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Digital Technology in Health Education? – Opportunities for New Mothers in Mexican Public Healthcare Services

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Abstract. The Mexican healthcare system deals with several challenges such as a high level of fragmentation, low investments by the state and remaining high out-of-pocket payments. The socioeconomic status of each family decides which access to healthcare is granted due to the form of health insurance provided. Health literacy rates depend highly on the educational level, correlate with health inequalities and influence health-related decisions such as breastfeeding strongly. This study presents first findings of problem-centered interviews (N=9) from a case-study in Guadalajara, Mexico. It shows a possible starting point to integrate the usage of digital devices in the Mexican public health sector to interact with new mothers who are hospitalized after having given birth. Findings suggest that the use of digital technology could help to raise the health literacy in the specific decision of breastfeeding.

Keywords: Breastfeeding, Healthcare, Inequality, Mexico, Technology

1 Introduction

Many countries have initiated attempts to reduce health inequalities. Improving health equity requires extensive collaboration between health and other sectors using evidence arising from new and innovative research strategies (Beckfield et al. 2015). Inequalities in healthcare have been analyzed and researched on several levels and in different country settings (Atun et al., 2015). The powerful role of health literacy as a concept to enable patients to better understand their health condition and make respective decisions with less uncertainty has been discussed extensively and with diverse perspectives since almost 50 years (Simonds, 1974). Not only has its importance been highlighted, but it is considered a global strategy. I Its goal has been to focus on the individual patients and the level of information they receive (Juvinyá-Canal et al., 2018). The interdependence of health inequalities and health literacy is underlined by the consensus of the European Consortium on Literacy for Health which defines the knowledge of relation, abilities and the opportunity of understanding and applying information related to individual health (Sørensen et al. 2012). People's literacy

level affects their ability to access health information, to learn about pre-care and health promotion, to follow treatments and communicate about health issues with others, and take decisions on a daily basis (Doson et al., 2015, Juvinyá-Canal et al., 2018). Moreover, there is a strong correlation between literacy and health self-assessment, and literacy has a specific, direct and independent effect on the assessment of health (Juvinyá-Canal et al., 2018).

1.1 Motivation

Despite these positive effects of health education for patients, health services globally struggle when it comes to professionally trained personnel, who can provide adequate care levels and fulfill the demand for a rising level of information. We argue that a digitalized education may serve as an alternative way to raise the level of individual health literacy of new mothers with a possible consequence of a direct impact of the children's health (Juvinyà-Canal et al., 2018).

1.2 Relevance

In Mexico, in a health system where prevention, pre-conception care and prenatal control are vulnerable, it is complicated for mothers to prepare for the arrival of their children, both physically and by informing themselves about pregnancy and breastfeeding (Gonzalez de Cosio, 2016). Especially, if they are not women with previous pregnancies their experience is only empirical, and transmitted by previous generations of other women in their family group and acquaintances. The influence of (older) family members is relevant for the transmission of cultural beliefs and nutrition habits between generations (Cosío-Martínez et al., 2017). The Mexican case study therefore presents an interesting case as there is a wide fragmentation and diversification within the system itself.

1.3 Aim of this contribution

This research first works out the advantages of increased health literacy for the decision process, then analyzes the Mexican health care system and answers the question of why it can make sense to take supporting action with digital contents. Finally, it presents first results of a possible solution to deal with the problem of a lack of knowledge of new mothers in the decision taking process of breastfeeding.

Specifically we ask: How could the specific knowledge of the benefits of breastfeeding be improved during hospitalization? How could the usage of digital technology be helpful in the context of the over-crowded public Mexican healthcare system? Which outcomes could be measured if minor digital tools are used by the medical staff right after giving birth or within the medical check-ups during a pregnancy?

2 Related work

One of the most important elements in the ability of a woman to engage in health promotion behaviors to protect their neonates and themselves is maternal health literacy. Cross-sectional studies have revealed that inadequate health literacy could be associated with adverse effects on health knowledge, preventive behaviors, use of preventive services, and the ability of mothers to care for their infants. (Khorasani et al., 2017).

Exclusive breastfeeding as part of this health education connects a variety of research fields. The knowledge and education about advantages of exclusive breastfeeding is connected to a certain level of education. Non-restricted access to such information is relevant for successful early-childhood health interventions. The role of the woman and the female image in a society is influencing the situation of a breastfeeding mother. In addition, there are several already researched outcomes of breastfeeding for children's health.

There are measurable variables such as weight gain of a newborn, vulnerability towards infections such as diarrhea, allergies and subjective, qualitative experiences of mothers e.g. bonding with newborn or a healthier lifestyle during the breastfeeding period (Perez-Escamilla et al., 2012). However, the process of

decision making for or against exclusive breastfeeding for the first 6 months of the newborns life is yet not-well examined. Those few studies existing show that in several societies exclusive breastfeeding for the first six months is no longer the norm (Colombara et al., 2015). Morover, the multifactorial determinants need support of several levels which include political guidelines, interventions to social norms and the role of the woman in a society (Swigart et al., 2017). Norms, values and the labor market play crucial roles in the complex context of a new mother to the decision of exclusive breastfeeding or not (cf. Perez-Escamilla et al., 2012, MICS Report, 2016).

It is therefore of due importance for policy-makers and the health system as a complex institution to gather information of women's decisions against exclusive breastfeeding (cf. Victora et al., 2016). After all, if relevant interventions are adequately undertaken and offered to the mothers, the percentage rates of breastfeeding mothers react quickly (Sinha et al., 2015). Sanchez Espino et al. (2019) used an educational intervention approach to improve direct skin-to-skin contact and early breastfeeding in a rural zone in Mexico. They underlined the power of a low-cost intervention which generated the direct skin-to-skin contact generated instead of an incubator as standardized practise. The medical and psychosocial importance of breastfeeding has been highlighted by interdisciplinary research. Nevertheless, the decision taking process has, to our best knowledge, not been researched so far.

