An Ontological Model for Indigenous Knowledge of Malay Confinement Dietary

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***Abstract*—Science and technology are intimately linked to the studies and expansion in the general progression of the society. However, Indigenous Knowledge (IK) which holds the same weight-age as the development of the society with science seems to be forgotten and it leads to its extinction. IK is a tacit, scattered and unorganized knowledge that being used by the people in certain environments in making their living such as health, spiritual and agriculture. Hence, this research intends to gather, structure and model Malay indigenous health knowledge with scope focuses on the Malay confinement dietary. This qualitative interpretive research is using a sampling of the purposive method in order to gather the data through the interviews with Malay traditional midwives, gynecologist and dietician. Then, the conceptual analysis is used to structure the unorganized data from the interviews. The ontological model is then developed and it is divided into five main classes which are the food, food pyramid, restriction, nutrient deficiency, and reason. The classes will be linked to each other through object properties of isEnhance, hasReason, hasRestriction and hasLevel. The web prototype is developed in Eclipse by using J2EE library integrated with Jena framework. This research contributes on modeling Malay confinement dietary into ontological model besides discovering the relationship indirectly between the scientific towards practicing of Malay confinement dietary.**

***Index Terms*—ontology, indigenous, knowledge, Malay, confinement, dietary**

I. Introduction

In the society, science and technology are closely linked feature for the studies and development in the general advancement of the society [1]. Since its rapid development, most of the new scientific knowledge had been developed day by day. Although modern science could be considered as one of the most important fields now, but [2] argues that modern science with the help of Indigenous Knowledge (IK) can be the potential to meet the hassles of the developing world. IK can be defined as knowledge that being used by the local people in certain environments in making their living [3]. However, people tend to forget about IK and according to [4] and [5], IK needs to be supported and promoted because it is a very sensitive issue that related to cultural and ethnicity of corresponding stakeholders. Indigenous Knowledge can be considered as one of the most important elements of the cultural identity. Although there are increasing attentions of indigenous knowledge received by academic and the development institutions but it does not yet lead to a common perception by articulating that the concept of indigenous knowledge is less important which will lead to the extinction of the knowledge [6].

There is no specific way to preserve the knowledge itself but an appropriate search and retrieval mechanism such as an ontological model is important and needed to describe the concept of the Indigenous Knowledge which is one of the tacit knowledge which belongs to individuals. The necessities then are needed to preserve the IK which is scattered and unorganized [7][8]. The scope of the Indigenous Knowledge in this research is within the Malay culture in Malaysia. The focus is on the Malay confinement dietary. There is a lot of important knowledge that can be captured from the traditional Malay midwife on the dietary restriction during the confinement period. This knowledge is rich but it is in a tacit form as it has been accumulated generation to generation.

II. Related Works

A. Indigenous Knowledge

IK is defined by [3] as the knowledge that being used by the local people in certain environments in making their living. This statement is in agreement with the definition by [9] and [10] which stated that IK generally means as a traditional practices and culture which involve the beliefs, rituals and expressions of cultural values. However, according to [11], IK should be differentiated from local knowledge. Local knowledge is more focused on the knowledge of the people which had stayed in a certain area for a long time. Meanwhile, IK itself refer to the knowledge of the original habitants of a particular geographic location. In conclusion, IK is not associated

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with the origin habitant but on the ways the habitant view and intermingle with their environment.

Previously, the emphases of IK are on its technicality. Currently, it had gone beyond that technical interpretation. IK at present includes the cultural knowledge such as the political, social, economic and spiritual aspects of life [11]. The culture of certain geographic area had become a vital aspect in determining the IK questions. For instance, spiritual beliefs are one of the IK areas. It concerns about how certain nature may influence the resources that being managed. Besides that, there is no guarantee on how willing the people adopt new resource management strategies to replace the old practiced system. Although there are wide areas or topics being researched in IK, but, the process of gathering this knowledge has been in slow strategies [12].

B. Indigenous Knowledge and Modern Science

Science is a basic part of the individual understanding and whether or not mainly people know it, science has significance for everyone. Previously, western scientists have in general rejected the IK and claimed it as unreliable, non-quantitative, and unempirical [13]. However today, the scientific importance of IK is recognized and valued by those carrying out research in areas that are inhabited by indigenous peoples [14]. Educators also are aware of the importance of using IK in the classroom and there are currently many efforts to develop culturally relevant curriculum for classrooms all across the globe. Using IK in science lessons, activities, and class projects give an added depth and meaning to difficult concepts, and build communication and respect with the community [15].

