0.071)	0.057 (0.101)	0.026 (0.107)	0.025 (0.111)
Hansen J p-value	0.263	0.293	0.724	0.481	0.306
Own a land alone or jointly	0.030 (0.083)	0.072 (0.047)	0.124 (0.081)	0.008 (0.077)	0.066 (0.088)
Hansen J p-value	0.621	0.259	0.269	0.863	0.409
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for

household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.

Table B4: Effect of the decision making autonomy dimension (each indicator) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Indicators of decision making autonomy					
Decides own health either own or jointly with partner	0.194	0.274*	0.207	0.370**	0.261*
	(0.159)	(0.143)	(0.156)	(0.163)	(0.143)
Hansen J p-value	0.980	0.907	0.965	0.824	0.777
Decides household purchases either own or jointly with partner	0.093	0.161	0.174	0.129	0.332*
	(0.172)	(0.157)	(0.172)	(0.172)	(0.173)
Hansen J p-value	0.318	0.154	0.623	0.354	0.019
Decides visit to family or relatives either own or jointly with partner	0.088	0.382*	0.220	0.126	0.263
	(0.207)	(0.200)	(0.205)	(0.206)	(0.208)
Hansen J p-value	0.507	0.736	0.925	0.989	0.712
Decides wife's cash earning either own or jointly with partner	0.001	0.068	0.018	0.102	0.038
	(0.109)	(0.092)	(0.109)	(0.114)	(0.108)
Hansen J p-value	0.143	0.052	0.222	0.772	0.054
Decides husband's cash earning either own or jointly with partner	0.090	0.298**	0.081	0.204	0.321**
	(0.153)	(0.151)	(0.146)	(0.159)	(0.150)
Hansen J p-value	0.912	0.269	0.645	0.950	0.953
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.

Table B5: Effect of the attitude towards domestic violence dimension (each indicator) on infant and young child feeding practices (Lewbel 2SLS (I+E) model))

Variables	(1)	(2)	(3)	(4)	(5)
	Minimum Dietary Diversity	Minimum Meal Frequency	Minimum Acceptable Diet	Vitamin-A Rich Food	Iron Rich Food
Indicators of attitude towards domestic violence					
Not justified beating wife if she: burns food	0.008	0.193***	0.032	0.129	0.002
	(0.124)	(0.059)	(0.125)	(0.113)	(0.111)
Hansen J p-value	0.201	0.138	0.163	0.272	0.414
Not justified beating wife if she: argues with him	0.032	0.135	0.017	0.183	0.104
	(0.113)	(0.117)	(0.113)	(0.129)	(0.118)
Hansen J p-value	0.023	0.019	0.081	0.295	0.096
Not justified beating wife if she: goes out without telling him	0.102	0.227	0.033	0.081	0.076
	(0.172)	(0.168)	(0.161)	(0.188)	(0.161)
Hansen J p-value	0.365	0.399	0.264	0.503	0.048
Not justified beating wife if she: neglects the children	0.274*	0.215	0.258*	0.162	0.301**
	(0.155)	(0.131)	(0.150)	(0.155)	(0.150)
Hansen J p-value	0.675	0.731	0.559	0.941	0.450
Not justified beating wife if she: refuses to have sexual intercourse with him	0.112	0.159**	0.077	0.129	0.155
	(0.134)	(0.067)	(0.136)	(0.134)	(0.129)
Hansen J p-value	0.139	0.131	0.286	0.696	0.558
Covariates included	Yes	Yes	Yes	Yes	Yes
Observations	1,440	1,440	1,440	1,440	1,440

Notes: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. Robust standard errors are shown in parentheses. All regressions are clustered at the enumeration area level. Covariates included mother years of schooling, mother's age, mother's age at first birth, a binary indicator for child gender (=1 if female), a child's age in months, a binary indicator for first birth order (=1 if firstborn child), a binary indicator for prenatal care visits (=1 if mother had 4+ antenatal care visits), indicators for household wealth quintiles (1-3), total number of children under the age of five in the household, and a binary indicator for urban residence (=1 if urban residence). Abbreviations: SLS: stage least square; I+E: internal + external.