We chose the Mexican healtcare system as object of investigation because it has two characteristics that are essential to the objectives of the study:

First, the topic of exclusive breastfeeding has to be researched in a specific country or region in the context that safe access to clean water or high standards of hygiene influence the preparation of milk supplements. This means the situation of developed countries has to be seen differently from the situation in developing or emerging countries (WHO, 1998). Exclusive breastfeeding is highly recommendable in least developed countries with low resources where a high mortality rate because of infectious diseases still exists (Fewtrell et al., 2011). Second, not only the Mexican healthcare system, but health services globally struggle when it comes to professionally trained personnel, their time for adequate care and the demand for more information of patients (Urquieta/Villareal, 2016). A digitalized education targeted to raise the individual health literacy of new mothers could in fact have a direct impact of the children's health (Juvinyà-Canal et al., 2018).

3 Theory

This chapter presents the theoretical background of this study as well as the institutional classification.

3.1 Health inequalities

Health inequalities begin to emerge during childhood and despite global improvements in infant and <5-year-olds' mortality rates in recent decades, significant inequalities in these rates exist within and between countries. Thus, socioeconomic inequalities generate health inequalities and vice versa (see Beckfield et al., 2015, Eikemo, 2008, Mackenbach 2012). Research has also indicated that social and economic factors embedded in societal structures are key drivers of these inequalities (Wilkinson et al., 1998).

The state is responsible to guarantee equity. In political terms, this means that every person is seen equally and has the same rights, independent of their socioeconomic status (Strünck, 2005). As example for political equality, the opportunity to access healthcare is a relevant example. Any deviation of these opportunities is counted as inequality in healthcare. Health inequality is a pressing societal and policy issue as it results in unnecessary premature deaths, entailing large economic costs in terms of lower productivity and higher healthcare costs (Hill, 2017, Mackenbach 2012). The Mexican healthcare system has developed strongly in terms of coverage rates. Although on paper equality and

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Methodological Implications of Research on Technology Use by Healthcare Professionals: A short Introduction to Multidimensional Scaling

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Abstract. Healthcare professionals currently face different challenges in an ongoing reconstruction of care. Digitization and the use of healthcare-related technologies promise both an improvement in quality of care and an increase of treatment efficacy. Especially telemedicine systems seem to be capable to overcome current spatial and temporal limitations of care. As telemedicine appears to be a non-uniform term describing a variety of technological characteristics, the explanatory power of entrenched models for technology use varies across different contexts of use. To explore important contextual factors in the field of healthcare technology research and to enrich the methodological diversity in Information Systems research, this paper provides a short introduction to Multidimensional Scaling. Being able to visualize underlying dimensions of subjective perceptions, Multidimensional Scaling shows complementary applicability and use with regard to elaborated methods and a high integrability into holistic research strategies.

Keywords: Information and Communication Technologies (ICT), Telemedicine, Multidimensional Scaling, Phenomenology, Healthcare

1 Introduction

Information and Communication Technologies (ICT) are recently discussed in their function of highly potent accelerators and catalysts for digitization processes in healthcare (Krick et al., 2019). In its basic function to enable and extend interaction between persons and organizations, ICT promises to address different challenges present in many healthcare systems all over the world. While demographic change and the increase of multi-morbidity among elderly patients (Svensson, 2019) result in a need for coordination of interdisciplinary and intersectoral care, simultaneously an agglomeration of healthcare professionals in urban areas complicates an equitable delivery of care (Wilson et al., 2009). Meanwhile, Primary Care Physicians (PCP) serve as important coordinators in healthcare systems, as they regulate access to general and specialized (medical) care (Bashshur et al., 2016). Therefore, PCPs and their use behavior concerning healthcare-related technologies are of special interest. In the ongoing debate about ICT and its potential to improve quality of care, the use of telemedicine systems in primary care becomes a prominent issue, as telemedicine

systems might be able to overcome spatial and temporal limitations (Bashshur et al., 2016). From this objective, the necessity arises to define theoretical and methodological foundations of research. Primary care consists of many dissimilar facets due to a high variety of medical cases and treatments, while the concept of telemedicine comprises different technological settings (e.g. messaging, medical advice via telephone, audiovisual appointments, etc.). Therefore, generalizing, deductive research methods focusing on user acceptance show some limitations that might be encountered by increasing the methodical variety of research. In this context, a method is needed that is able to explore subjective latent dimensions of technology use, but simultaneously provides the possibility to deduce intersubjective results integrable into structural models. This paper addresses this issue by proposing Multidimensional Scaling as a complementary method and provides legitimation of theoretical considerations.

2 Theoretical Background

Telemedicine appears to be feasible to address current issues concerning different challenges of healthcare systems, as it "provides a virtual environment that enables remote interaction between healthcare professionals and their patients, and among healthcare professionals themselves" (Flumignan et al., 2019, p. 184). From this broad definition, different aspects concerning the concept of telemedicine arise: (1) There are different kinds of technology associated with telemedicine. "Virtual environment" might refer to telephone consultation (Baumeister et al., 2014), a combination of telephone advice and text messaging (van den Berg et al., 2015), an audiovisual appointment between physician and patient (McConnochie, 2019), or other forms of virtual interaction. (2) Telemedicine can be applied to different persons and different numbers of persons. Aside from a direct connection between physician and patient (Reed et al., 2019), other healthcare professionals might as well use telemedicine to connect with patients or other healthcare professionals (Marcolino et al., 2013). (3) Different patients or groups of patients can be addressed through the use of telemedicine systems. While some studies focus on heterogeneous groups of patients in primary care, e.g., patients with non-specific chronic diseases associated with a single PCP's practice (Orozco-Beltran et al., 2017), others report the use of telemedicine for very specific diagnostic procedures, but for a whole population of patients (Stanimirovic et al., 2020). These aspects show that studies investigating factors constituting user acceptance of telemedicine systems are not easy to compare. The explanatory power of generalizing models to explain user acceptance, e.g., the Technology Acceptance Model (TAM) (Davis, 1989), therefore varies strongly across different contexts of telemedicine use by healthcare professionals (R^2 varies from 0.161 to 0.78 in a review of different theoretical models predicting end user acceptance by Harst et al. (2019)). Thereby, uncertainty about an actual positive effect on patient related outcomes might even intensify the prediction of user acceptance amongst healthcare professionals. Designated the highest standard for systematic reviews in evidence-based healthcare, the Cochrane Library lists twelve different reviews directly addressing issues of telemedicine and its general usefulness in different medical disciplines. In summary, the majority of these reviews leads to the impression that sufficient evidence for an actual positive effect on patient outcomes is currently not given (Flumignan et al., 2019).