IK cannot be verified by scientific standard nor can science be sufficiently measured according to the beliefs of IK [16]. Each is constructed on distinguishing philosophies, methods, and criteria. The method is all vital and objective measurement is the final authority. Systems of knowledge that do not subscribe to scientific principles are afforded lesser status and, if given any recognition at all, run the risk of being rationalized according to scientific principles [17]. But just as science ignored IK as the one of the source of the valid and proven knowledge, indigenous people also disregard science as the absolute source of knowledge because it seems unable of clearing up spiritual phenomenon or even identified the existence of nature as incredible more than a scientifically-observable construct [18].

Although IK and science seem to disregard each other, actually they have something in common which a tendency to evaluate each other according to limited criteria. Science is one body of knowledge; faith is another; and indigenous knowledge is yet another. It is important that the tools of one are not used to analyze and understand the foundations of another. A system of knowledge that cannot survive scientific analysis, or alternately a body of knowledge that is incapable of locating people within the natural world is called as lack of credibility [19]. The understanding of difficult systems remains a main challenge for the future, and science cannot fully claim that it has at hand the suitable methods with which to achieve this. Thus, it cannot discuss the future of science without taking into account the philosophical problems generated by the study of complexity [20]. Modern, or Western, science may not be best suited to fulfil the IK task, as its view of the world is too constrained by its characteristic empirical and analytical approach that in the past which made it so successful [21].

According to [3], and [22], Indigenous knowledge differs from Western or scientific knowledge on:

- Substantive grounds – because of differences in the subject matter and characteristics of IK and Western knowledge;
- Methodological and epistemological grounds – because the forms of knowledge employ different methods to investigate reality;
- Contextual grounds – because traditional IK is more deeply rooted in its environment.

Besides the difference, IK and science systems are complementary or parallel to each other. Basically, the distinctive between IK and science can be resolved through mutual approaches and by finding its common ground. Some IK-based practices resemble science but the former tend to based on important social mechanisms [23] which can be shown in Fig 1.

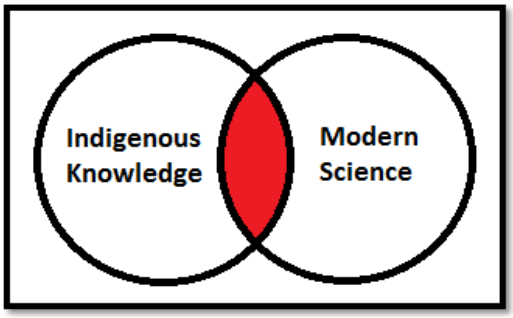

Figure 1. Relationship between Indigenous Knowledge and Modern Science.

Based on Fig 1, the intersection is called common ground that can relate the modern science and IK. The common ground which acts as the relationship between modern science and IK are much more discussed in:

- Organizing principles - the universe is unified and body of the knowledge is stable but subject to modification.
- Habits of mind - honesty, curiosity, determination, and open-mindedness in discussing any related issues.
- Skills and procedure – both have experimental observations in natural settings, pattern recognition, and the verification through repetition, inference and prediction for any issues discussed.

Common ground is an innovative way to emphasize similarities between modern science and IK. It seems importance as it is one of the ways to integrate the knowledge. One of the reasons to integrate this knowledge is that the global culture is facing much uncertain diversity. Hence, by integrating IK and modern

science is one of the appropriate ways to valued and protected through integration that brings benefits to both scientists and local people interested in maintaining that diversity [24]. Besides that, although science is more accepted currently, but IK contribute invaluable information for science and natural resource management; indeed, IK often fill gaps in understanding that science cannot [25] [26]. Hence, the preservation of IK is becoming an added value to make the information which cannot be explained through science is accessible [27].

C. The Challenges & Importance of Preserving Indigenous Knowledge

There are lots of threats, limitations and issues that make IK difficult to be preserved. According to [28] the deficiency of protection on a nationwide level by all means of government becomes one of the major factors. Besides that, the influence of modern technology and education also becomes one of the threats to IK as lots of new education systems are not considered IK as the knowledge that is needed to be protected [10]. Moreover, the collection of IK information needs more of labor resources and time consuming which is really costly if needs to be maintained [29]. Another issue that arises after collecting IK is the protection of Intellectual Property (IP). The misused of the knowledge could lead to bad perception to a certain group which will lead them to not reveal the knowledge to the outsiders. Besides that, since IK practices are not recorded previously and just being transmitted by mouth to mouth from generation to the next generation orally, the knowledge itself could be easily faded away [30].

Hence, a proper storage and management is very important in order to make the information is available and accessible. Other than that, the importance in preserving the knowledge is, since the lifestyle had changed, certain communities are concerned the knowledge will disappear [31]. IK has a broad range of business and scientific uses until becoming gradually more valued by people outside the inhabitant group. Moreover, the local empowerment and development will be increased if IK are incorporated into research projects [11]. They also can provide very valuable input about the local environment and how to manage their own resources which is important as it can be useful on how to manage without damaging local ecologies. Besides that, if IK are not recorded and preserved, the probability of the knowledge lost and remain inaccessible is very high as IK is very important in any specific area of development and gives benefit to the society.

