International Journal of Epidemiology, 2020, 1–15
doi: 10.1093/ije/dyaa182
Opinion

Opinion

Religious dietary rules and their potential nutritional and health consequences

Jean-Pierre Chouraqui [1]*, Dominique Turck [2], André Briend [3], Dominique Darmaun [4], Alain Bocquet [5], François Feillet [6], Marie-Laure Frelut [7], Jean-Philippe Girardet [8], Dominique Guimber [9], Regis Hankard [10], Alexandre Lapillonne [11], Noel Peretti [12], Jean-Christophe Roze [13], Umberto Siméoni [14] and Christophe Dupont [15], on behalf of the Committee on Nutrition of the French Society of Pediatrics.

[1]Pediatric Nutrition and Gastroenterology Unit, Division of Pediatrics, Woman, Mother and Child Department, Lausanne University Hospital (CHUV), Lausanne, Switzerland, [2]Division of Gastroenterology, Hepatology and Nutrition, Department of Pediatrics, Lille University Jeanne de Flandre Children's Hospital and Faculty of Medicine, University of Lille; INFINITE-INSERM U1286, Lille, France, [3]Institut de Recherche Pour le Développement, Marseille, France, [4]Université Nantes-Atlantique, Nantes, France, [5]French Association of Ambulatory Paediatrics, Orléans, France, [6]Lorraine University, Nancy, France, [7]Paris-Sud, University, CHU de Bicêtre, Le Kremlin-Bicêtre, France, [8]Cabinet de Pédiatrie, 81000 Albi, Pierre et Marie Curie-Paris 6, University 75005, Paris, France, [9]Division of Gastroenterology, Hepatology and Nutrition, Department of Pediatrics, Lille University Jeanne de Flandre Children's Hospital and Faculty of Medicine, University of Lille, Lille, France, [10]Tours University and Inserm UMR 1069, Tours, France, [11]Paris Descartes University, APHP Necker-Enfants Malades Hospital, Paris, France and CNRC, Baylor College of Medicine, Houston, TX, USA, [12]Pediatric Nutrition, University Pediatric Hospital of Lyon and INSERM U1060, CarMeN laboratory, Claude Bernard Lyon-1 University, France, [13]Neonatology and Pediatric Intensive Care Unit, Univesity Hospital of Nantes and UMR 1280 INRA, Nantes University, France, [14]Division of Pediatrics and DOHaD Lab, Woman, Mother and Child Department, Lausanne University Hospital (CHUV), Lausanne, Switzerland and [15]Pediatric Gastroenterology Department, Necker Enfants-Malades Hospital, Paris Descartes University, Paris, France

*Corresponding author. Pediatric Nutrition and Gastroenterology Unit, Division of Pediatrics, Woman, Mother and Child Department, Lausanne University Hospital (CHUV), 38, rue de l'Isère-Gières, 38610, France. E-mail: chouraquijp@wanadoo.fr

editorial decision 10 August 2020; Accepted 24 August 2020

Abstract

Background: The vast majority of the world population declares affiliation to a religion, predominantly Christianity and Islam. Many religions have special dietary rules, which may be more or less strictly adhered to.

Methods: Religious food rules were collected from holy books and religious websites as well as their translation into dietary practices. The literature was searched for potential associations between these rules and potential nutritional consequences.

Results: Jewish, Islamic and Indian religions support prolonged breastfeeding. Religious avoidance of alcohol is probably beneficial to health. When strictly applied, a few rules may lead to nutritional inadequacies, mainly in populations living in unfavourable socio-economic or environmental conditions. In Jewish and Muslim observants, animal slaughtering procedures may increase the risk of iron deficiency. Jews may be at risk of excess sodium intake related to home-prepared foods. A vegan diet, as observed by some believers, often by drifting from original precepts, or by some Hindus or Buddhists, may result in vitamin B12, calcium, iron, zinc, selenium and *n*-3 fatty acids deficiencies.
Conclusion: When implemented in accordance with the rules, most religious food precepts are not detrimental to health, as suggested by the fact that they have more or less been followed for millennia. Nevertheless, some practices may lead to nutritional inadequacies, such as iron, calcium, vitamin D and vitamin B12 deficiencies. Patients with low socio-economic status, children and women of childbearing age are of particular risk of such deficiencies. Being aware of them should help health professionals to take an individualized approach to decide whether to supplement or not.

Key words: Asian philosophies, breast feeding, iron deficiency, nutritional inadequacies, religions, vegan diet, vitamin D deficiency

Key Messages:

- The majority of religious dietary rules have no nutritional consequences.
- Most religions strongly encourage prolonged breastfeeding.
- Jewish and Muslim slaughtering procedures may increase the risk of iron deficiency.
- Vegan diet can result in vitamin B12, iron, calcium and *n*-3 fatty acids deficiencies.
- Nutritional inadequacies associated with some religious practices mainly relate to unfavourable socio-economic conditions and/or to deviation from the original rules.