Taking into account these current issues in research on telemedicine systems and user acceptance of healthcare professionals as well as considering the importance of theoretical contextualization to improve description, explanation, and prediction of relevant phenomena (Hong et al., 2014), one might ask for a theoretical approach to formulate methodological implications that are able to

enrich the current set of methods used for research. Phenomenology appears to be an evolving approach in healthcare research to explore context-specific facets of phenomena (Carel, 2011), while being considered relevant for explaining healthcare professionals' use of digital technologies (Müller et al., 2020). Generally speaking, a phenomenological approach focuses on subjective human experience, e.g., using a telemedicine system to advice patients in a critical situation related to their chronical disease. To understand a phenomenon completely, such an approach asks to explore contextual (subjective) facets of the phenomenon and, by comparing it with similar experiences, extract the essence of it (Husserl, 2019). Such essential factors might then be integrated into generalizing (existent) models to be tested deductively. Introna and Ilharco (2004) demonstrate such a phenomenological *reduction* on the example of screens. While different research methods can be integrated into a phenomenological approach, in the context of user acceptance concerning telemedicine systems primarily explorative and inductive methods seem to be of interest. Following Carel (2011) on her assumption that human experience is based on perception, Multidimensional Scaling (MDS) offers an interesting statistical approach as it is capable to visualize individual perceptions on a specific objective and therefore makes it more accessible to analysis. Originating from psychology, an introduction of MDS in the context of technological use by healthcare professionals within Information Systems (IS) research is missing to date. The following section provides an overview of MDS and illustrates its value for this research field of IS exemplarily.

3 Methodological Implications

To understand contextual factors determining the use of telemedicine systems by therapists and patients, it is of great interest to explore their perception on relevance of a specific technology for their professional activity. Following a phenomenological perspective on human experience and its perceptual foundation, one possible way to explore the meaning of relevant technologies for therapists or patients is to analyze (dis)similarities of an individual's ideas about telemedicine (Introna & Ilharco, 2004). Therefore, one is able to recreate a therapist's or a patient's understanding of a 'useful' technology. One method that is capable of visualizing (dis)similarity data is called Multidimensional Scaling. In general, through using MDS one is able to arrange objects in a one- or multidimensional space with regard to their (dis)similarity. The configuration of objects, normally presented in two- or three-dimensional space, can then be interpreted through our visual senses, resulting in an intuitive way of analyzing even complex relations of objects (Borg & Groenen, 2010). In the following, a fundamental methodological introduction to MDS is presented. By comprehending the required statistical operations leading to an MDS configuration, the potential of this method to evaluate context specific aspects of technology use by healthcare professionals and patients unfolds.

An MDS configuration represents (dis)similarities of objects in an m-dimensional space ($m \in \mathbb{N}$). Therefore, it is the basis for an interpretation of underlying factors constituting (dis)similarities. The position of the included objects can be determined by different types of (dis)similarity data, i.e., correlations between objects or ordinal ratings of objects (i.a.). A typical method to collect data of ordinal ratings is to ask participants to compare sets of two different objects (e.g., technologies, countries, food), without specifying any underlying assumptions, on a Likert-scale (Borg & Groenen, 2010). In such a configuration, similar or highly correlated objects are close to each other, while dissimilar or weakly correlated objects are highly distanced (Borg et al., 2013; Borg & Groenen, 2010). To transform (dis)similarity data into distances within a visual representation, i.e., an MDS

configuration, different types of distance functions can be used. The two most commonly used distance functions are the *Euclidean Distance Function* and the *City Block Metric*, which are both specific versions of the *Minkowksi distances*. The following formula is used to calculate the distance $d_{ij}(\mathbf{X})$ between an object i and an object j within an MDS configuration **X** by effectively summing up the differences of i and j in every dimension $a = 1, \ldots, m$ and modelling values of $d_{ij}(\mathbf{X})$ through the parameter p:

$$d_{ij}(\mathbf{X}) = (\sum_{a=1}^{m} |x_{ia} - x_{ja}|^{p})^{\frac{1}{p}}$$

For p=1, the dimensional differences between two objects are summed up without actually modelling the resulting distance $d_{ij}(\mathbf{X})$. This kind of calculation corresponds the following visualization (Figure 1) of distance from one object A to another object B:

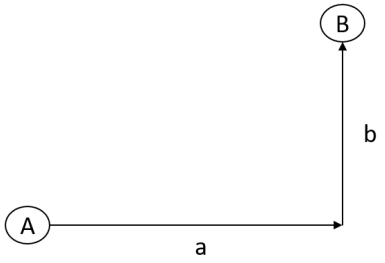

Figure 1. Calculation of distance within the City Block Metric.

The resulting distance is simply calculated through the addition of **a** and **b**. From its analogy to building structures of specific cities (e.g., New York) this kind of distance calculation is called *City Block Metric* (Borg & Groenen, 2010). In contrast, for calculating the Euclidean distance (p=2) between objects, dimensional distances are summed, squared, and finally their square root is taken. The following figure illustrates this kind of distance calculation:

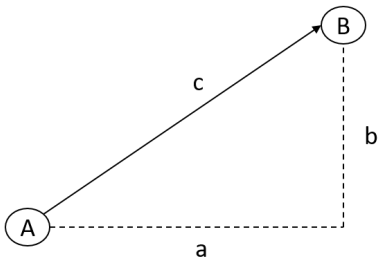

Figure 2. Calculation of distance within the Euclidean Distance Function.