D. Knowledge Representation: Ontology

Knowledge Representation (KR) aims to transform tacit knowledge to explicit knowledge [9]. The issue associated with KR is on how knowledge can be represented. However, KR actually can be made to be independent of the fundamental knowledge model such as the semantic network of the Knowledge Base System which represents the logical description of the concept [32] [33]. The ontology is an example of knowledge modeling which represent the knowledge in a manner which a computer can facilitate [34]. One of the fundamental roles of KR in Artificial Intelligence is a set of ontological commitments which establishes the categories of things that may or may not exist in an application field. Those categories are the set of the ontological commitments which will be determined by the knowledge engineer.

The role of ontology in Knowledge Management (KM) processes aids in knowledge creation, storage, retrieval, transfer, and application together with performance improvement [35] [36]. The adoption of ontology also had been used widely nowadays; for example, the concept of analysis of medicine, concept of recipe plus the scheduling ontology is representing food industry and analytic hierarchical process from tourism [37]. Developing ontology is similar to the essential set of data and their organization for other programs to use. Problem-solving methods, software agents and domain-independent applications use ontology and knowledge bases built from the ontology as information. There are a few approaches such as hybrid and task based approach to develop ontologies. However, declarative approach to ontology is needed for the knowledge preservation because ontology is a method where the domain is represented in structured and may provide the benefits to those who implemented it [38] [39].

E. Postpartum Practices as Indigenous Knowledge

Pregnancy and childbirth are practiced within a socio-cultural circumstance and the temperament of the experience, particularly for the mother, is shaped by the viewpoints and practices of her own culture [40] [41]. The term ‘traditional birthing practices’ is generally defined as all philosophy, behaviors, ceremony demonstrated during antenatal, labor and birth, and postnatal periods, which are commonly constructed and produced by the sensitivity and customs of that particular culture [42] [43].

The period of postpartum is considered as a very special phase experience for the women and her newborn. For women who experiencing childbirth for a very first time, probably the experience is marked as the most noteworthy and life-changing event that they have yet live [44]. It is noticeable by tough emotions, obvious physical changes, new and altered relationships and the conjecture of a modification to a new role of the social status of a woman to a mother [45]. The postpartum period is a public as well as a private occasion and has significance well further than the simple physiological dealings which make it. However, in both developing and developed countries, the attention given during pregnancy and birth had overshadowed the women’s and their newborn health during the postpartum period.

During the postpartum period, the affectionate death and mother’s disabilities have always been neglected. It is believed that the insufficient considerations or even an absent care being offered to women and their newborns at home or in health conveniences provides a little role to their well-being and forms a fragile basis for their future healthiness. The less care the mother gets, the poorer the quality of getting a better health. It includes the early

detection and sufficient management of struggles and ailment. Therefore, the qualities of postpartum care are long-term ventures in the future well-being of women and their newborn [44].

F. Malay Indigenous Health Knowledge

Indigenous health knowledge is the sum of knowledge used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness. It includes the skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not [44]. In Malaysia context, Malay health knowledge can be defined as a cultural system based on beliefs, information and practices related to the concept of well-being of life in the society as a whole [46]. Basically the knowledge is divided into two features: the spiritual and the empirical. The spiritual aspect involves magic, shamanism and religious sources in aspects of treatment. This feature is not easily proven and explained logically and scientifically but it's still happening in Malay culture. The empirical aspect covers an area which at least can be researched scientifically. These aspects include usage of natural resources such as plants, animals and minerals for health and curing treatments.

According to [47], there are currently 14 modalities of conducts that have been identified in Malay indigenous health knowledge which are traditional Malay herbal medicine, massage, traditional bone setting, traditional Malay postnatal care, male vitality treatment, female health treatment, traditional Malay exercises, traditional Malay blood cupping/letting (phlebotomy), traditional sinus treatment, shingles, hernia, traditional treatment for stones, treatment for cancer and spiritual healing. Malay medical practitioners are known in Malay terms as 'pawang', 'dukun', 'bomoh', 'bidan' and 'tabib'. Although curing the sick is an important aspect of a Malay practitioner, his/her first and utmost task is rather to stop the occurrence of diseases that would have an effect on the society as a whole. It is only when these preventive measures somehow fail that he/she would shift his accountability to that of curing those affected [48]. However in this research, the focus is on the traditional Malay postpartum care. Fundamentally, there are seven

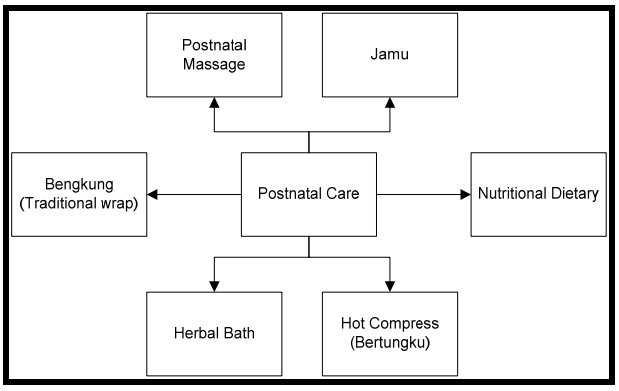

Figure 2. Postnatal Care as Part of Malay Indigenous Health Knowledge.

categories fall under the traditional Malay postnatal care category. According to [49], the categories were illustrated as in Fig. 2.

Postnatal care in Malay culture involves 'bengkung' (traditional wrap), massage, eating 'Jamu' (herbs), nutritional dietary, herbal bath and 'bertungku' (hot compress). Hot compress is the essential practiced as it is an application to the new mum's abdomen before she gets a postnatal massage and puts on the 'bengkung' or traditional wrap. One of the major reasons for applying the hot compress is to dissolve residual blood clots in the uterus [50]. Traditional wrap is a tradition which can flatten the tummy, reduces weight and tone the body, protects the internal organs as well as help swollen organs return to their pre-baby state, tighten the abdomen and other parts of the body that have sagged or lost their muscle tone after childbirth, promote good posture that will aid in breastfeeding, and break down fat and cellulite

Besides that, according to [51], nutrition and dietary supplements (commonly known as 'jamu') are considered an essential part of the Malay confinement. It is believed that the right foods and supplements will help new moms recover their energy and heal from the rigors of labor and birth. For postnatal massage, it is believed can lift back the womb and keep it from sagging, break down fat, tone and shape the body to help the new mum get her pre-baby body back, speed up overall recovery from labor and birth. Interestingly, the traditional postnatal massage includes breast massage in the belief that it will stimulate milk production.

All of the elements in postnatal care are practiced to ensure that the mother will get their health spiritually and mentally back to its normal condition just like before they gave birth [44].

G. Nutrients Deficiency during Postpartum

The nutrient needs of human beings show a discrepancy according to age, weight, height, gender and daily activities. The study in 2005 Malaysian Recommended Nutrient Intakes (RNI) had classifies individuals into 33 age-gender collections and lists on a daily basis of the requirements for 15 nutrients [52]. The nutrients included the Protein, Calcium, Vitamin A, Carbohydrate and so forth. There is much instructive involvement has focused on the pregnancy linked nutrition and health inconveniences [53] [54]. Normally, such edification programs are often not being preserved during the postpartum period. Postpartum period received not much consideration as compared with pregnancy and childbirth [55]. The postpartum period starts as soon as an hour after the deliverance of the placenta and includes the following six weeks [44]. By six weeks after the mother gave birth, most of the changes of labor, pregnancy, and delivery have been determined and the body has changed back to the non-pregnant condition [56]. The postpartum period is an extraordinary stage in the life of women. Their body needs to recover and heal healthily from pregnancy and childbirth. A good balance and postpartum diet during the confinement period is considered very significant for the health of a woman.

Based on the study by [57], the nutrients needed by the mother's body in the postpartum period are shown in Fig. 3:

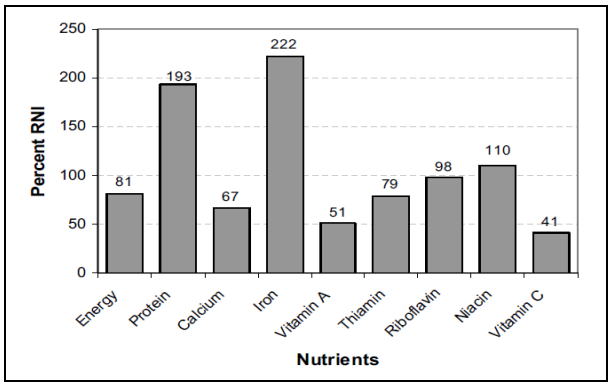

Figure 3. Nutrients deficiency in Postpartum Mother

Fig. 3 shown that positive views of the current interference include the nutrition information about the women improved to a great extent, thus the intervention have to optimally have constructive consequences on both the women themselves and their babies. The positive influences will facilitate the mothers form a foundation for good nutrition to be followed in afterwards years. The postpartum woman needs to eat a nutritious diet because they need to replace the nutrients she lost during pregnancy for energy, and to maintain her body. General nutrition recommendations for postpartum women are to eat a wide variety of foods with high nutrient density because many of nutrients provided in a moderate amount of calories. Besides that, eat the recommended servings from each food group using the Food Guide Pyramid as a guide for family meal selection and preparation. The mother also has to use foods and recipes that require little or no preparation because this can avoid high-fat fast foods and take in plenty of fluids such as water, juice, and soups. The strict diet recommended that they should avoid are fad weight reduction diets, harmful substances such as alcohol, tobacco and drugs, and excessive intake of fat, salt, caffeine, sugar, and artificial sweeteners.