The resulting distance between **A** and **B** in Figure 2 is **c**, calculated from **a** and **b**. MDS configurations are typically generated through an iterative process. Included objects are positioned in an m-dimensional space until their distances represent the objects' (dis)similarities as precisely as possible. For this step, different types of algorithms are used, e.g., *Torgerson scaling* or the *SMACOF procedure* (for more detailed information consider Borg et al. (2013, 81-86). To better interpret an MDS configuration, it is helpful to identify specific patterns of objects. Geometrical differentiations then need to be linked to content-related differentiations. In general, these content-related differentiations are based on heuristics, empirical and/or theoretical findings (Borg & Groenen, 2010). Figure 3 illustrates an example for an MDS configuration calculated with R (R Core Team, 2019) and the package *smacof* (Leeuw & Mair, 2009) using the *Euclidean Distance Function*. The configuration is based on data that results from pairwise ratings of healthcare-related technologies. Each data point represents an individual's comparison of two technologies on a 9-point Likert Scale (1-very similar to 9-very dissimilar). Overall, ten different technologies were rated (equal to 45 different ratings). For illustration in the context of this paper, data of the exemplary configuration was generated by the author's comparison of technologies that were discussed by PCPs and PCPs' assistants within a regional project about the digitization of home visits through tele-medical technologies. It is important to note that the assigned numbers on the dimensions of Figure 3 do not represent specific numerical values that can be assigned

to the objects (especially the zero points of the axes), but are only for orientation. As a possible interpretation for the distribution of the objects in Figure 3, dimension 1 might represent the intensity of physical contact between healthcare professional and patient. Objects on the left (i.e., Blood Coagulation Monitor [BCM], Blood Glucose Meter [BGM], and Blood Pressure Monitor [BPM]) appear to be associated with the most invasive interactions involving the patient. For measuring the blood coagulation and the blood glucose level of a patient, it is necessary to extract capillary blood, while the measurement of blood pressure requires direct contact to a patient repeatedly, especially while palpating the patient's pulse. In contrast, objects on the right (i.e., Digital Medical Visit [DMV], Smartphone [SP] and Electronic Health Record [EHR]) are associated with an interaction of the healthcare professional with a specific technology, e.g., documenting relevant patient-related information in an EHR, without having actually physical contact to a patient. For dimension 2, the degree of digitization appears to be a possible explanation. As venoscopes and infrared thermometers for ambulant care are currently designed mainly for analogous use, technologies like a tele-medical stethoscope or a mobile Electrocardiogram [ECG] are capable to transmit data via remote connections between physician and patient or physician and physician's assistant. Furthermore, the already mentioned objects on the left, associated with more invasive interactions between physician (or assistant) and patient, are currently combined with automated data storage and/or transmission and therefore can be thought of as technologies integrating digital functionality. Noteworthy, the interpretation of specific geometrical distributions of objects in an MDS configuration depends on a priori assumptions, hypotheses, or heuristics of the person interpreting it. To visualize an intersubjective understanding of a phenomenon, different individual ratings can be summarized into a single configuration by using specific algorithms. As a result, a common geometrical space for different subjective ratings can be generated, from which generalizable tendencies can be deduced (Carroll & Chang, 1970).

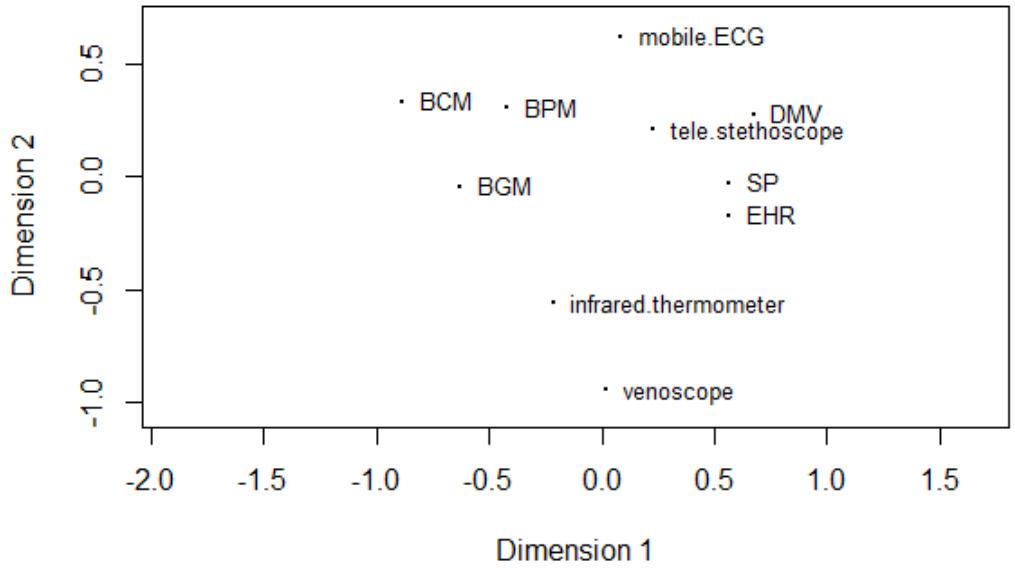

Figure 3. Exemplarily explorative MDS configuration for preference data

One possibility to visualize multiple individual perceptions on a set of objects (i.e., healthcare-related technologies in this context) is to use Unfolding Models, a type of Multidimensional Scaling that is based on hierarchical sorting. To evaluate the goodness of an MDS configuration, residuals are basically calculated through summing up the differences between configuration mapped distances and empirical (dis)similarity data. These residuals are then modified (e.g., through normalization) and transformed into different measures of fit, the so-called stress measures (Borg et al., 2013).

4 Discussion

In general, MDS can be used for both purposes to generate and to test hypotheses (Borg & Groenen, 2010). In its function to generate (or explore) hypotheses, MDS appears to be a suitable method to gain insights upon a research objective that needs to be further contextualized. Through the visualization of subjective and intersubjective perceptions regarding the (dis)similarity of specific objects, one is able to generate hypotheses, which can be tested deductively in the ongoing process of research. Although MDS is capable of illustrating subjective perceptions of a person or persons, qualitative interviews (especially semi-structured or open ones) normally generate more detailed insights. For a purely explorative approach, it might therefore be reasonable to conduct interviews before using preference data to select a group of analyzable objects for a later statistical analysis through MDS. Additionally, interviews conducted after explorative MDS might be very helpful to discuss the interpretation of an MDS configuration with participants, especially when it seems difficult to name dimensions of the configuration. While different qualitative interviews are not easy to compare because of their non-uniform structure, MDS configurations are calculated through a standardized process. By comparing different MDS configurations or integrating various individual configurations, intersubjective results can be generated.