III. Research Methodology

A. Research Methodology Overview

A research methodology is supposed to support the overall of research development. Basically, there are few methods that can be used in doing research. The approaches that are available are quantitative approach, qualitative approach and mix method approach [58] [59]. Each of research methodology has its own qualified flaw and strong point. However, in this research, interpretive qualitative research is chosen as qualitative methodology is very oriented toward breakthrough and procedure, have strength, less generalization, and more concerned with a thorough understanding of the research problem in its unique context. There are few stages involved in the design of this research. The stages are Literature Review, Conceptual Framework, Data Collection, Data Analysis, Ontology Framework, Ontology Model and Web Prototype which being shown in Fig. 4 as follows:

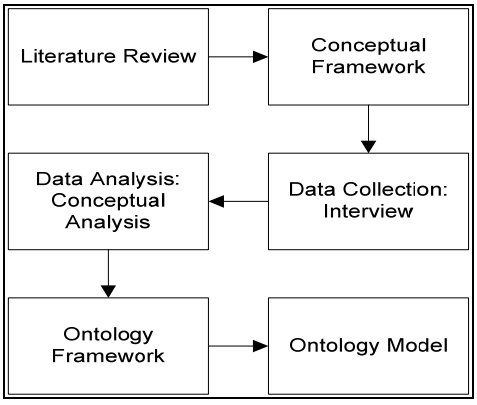

Figure 4. Research Methodology Stages

The research starts with literature review which will give a conceptual framework for Malay confinement dietary. Then, it is followed by data collection through the interviews, conceptual data analysis, ontological framework and model.

B. Data Collection

Data collection starts which using the interview method to obtain the data. Data are the raw materials with which an evaluation is built. Evaluation data systematically collect information relevant to the research that will be used in assessing whether the objectives of the research is achieved or not [60]. In this research, the data collection framework consists of interview questions, sampling method, interview protocol. According to [61], the first step in data collection is to clarify the data collection goals. At this moment, the collection of Malay confinement dietary is unorganized and unstructured. Hence, the purpose of the interview is to expand the social understanding about the subject matter. Then, develop operational definitions and procedures which to decide on the sampling method. In qualitative research, there are few sampling methods that can be adopted such as convenience sample, theoretical sample, selective and purposive sample. However, in this research, purposive sampling was adopted as participants who have specific characteristics or features such as the Malay traditional midwives were interviewed. The main goal of purposive sampling is to focus on particular characteristics of a population that are of interest, which will best enable to answer the research questions. It is a non-probability sampling which focuses on sampling techniques where the units that are investigated are based on the judgment of the researcher [62] [63] [64].

Besides Malay traditional midwives, the interviewee involves the gynecologist and dietician who provide the information of nutrients and its deficiency. The questions asked to the midwives include the foods that are allowed and not allowed together with its preventive and permissive reasons. For the gynecologist, their expertise is useful in determining the nutrient deficiency in mother's body during confinement period. For dietician, the questions that will be asked involve the food pyramid level for each food and its nutrients.

Then, the type of data collection and its protocol is determined. Types of interview consist of informal

conversation interview, general interview guide approach and standardize open-ended interview. In this research, standardize open-ended interview was chosen as the interview is particularly structured in terms of the phrasing of the questions. Participants were constantly asked identical questions, but the questions are worded so that responses are open-ended and the participants to fully express their responses as much detail as desired. The interview protocol in this research includes:

- Each of the interviewees will be informed by phone equally about the purpose, place and time of the interview seven days before the actual interview day.
- The actual interview is a face to face interview with the consent of the interviewee.
- There are roughly five to ten standardize open-ended questions depends on the expertise of the interviewee.
- The interview session roughly took about one hour.
- All of the conversation during the interview is recorded using a voice recording device with consent from the interviewee.
- All of the personal details of the interviewee are being kept confidential.
- The conversation with the interviewee is fully voluntary and the interviewee may withdraw without any consequences.

Then, the process and steps in data collection can only be stopped when the data collected is saturated.

C. Data Analysis

Data analysis may begin unofficially when frequent subjects and categories become main evident during interviews or observation session. The main purpose of data analysis is to describe the case and its setting in detail. Researchers normally will use a number of different kinds of analysis before come out with general indications of what can be done with the data and how to represent it. However, it is clearly stated that the theory emerges from the data and not imposed on the data (Coolican, 1994). The data will be in significant points or structures to make it easier to be categorized and patterned. The other technique is a data reduction which contains the quantification with the use of models [63]. Conversely, in this research, conceptual analysis process is used to analyze the data of Malay confinement dietary. According to [65], conceptual analysis begins with identifying research questions and choosing the concepts of sampling. Next, the appropriate steps have to be taken once the data have been collected, which are:

- Categorical aggregation – potential categories are drafted in the Malay confinement dietary data according to its properties.
- Direct interpretation – structure the Malay confinement data based on its taxonomy.
- Establish patterns – defined the relationships in the ontology
- Develop naturalistic generalizations – defined the relationship of each class in the ontology

In other word, the methods suggested from the above conceptual analysis model is required to choose an important aspect to be concerned such as concepts or patterns. For this research, the categories and patterns of Malay confinement dietary data are studied to produce a set of data representation that is used to model the data. In some way, this analysis model can guide in order to choose which information that should and should not be taken into consideration as a meaningful data. After the data collection and data analysis is done, the ontological framework is drafted before the model being developed in an editor tool.

IV. Discussion and Findings

A. Analysis of Interviews

There is a lot of information being gathered from the Malay traditional midwives, a gynecologist and dietician from the interviews. They were ten interviewees involved in the interview sessions which is a dietician, two gynecologist and the rest are Malay traditional midwives. For the Malay traditional midwives, they are located from different states in Malaysia, which is Terengganu, Kelantan, Melaka, Kedah, Pahang, Johor, and Sarawak. Each of the midwives ranging from 50-70 years old has more than 30 years of experience in handling the mothers during the postpartum and most of them are still active. The interviews gave the unstructured data regarding Malay confinement dietary, nutrient deficiency and food pyramid level. Each and every interviewed was conducted for about one hour and the contents of the interview was recorded using a voice recording device. For Malay traditional midwives, the interview was held at their respective home and for the gynecologist and dietician; the interview was held at their own workplace, which is in the hospital/clinic after the midwives had been consulted. Before the interview, all of the interviewees are informed regarding the purpose of the interview.

There was some different information given by the traditional midwives. In Mark Timah's case, anchovy is not allowed, however, from Cik Siti's perspective, anchovy is allowed. To solve the ambiguity, more experienced midwives, Nek Ku and Nek Ndik were consulted. From the different perspective and expertise from the midwives themselves, then, the ambiguity is solved. The different information given is not to prove that the information given by a particular midwife is not valid, but it is to prove that the midwife in every single place has its own expertise in defining the food allowed and not allowed. For example, Mak Timah is an expert in vegetables' information; hence, she is more reliable to define the vegetable's restriction and so forth.

From the gynecologist and dietician's standpoint, they believe that all the foods can be eaten during the postpartum period as all of the food is the source of energy. However, they did not claim that the confinement dietary custom is not good to be practiced. They took all the practiced by the mothers as the complementary for a win-win situation and not offending the mothers. They believe that although there is no restriction, but the food

being allowed can boost the nutrient deficiency in mothers' body. They also agree that certain food that is not allowed is really can bring harm to the mother's body such as the egg yolk and seafood which is itchy and not good for the wound healing process.

B. Categories in Malay Confinement Dietary

There are lots of data being gathered from the Malay traditional midwives regarding the dietary for mothers in the postpartum period. Besides that, the information is also extracted from the modern dietician and gynecologist in order to get the information on the mother's condition during the postpartum period. However, the gained information is unstructured and unorganized. After going through the conceptual analysis, there are about four main categories of foods being processed from the Malay traditional midwives. The data collected and analyzed for the Malay confinement dietary is comprised into four categories which is Meat, Fruit, Vegetable and Others. The classifications of Meat are divided into Red and White Meat [66]. For Fruit classification, it is divided according to use rather than botanical classifications [67] which is tropical, citrus, stone, pomes, berries and melon. For vegetables, the categories are divided into Flowers, Fruits, Flowers, Leaves, Roots, Seeds, Stems and Tubers [68]. For Others categories its include all the other foods in cereal and grains categories of food pyramid level. Besides that, the categories were drafted from the interview with all the midwives. Hence, the proposed food categories of Malay confinement dietary can be concluded as in Fig. 5.

The taxonomy of each food is created to make the addition of data will be easier later. From the interview with the gynecologist, the questions being asked were relatively about the mother's condition in the postpartum period. The doctors divided the deficiency in mother's body into two categories, the vitamins and minerals as in Fig. 6.