Considering further inductive methods, explorative MDS and Exploratory Factor Analysis (EFA) both are utilized to find hidden structures in data. While explorative MDS is applied to find latent dimensions persons use for their judgements on specific objects or groups of objects (Borg & Groenen, 2010), the concept of EFA is based on the assumption that underlying factors account for relationships between specific variables (Kline, 1994). Although MDS configurations can be calculated through both subjective ratings and correlation of objects, EFA only uses the latter. As EFA is normally conducted with items based on psychometric assessments, one might argue that EFA requires a higher amount of a priori information than explorative MDS (for which subjective ratings are sufficient), but provides results that are easier to interpret. Analogically, confirmatory MDS and Confirmatory Factor Analysis (CFA) share a common requirement to formulate latent dimensions or factors to be tested, but differ in the extent to which such information has to be determined. As MDS and Factor Analysis therefore share a common understanding of latent dimensions constituting relationships between specific variables, MDS might also be utilized to inform structural models, which are key elements of Structural Equation Modeling (Little & Kline, 2016). Therefore, MDS can be considered valuable, especially through combination with other already entrenched methods in the field of IS research to enrich a methodological diversity (Venkatesh et al., 2013).

5 Conclusion

Following a phenomenological perspective on technology use by healthcare professionals, this paper introduces explorative MDS as a method to gain insights on contextual factors (or dimensions) constituting a wide range of explanatory power concerning generalizing models. While MDS is compared to other research methods in the field of IS, its comparability and integrability is demonstrated. As the scope of this paper and the illustration of

MDS is limited to its explorative approach, different issues have to be addressed by future research. Therefore, an analysis of hierarchical sorting data of PCPs and PCSs' assistants from an online survey by using Unfolding Models is considered a possible next step to demonstrate the practical application of MDS.

6 References

Bashshur, R. L., Howell, J. D., Krupinski, E. A., Harms, K. M., Bashshur, N., & Doarn, C. R. (2016). The Empirical Foundations of Telemedicine Interventions in Primary Care. *Telemedicine Journal and E-Health : The Official Journal of the American Telemedicine Association*, *22*(5), 342–375. https://doi.org/10.1089/tmj.2016.0045

Baumeister, S. E., Gelberg, L., Leake, B. D., Yacenda-Murphy, J., Vahidi, M., & Andersen, R. M. (2014). Effect of a primary care based brief intervention trial among risky drug users on health-related quality of life. *Drug and Alcohol Dependence*, *142*, 254–261. https://doi.org/10.1016/j.drugalcdep.2014.06.034

Borg, I., & Groenen, P. J. F. (2010). *Modern multidimensional scaling: Theory and applications* (2nd ed.). *Springer series in statistics*. Springer.

Borg, I., Groenen, P. J. F., & Mair, P. (2013). *Applied multidimensional scaling*. *SpringerBriefs in Statistics*. Springer. https://doi.org/10.1007/978-3-642-31848-1

Carel, H. (2011). Phenomenology and its application in medicine. *Theoretical Medicine and Bioethics*, *32*(1), 33–46. https://doi.org/10.1007/s11017-010-9161-x

Carroll, J. D., & Chang, J.-J. (1970). Analysis of individual differences in multidimensional scaling via an n-way generalization of "Eckart-Young" decomposition. *Psychometrika*, *35*(3), 283–319. https://doi.org/10.1007/BF02310791

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319. https://doi.org/10.2307/249008

Flumignan, C. D. Q., Rocha, A. P. d., Pinto, A. C. P. N., Milby, K. M. M., Batista, M. R., Atallah, Á. N., & Saconato, H. (2019). What do Cochrane systematic reviews say about telemedicine for healthcare? *Sao Paulo Medical Journal = Revista Paulista De Medicina*, *137*(2), 184–192. https://doi.org/10.1590/1516-3180.0177240419

Harst, L., Lantzsch, H., & Scheibe, M. (2019). Theories Predicting End-User Acceptance of Telemedicine Use: Systematic Review. *Journal of Medical Internet Research*, *21*(5), e13117. https://doi.org/10.2196/13117

Hong, W., Chan, F. K. Y., Thong, J. Y. L., Chasalow, L. C., & Dhillon, G. (2014). A Framework and Guidelines for Context-Specific Theorizing in Information Systems Research. *Information Systems Research*, *25*(1), 111–136. https://doi.org/10.1287/isre.2013.0501

Husserl, E. (2019). *First Philosophy: Lectures 1923/24 and Related Texts from the Manuscripts (1920-1925)*. *Husserliana: Vol. 14*. Springer Netherlands. https://doi.org/10.1007/978-94-024-1597-1

Introna, L. D., & Ilharco, F. M. (2004). The ontological screening of contemporary life: a phenomenological analysis of screens. *European Journal of Information Systems*, *13*(3), 221–234. https://doi.org/10.1057/palgrave.ejis.3000503

Kline, P. (1994). *An easy guide to factor analysis*. Routledge. http://lib.myilibrary.com/detail.asp?id=578203

Krick, T., Huter, K., Domhoff, D., Schmidt, A., Rothgang, H., & Wolf-Ostermann, K. (2019). Digital technology and nursing care: A scoping review on acceptance, effectiveness and efficiency studies of informal and formal care technologies. *BMC Health Services Research*, *19*(1), 400. https://doi.org/10.1186/s12913-019-4238-3

Leeuw, J. de, & Mair, P. (2009). Multidimensional Scaling Using Majorization: SMACOF in R. *Journal of Statistical Software*, *31*(3), 1–30. URL http://www.jstatsoft.org/v31/i03/

Little, T. D., & Kline, R. B. (Eds.). (2016). *Methodology in the social sciences*. *Principles and practice of structural equation modeling* (Fourth edition). The Guilford Press.

Marcolino, M. S., Maia, J. X., Alkmim, M. B. M., Boersma, E., & Ribeiro, A. L. (2013). Telemedicine application in the care of diabetes patients: Systematic review and meta-analysis. *PloS One*, *8*(11), e79246. https://doi.org/10.1371/journal.pone.0079246

McConnochie, K. M. (2019). Webside Manner: A Key to High-Quality Primary Care Telemedicine for All. *Telemedicine Journal and E-Health : The Official Journal of the American Telemedicine Association*, *25*(11), 1007–1011. https://doi.org/10.1089/tmj.2018.0274

Müller, M., Knop, M., Ressing, C., Freude, H., Oschinsky, F. M., Klein, H. C., & Niehaves, B. (2020). Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas. In T. Bui (Ed.), *Proceedings of the Annual Hawaii*

International Conference on System Sciences, Proceedings of the 53rd Hawaii International Conference on System Sciences. Hawaii International Conference on System Sciences. https://doi.org/10.24251/HICSS.2020.447