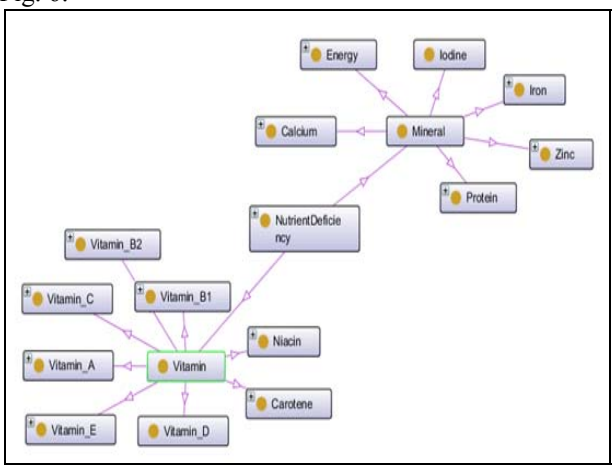

Figure 6: Nutrients Deficiency in Postpartum Mothers Body

The mineral consists of Energy, Calcium, Iodine, Iron, Zinc and Protein while in vitamin class, there are vitamin A, B1, B2, C, D E, Niacin and Carotene. Besides that, there is Restriction category there is Allowed and Not Allowed category and from the dietician perspective, there is level one, two, three and four resides in Food Pyramid class.

C. Malay Confinement Dietary Ontology

From the interview with the Malay midwives, dieticians and gynecologist, the data consist the categories of foods, its pyramid level, nutrients and vitamins, and the reason why the food is allowed and not. The foods, restriction and reason were extracted from the interview with the Malay traditional midwives, the nutrient deficiency is from the gynecologist and the nutrients and food pyramid level is coming from the dietician. From the structured information gained in the previous findings, the knowledge of Malay confinement dietary is represented in ontological view. Taxonomy of the foods is taken from [66], [67], [68] and [69] which each of them had classified the meat, fruits, and vegetables according to their own categories. Each class is comprised of a set of attributes that represent the characteristic of the foods whether it can be eaten during the postpartum period and the reason, the nutrients and vitamin, and the food pyramid level. The main ontology is shown in Fig. 7:

The main overview of Malay confinement dietary ontological model where there are five main classes

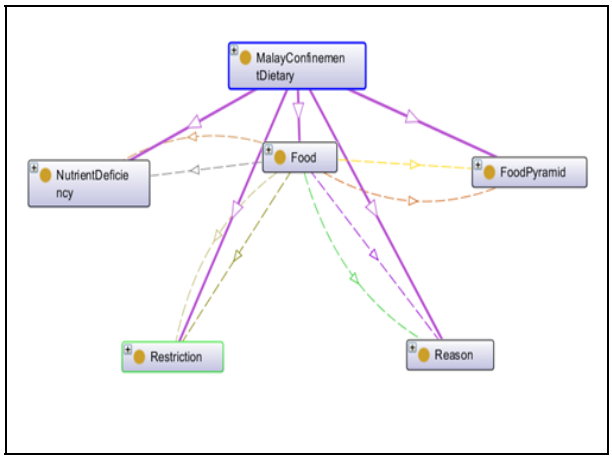

Figure 7: Ontological Model of Malay Confinement Dietary

involved in the ontology. The classes are the Food, Food Pyramid, Nutrient Deficiency, Reason, and Restriction. For each class, there are object properties that will relate all the classes. The relationships being defined are:

- hasLevel
- hasRestriction
- hasReason
- isEnhance

All of the object properties are being created based on the Food class relationship with the other classes. The relationship of the classes and the object properties being defined in this ontological model are:

- Food hasLevel only Food Pyramid
- Food hasRestriction only Restriction
- Food hasReason some Reason
- Food isEnhance some Nutrient Defieciency

Based on the relationship, each and every food under Food class must reside in only one of the four levels in

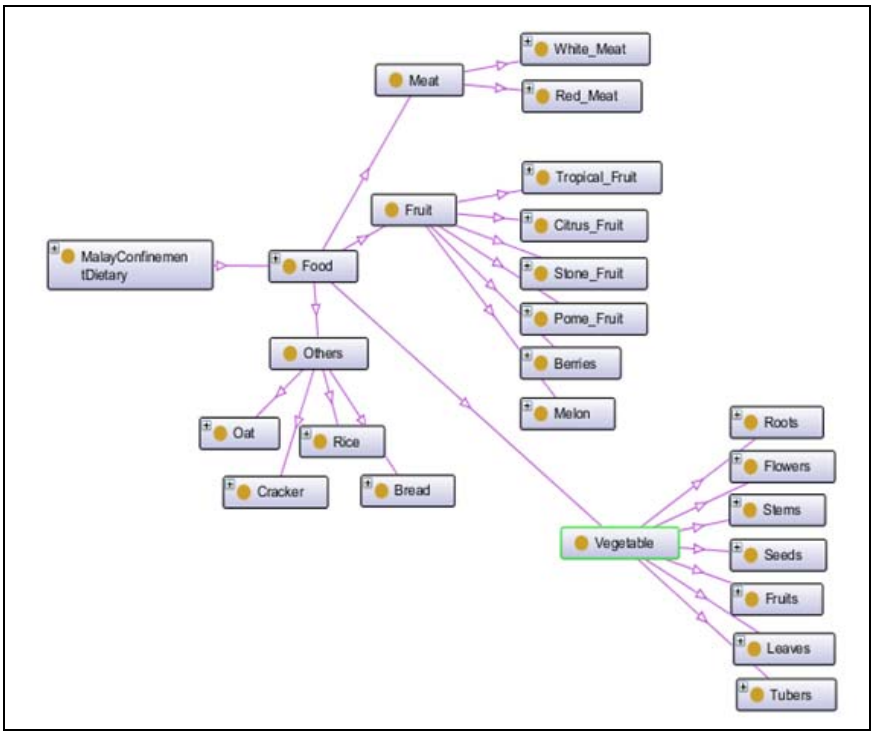

Figure 5: Food Ontology in Malay Confinement Dietary

the food pyramid. Then, each and every food also must only have one restriction whether it is allowed or not. The only axiom is used to indicate that each food can only reside in only one level of the Food Pyramid and if the food is restricted as allowed, the same food cannot have another restriction as not allowed. The subclasses of Food also can have some reason and can enhance some of the nutrient deficiencies in the mother's body while in the postpartum period. The some axiom being used to indicate that the foods can have many reasons whether it can be eaten or not. Besides that, the food also can enhance one or many of the nutrients or vitamins in the body. For each and every type of foods, there are restriction, food pyramid level and a reason whether it is permissive or preventive. If the food is under Allowed restriction, there is a relationship with the nutrient deficiency class. For the next subsection, the ontological model for each category will be shown only one Allowed and Not Allowed food.

By having a concept, instance, relation and axiom, the ontology development is done as it is what is required for a concept to be called ontology [70].

V. Limitation and Recommendation

This research covers on the knowledge of Malay confinement dietary, where unorganized information on what food is allowed and not allowed together with its reason and nutrients is transformed into the structured form. The data used in this research to develop the knowledge model for Malay postpartum dietary which is in explicit and tacit data form, where the several interviews had been conducted and analyzed. During the interview session, there is some limitations happened as the traditional midwives are the old women aged from 50-70 years old, hence, their memory is not in a good state, hence, it may affect the data collected as it is maybe not details and as much as needed. Recommendation for this limitation is, the techniques of reminiscing memory of intergeneration knowledge might be used in order to get full information or knowledge from these midwives.

The finding of this research gives the allowed and not allowed based on permissive or preventive reasons. However, there is a limitation in the reason given by Malay traditional midwives. At this moment, there is less scientific proven to the reasons that the Malay traditional midwives gave was valid. Hence, for recommendation in the future, the reason given by the midwives can be proven by searching for the scientific references to support the statement and the reasons given. Besides, future research can expand on the amount of food collected so that more collection of foods can be stored in the ontology model.

Another recommendation for further research is to make it more flexible, which many-to-many relationship could be implemented regarding the food restriction, time frame based on confinement day, and suggested meal per day. Instead of allowed and not allowed food being suggested, more food restriction such as the food that is recommended and being in the middle of allowed and not allowed can be included in the future so that it will not be restricted into few food categories only.

VI. Research Contribution

The research provides better insights on the knowledge of Malay confinement dietary. Most of the understandings about Malay postpartum dietary are resting on the first objective of this study, where the tacit and elicitation of Malay confinement dietary knowledge

from the midwives and modern medical practitioners acts as a key factor to transform the unorganized knowledge in a structured form. Thus, from that finding, this research contributed to the construction of food taxonomy and ontology for Malay confinement dietary. The food taxonomy is quite important in this dietary context as most of the food within the same category have their own significant characteristics. In future, if there is new food needs to be included in the ontology; the characteristics of the food itself can decide the food belongs under which food taxonomy class.

The findings of this research discovered that there is relationship indirectly between the modern and traditional perspective. Although the modern medical practitioner said that there is no confinement dietary needed, however, the foods that the Malay traditional midwives practiced from generation to generation have its own benefits in enhancing the nutrient deficiency that the mother loss after giving birth. Besides, this research discovers a gap between the unorganized and organized form of information. Previously, the information regarding the dietary for mother in the postpartum period is only transmitted through mouth to mouth and in unorganized documents. Hence, with the web semantic representation of the knowledge, it is hopefully can contribute more into organized and centralized information retrieval and prevent this indigenous knowledge from being extinct.

VII. Conclusion

This research discussed about the structured information of Malay confinement dietary, the food taxonomy and ontological model of Malay confinement dietary. A few limitations have been identified through this research and can be improved for future research. For future research, other researchers are suggested to explore more knowledge to ensure the completeness of Malay confinement dietary information and also to expand on the development of a prototype system. Lastly, this research describes the contribution of the study which mainly rest on the understanding of Malay confinement dietary knowledge which focuses on the food taxonomy and its nutrient values, indirect relationship of modern and Malay traditional dietary practiced, and last but not least, the organized and centralized information retrieval of Malay confinement dietary.

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