Orozco-Beltran, D., Sánchez-Molla, M., Sanchez, J. J., & Mira, J. J. (2017). Telemedicine in Primary Care for Patients With Chronic Conditions: The ValCrònic Quasi-Experimental Study. *Journal of Medical Internet Research*, *19*(12), e400. https://doi.org/10.2196/jmir.7677

R Core Team. (2019). *R: A language and environment for statistical computing.* URL http://www.R-project.org/

Reed, M. E., Huang, J., Parikh, R., Millman, A., Ballard, D. W., Barr, I., & Wargon, C. (2019). Patient-Provider Video Telemedicine Integrated With Clinical Care: Patient Experiences. *Annals of Internal Medicine*, *171*(3), 222–224. https://doi.org/10.7326/M18-3081

Stanimirovic, A., Francis, T., Shahid, N., Sutakovic, O., Merritt, R., Brent, M. H., & Rac, V. E. (2020). Tele-retina screening of diabetic retinopathy among at-risk populations: An economic analysis. *Canadian Journal of Ophthalmology. Journal Canadien D'ophtalmologie*, *55*(1S1), 8–13. https://doi.org/10.1016/j.jcjo.2019.06.008

Svensson, A. (2019). Challenges in Using IT Systems for Collaboration in Healthcare Services. *International Journal of Environmental Research and Public Health*, *16*(10). https://doi.org/10.3390/ijerph16101773

van den Berg, N., Grabe, H.-J., Baumeister, S. E., Freyberger, H. J., & Hoffmann, W. (2015). A Telephone- and Text Message-Based Telemedicine Concept for Patients with Mental Health Disorders: Results of a Randomized Controlled Trial. *Psychotherapy and Psychosomatics*, *84*(2), 82–89. https://doi.org/10.1159/000369468

Venkatesh, V., Brown, S. A., & Bala, H. (2013). Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems. *MIS Quarterly*, *37*(1), 21–54. https://doi.org/10.25300/MISQ/2013/37.1.02

Wilson, N. W., Couper, I. D., Vries, E. de, Reid, S., Fish, T., & Marais, B. J. (2009). A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas. *Rural and Remote Health*, *9*(2), 1060.

service for all is guaranteed a closer look shows high rates of inequality in terms of rural areas, subgroups of the society as well as dependency on socioeconomic backgrounds (Urquieta/Villareal, 2016). Therefore the socioeconomic situation decides which type of healthcare is accessible and the inequality of health is a major decisive factor (Puig et al., 2009).

3.2 Health literacy

To counter those inequalities, researchers often promote the training of health literacy, whichis explained as the ability to understand health related information in written or oral from and being able to translate this information into action and decisions (Sørensen et al. 2012). The term roots from the clinical perspective and describes a critical risk factor (if not able to understand health related information) and from the public health sector when it comes to the personal asset of being able to transform the information e.g. into health related behaviour (Nutbeam, 2008). The public health' point of view is strongly related to ideas of socioeconomic and educational inequalites (Mackenbach, 2012) which, as stated above, lead to health inequalities overall. The relation between health literacy and health inequalities is a persistent one. Research shows that both theorized concepts, even if they range between the individual to a systemic or institutional level, are strongly connected to each other (Betterham et al., 2016, Volandes/Paasche-Orlow, 2007).

The relation between health literacy and any digitalized access to health is highly relevant to the successful usage of digital tools of all kind. All forms of digitalized usage of mobile and digital health information has become more important over the last decade. The used applications need to be applied to the potential consumer taking into consideration their level of health literacy (Kreps, 2017, Anstey Watkins et al., 2018).

3.3 Mexican Healthcare System

The Mexican healthcare system is broadly spoken devided into three different pillars.

The first is formed by the social security institutions which are led by the federal government and mostly financed by manditory employer, employee and government contributions. The services are free of charge for members in the clinics and centers run by the *Instituto Mexicano del Seguro Social* (IMSS), the Mexican social security institute. A smaller part of this string is designed for civil cervants (ISSSTE), the armed forces and workers in the biggest petrol fabric (PEMEX) (OECD, 2017).

The second pillar is organized mainly by the Ministry of Health (MoH) which is responsible for the population who is not in formal employment situations. Each health insurance covers different health services and guarantees access to distinguished health centers, diagnostical tools and the type of hospital (Puig et al., 2009). In Mexico a 3.6% equivalent to 2.1 million people do not count with formal employment and regular salaries according to a report by the National Institute of Statistics and Geography (INEGI, 2015). The social health insurance program which was in place during this study was called *Seguro Popular*. The ongoing reform renamed it now as *INSABI*. It is mainly financed by public funds and added up with modest user fees for affluent users.

The insurance program "*Seguro Popular*", which was still in place during this research, was created as a public policy that sought, through public health insurance, to provide financial protection to the population that lacks social security, ensuring thus their access to health services. This program was intended, among other things, to strengthen the actions involved with mother and child health and to implement a system to prevent complications before, during and after pregnancy, for mother and child (Mexican Government, 2018).

The third pillar represents the private health sector which is highly unregulated but plays a

significant role in the Mexican healthcare system. The respective quality, prices and accessibility vary. However, these services are often used to avoid waiting periods, receive test results more quickly and enjoy direct contact to a practioner. Most private services are financed directly out-of-pocket. The invention of *Seguro Popular* has strongly minimized the out-of-pocket payments (OECD, 2017) but there is still work to be done as it covers about 41% of overall health spending per household, which is the second highest in the OECD comparison (OECD, 2017).

Consequently, we therefore argue that the Mexican healthcare system struggles because of overstrain, lack of time for medical staff to explain the benefits of breastfeeding and institutional factors that mothers do not knot know sufficiently of the measurable advantages of breastfeeding. We therefore conducted an intervention study to investigate whether the provision of information about exclusive breastfeeding, available on a mobile device, has a positive effect on the health literacy of hospitalized mothers.

4 Data and Methods

This study uses the technique of problem-centered interviews (Witzel/Reiter, 2012). Within the semi-standardized interviews we utilized a deductively developed questionnaire which combined closed and open ad-hoc questions to compare results between interviees as well as gaining in-depth knowledge about the construct of breastfeeding in the Mexican health system.

Empirical data was collected in may 2019 in the “Hospital civil Dr. Juan I. Menchaca” in urban Guadalajara, Mexico. The interview guideline was designed to gain in-depth knowledge of the experiences mothers had when giving birth in different institutional settings within the health system in Mexico and additionally of their knowledge of breastfeeding (complete questionnaire upon request).

Mothers were interviewed while they or their children were hospitalized. All mothers gave oral consent to use their data trustworthily and in an anonymized way. In total we interviewed nine mothers in this hospital. All of them stopped working because of the pregnancy or do not work in general which excluded work as a main opportunity cost to stop breastfeeding.

If mothers had never heard of breastfeeding or could not provide any information about that topic and its positive consequences, we conducted a direct intervention by the use of digital media technology. This utilized intervention needed low digital capacity from the participants, as this knowledge might always be a limiting factor when using digital technologies (cf. Deiters et al. 2018).

Participants watched videos on 1) the topic of breastfeeding in general, 2) breastfeeding techniques and 3) advice on storing human milk. We used an IPad as a visual and auditory support, thus projecting bed by bed and contributing to the information through digitalization.

The videos were obtained from the course of advisors in breastfeeding, which is provided by the foundation of Carlos Slim "Capacítate para el empleo" (Fundación Carlos Slim, 2019) and are easy to understand in all strata. In addition, the techniques and information provided at the end of the interviews about breastfeeding were taken from the manual of the "Advanced Course of Support to Breastfeeding" (CAALMA by its acronym in Spanish) (Vazquez-Reyes/Martinez Gonzalez, 2018).

After the intervention, mothers were asked if there was a difference in their perception of the topic, and if they believed that they were better informed than before, as well as if they understood what they were being informed about. They answered to be more positive and optimistic towards the topic knowing more techniques. Women felt encouraged to try exclusive breastfeeding.

In addition, we encouraged them to continue watching videos, join breastfeeding groups in social networks and use media such as Facebook®, youtube®, etc., with previous medical guidance to continue updating on this issue that has a significant social, economic, and health impact, which is a reflection of the quality of life of an entire country.

5 Analysis

Women in our sample did not have a high socioeconomic status and most of them, although they had taken prenatal care during their pregnancy, did not have sufficient pre-conceptional knowledge. During the prenatal control, although they had been informed about lactation and the benefits that it can have in the short and long term to their newborns, few had knowledge of the subject of lactation in an exclusive way. Only one out of nine interviewees could explain what exclusive breastfeeding means. Several participants stated that they supplemented the breastmilk with tea, water or formula milk (I2, I4, I5).

Although they had access to media, social networks, and the internet, most mothers in our study had not used the media for health education or had not received the benefits that digitalization can offer. As a result, most mothers were unaware of the enormous variety of benefits of breast milk. None of them were hardly able to mention at least one benefit like the reduced economic cost, the lower need of material such as baby bottles and their desinfection and lower probability of diseases for their babies (I2, I3, I5, I8).

Moreover, the different techniques of breastfeeding, the techniques of expressing and storing milk, the nutrients it contains, the length of breastfeeding and more specific issues were never mentioned. In addition myths and cultural influences are strong when it comes to exclusive breastfeeding. One interviewee (I2) explained "neighbours told me that I should not breastfeed my child as I was getting angry and was fighting a lot with my husband. They told me I will transmit all my anger to the baby through my milk"[1].

After intervention, however, participants stated that they will now intend to practice exclusive breastfeeding to the best of their ability. Mothers gained knowledge, myths and false information were clarified.

6 Discussion

The experience with the participants who were informed by videos was satisfactory for the intervening medical staff, since we were able to highlight the importance of the information. The natural interview scenario as well as the professional environment without influences by family members generated an open space to discuss questions and the lack of information. We found evidence that the information shared had a positive impact on those mothers who received the guidance on an individual level. Thus, the usage of digital tools helped medical staff to improve the individual health literacy on one specific topic in an efficient amount of time.

Of course our study has limitations. In this preliminary study, due to the small sample size and the limited setting, we do not aim to generate representive outcomes. Other measurable tools and an outcome check to evaluate the results could help to confirm findings in the future. In addition, although all mothers stated after the intervention that they now want to engage more in exclusive breastfeeding than before, we cannot rule out that social desirability distorts our results. In addition, it was not possible to control the potential change in behaviour. Nevertheless, the study shows a potential technique to generate relevant improvement of health literacy for new mothers in developing countries using small digital technologies as supporting tools. Not only could this usage of digital tools help to minimize persistent health

[1] Translated from Spanish to English.

inequalities which are strongly related to individual health literacy. A generalized and standardized usage of these tools might even help to even improve the institutional conditions for all new mothers within the Mexican healthcare system.

References

Anstey Watkins, J., Goudge, J., Gómez-Olivé, F. X., Huxley, C., Dodd, K., & Griffiths, F. (2018). Mhealth text and voice communication for monitoring people with chronic diseases in low-resource settings: A realist review. BMJ Global Health, 3(2), e000543. https://doi.org/10.1136/bmjgh-2017-000543.

Atun, R., Andrade, L. O. M. de, Almeida, G., Cotlear, D., Dmytraczenko, T., Frenz, P., Garcia, P., Gómez-Dantés, O., Knaul, F. M., Muntaner, C., Paula, J. B. de, Rígoli, F., Serrate, P. C.-F., & Wagstaff, A. (2015). Health-system reform and universal health coverage in Latin America. The Lancet, 385(9974), 1230–1247. https://doi.org/10.1016/S0140-6736(14)61646-9

Beckfield, J., C. Bambra, T. Eikemo, T. Huijts, C. Wendt (2015): A Theory of Welfare State Effects on the Distribution of Population Health, Social Theory and Health, 13, p. 227-244.

Batterham, R. W., Hawkins, M., Collins, P. A., Buchbinder, R., & Osborne, R. H. (2016). Health literacy: Applying current concepts to improve health services and reduce health inequalities. Public Health, 132, 3–12. https://doi.org/10.1016/j.puhe.2016.01.001

Colombara, D. V., Hernández, B., Gagnier, M. C., Johanns, C., Desai, S. S., Haakenstad, A., McNellan, C. R., Palmisano, E. B., Ríos-Zertuche, D., Schaefer, A., Zúñiga-Brenes, P., Zyznieuski, N., Iriarte, E., & Mokdad, A. H. (2015). Breastfeeding Practices among Poor Women in Mesoamerica. The Journal of Nutrition, 145(8), 1958–1965. https://doi.org/10.3945/jn.115.213736

Cosío-Martínez, T. G. de, Hernández Cordero, S., Rivera-Dommarco, J., & Hernández-Ávila, M. (2017). Recomendaciones para una política nacional de promoción de la lactancia materna en México: postura de la Academia Nacional de Medicina, Salud publica de Mexico, 59(1), 106–113. https://doi.org/10.21149/8102

Deiters, W., Burmann, A., & Meister, S. (2018). Digitalisierungsstrategien für das Krankenhaus der Zukunft [Strategies for digitalizing the hospital of the future]. Der Urologe. Ausg. A, 57(9), 1031–1039. https://doi.org/10.1007/s00120-018-0731-2

Dodson S., Good S., Osborne RH. Health literacy toolkit for low- and middle-income countries: a series of information sheets to empower communities and strengthen health systems. New Delhi: World Health Organization, Regional Office for South-East Asia, 2015.

Juvinyà-Canal, D., Bertran-Noguer, C., & Suñer-Soler, R. (2018). Alfabetización para la salud, más que información. Gaceta Sanitaria, 32(1), 8–10. https://doi.org/10.1016/j.gaceta.2017.07.005

Gonzalez de Cosio-Martinez T, Hernandez Cordero S. (2016) Lactancia materna en Mexico Recomendaciones para el diseño e implementación de una política nacional multisectorial de promoción, protección y apoyo de la lactancia materna en México.

Hill, S. A. (2017). Inequalities and African-American health: How racial disparities create sickness. Policy Press.

INEGI, Instituto Nacional de Estadística y Geografía, 2015 https://www.inegi.org.mx/temas/derechohabiencia/ (April 11 2020).

Khorasani E-C, Peyman N, Esmaily H. (2017) Relations between Breastfeeding Self-efficacy and Maternal Health Literacy among Pregnant Women Evidence Based Care Journal, 6 (4): 18-25. Doi: 10.22038/ebcj.2016.7986

Mackenbach, J. P. (2012). The persistence of health inequalities in modern welfare states: The explanation of a paradox. Social Science & Medicine (1982), 75(4), 761–769. https://doi.org/10.1016/j.socscimed.2012.02.031

Mexican Government (2018) Seguro Popular Program, https://www.gob.mx/salud/seguropopular (April 12 2020).

MICS Report Mexiko (2016): Instituto Nacional de Salud Pública y UNICEF México, Encuesta Nacional de Niños, Niñas y Mujeres 2015 - Encuesta de Indicadores Múltiples por Conglomerados 2015, Informe Final. Ciudad de México, México: Instituto Nacional de Salud Pública y UNICEF México.

Nutbeam, D. (2008). The evolving concept of health literacy. Social Science & Medicine (1982), 67(12), 2072–2078. https://doi.org/10.1016/j.socscimed.2008.09.050

Puig, A., Pagán, J. A., & Wong, R. (2009). Assessing quality across healthcare subsystems in Mexico. The Journal of Ambulatory Care Management, 32(2), 123–131. https://doi.org/10.1097/JAC.0b013e31819942e5

Programa seguro popular, 2005. Centro de estudios sociales y de opinion publica. Pag 28.

Fundacion Carlos Slim (2019) Capacitate para el empleo https://capacitateparaelempleo.org, Cursos, salud, Asesor en lactancia materna. (April 12 2020)

OECD (2017) Health at a Glance, Kex findings Mexico, www.oecd.org/health/health-at-a-glance.htm (April 12 2020).

Perez-Escamilla, R., Curry, L., Minhas, D., Taylor, L., Bradley, E. (2012): Scaling up of breastfeeding promotion programs in low- and middle-income countries: the "breastfeeding gear" model. 3: S. 790–800.

Roberts, T. J., Carnahan, E., & Gakidou, E. (2013). Can breastfeeding promote child health equity? A comprehensive analysis of breastfeeding patterns across the developing world and what we can learn from them. BMC Medicine, 11, 254. https://doi.org/10.1186/1741-7015-11-254

Sanchez-Espino, L. F., Zuniga-Villanueva, G., & Ramirez-GarciaLuna, J. L. (2019). An educational intervention to implement skin-to-skin contact and early breastfeeding in a rural hospital in Mexico. International Breastfeeding Journal, 14, 8. https://doi.org/10.1186/s13006-019-0202-4

Simonds, Scott K. (1974) Health Education as Social Policy - https://journals.sagepub.com/doi/10.1177/109019817400200S102

Sinha, B., Chowdhury, R., Sankar, J., Martines, J., Taneja, S., Mazumder, S. (2015): Interventions to improve breastfeeding outcomes: a systematic review and meta-analysis. In: Acta paediatrica 104 (467), S. 114–134.

Swigart, T. M., Bonvecchio, A., Théodore, F. L., Zamudio-Haas, S., Villanueva-Borbolla, M. A., & Thrasher, J. F. (2017). Breastfeeding practices, beliefs, and social norms in low-resource communities in Mexico: Insights for how to improve future promotion strategies. PloS One, 12(7), e0180185. https://doi.org/10.1371/journal.pone.0180185

Urquieta-Salomón, J. E., & Villarreal, H. J. (2016). Evolution of health coverage in Mexico: Evidence of progress and challenges in the Mexican health system. Health Policy and Planning, 31(1), 28–36. https://doi.org/10.1093/heapol/czv015erez

Vazquez-Reyes, H.L., Martinez Gonzalez A. (2018) Manual Del Curso Avanzado de Apoyo a la lactancia Materna CAALMA, Asociacion pro lactancia materna A.C.

Volandes, A. E., & Paasche-Orlow, M. K. (2007). Health literacy, health inequality and a just healthcare system. The American Journal of Bioethics: AJOB, 7(11), 5–10. https://doi.org/10.1080/15265160701638520

Wilkinson, Richard G, Marmot, Michael (1998) World Health Organization. Regional Office for Europe, WHO Centre for Urban Health (Europe) & International Centre for Health and Society.

Witzel, A., & Reiter, H. (2012). The problem-centred interview: Principles and practice. SAGE.

Weltgesundheitsorganisation, New York.

World Health Organization (WHO) (1998): Complementary feeding of young children in developing countries: a review of current scientific knowledge. World Health Organization, Geneva.