Introduction

Worldwide, 84% of the population identify themselves as belonging to a religious group[1,2] Most religions promote the healing of the mind and the body, by placing the body at the service of the spirit to achieve the highest human ideal. To that end, many religions have developed specific dietary laws and practices, which may be more or less closely adhered to by the practicing persons. Compliance is an act of faith and often an affirmation of identity. Understanding the role of food in cultural and religious practices helps health professionals respect and respond to the needs of people from a wide range of religious communities.[3] This understanding is becoming increasingly relevant as the proportion of migrant populations increases in many countries. It has been estimated that at year-end 2018 there were about 70 million people forcibly displaced worldwide.[2] Health professionals are key when it comes to translating information on food, nutrition and health into dietary choices. Many practitioners are concerned about the health consequences of some eating behaviours that arise from obedience to certain religious rules and from cultural background. We hypothesize that religious dietary rules may have some nutritional consequences. To our knowledge the evidence of a relationship between these rules and habits and a possible deleterious effect on health has been the subject of scattered studies but not of an overall review. Therefore, the purpose of our review is to make health care professionals aware of the various religious dietary rules and to increase their understanding of these rules to help them identify potential nutritional inadequacies. With that aim, this article describes the different religious rules and their translation to dietary practices, while avoiding any judgment. It analyses the potential nutritional impact of these practices by reviewing the published data and assessing the relationship of specific religious feeding practices with a health outcome. After discussing the potential benefits and risks of the practices described, practical recommendations are formulated to support health care professionals in their dietary advice to religious persons.

Table 1 Estimated distribution of the world's major religious groups (adapted from references 2–4). Data shown are estimates and are given mainly for the purpose of ordering the groups, not providing a definite number. Results are given as percentage of the total population and in brackets as number of individuals expressed in millions

	World population % (*n* in millions)	Percentage of the world population in the geographical area					
		Asia –Pacific	Europe	Latin America-Caribbean	North America	North Africa - Middle East	Sub-Saharan Africa
Overall global population	100%	57.6%	9.6%	8.5%	4.8%	5.9%	13.6%
	(7700)	(4435)	(740)	(653)	(371)	(452)	(1049)
Religion	In the world population	Percentage of each religious group in the total population living in the area[a]					
Christians	31.4% (2418): Catholics 50% Protestants 37% Orthodox 12%	7.2%	72.3%	89.6%	74.7%	3,5%	62%
Muslims	23.2% (1787): Sunni 85% Shia 15%	25.7%	7%	0.14%	1.3%	93.2%	31.5%
Hindus	15% (1155)	26%	0.22%	0.1%	0.8%	0.6%	0.14%
Buddhists	7.1% (547)	11.3%	0.2%	0.06%	1.2%	0.18%	0.016%
Jews	0.2% (15.5)	0.005%	0.19%	0.07%	1.6%	1.5%	<0.01%
Traditional believers	5.9% (454)	8.6%	0.1%	1.8%	0.35%	0.3%	3.2%
Others	0.8 % (61.6)	1.2%	0.1%	0,15%	0.9%	0.06%	0.2%
Unaffiliated	16.4 % (1263)	20%	20%	8%	19%	0.6%	3%

[a]For a detailed description by country see references 1 and 2.

Methods

A literature search was conducted for articles or books describing the religious dietary rules and for studies that examined whether some of these rules are associated with health outcomes. This literature search used the PubMed, Medline, CNRS/Pascal-francis.inist, Google and Google Scholar databases without a date limitation until May 2020, and used the search terms 'Religion', 'Judaism', 'Jewish', ' Christianity', 'Christian', 'Catholic', 'Orthodox', 'Protestant', ' Islam', 'Muslim', 'Asian religion', 'Buddhism', 'Hinduism', 'Sikhism', 'Chinese culture', ' Nutrition diet or feeding pattern and one of the previous cited terms', 'Kashrut', 'Kosher', 'Kippur', 'Halal', 'Ramadan', 'Fasting'. Only articles published in English or French or having at least one informative abstract in English were included. Information on the religious rules was gathered from the holy books, books published by religion-supporting organizations, official religious websites of the various religions and descriptive articles published in scientific journals ($n = 10$). The parts corresponding to dietary rules of the following holy books have been consulted: The Holy Bible, i.e. The Torah especially the books of Leviticus and Deuteronomy, and the New Testament; the Quran; The Vedas; the Tipitaka, the Theravada texts and the Mahayana sutras; the Adi granth. We examined surveys reporting the world's religious profile ($n = 4$), and studies ($n = 54$), meta-analysis ($n = 4$) and review papers ($n = 27$) that report a possible link between a nutritional fact and a religious rule. We selected those judged as relevant, based on the methodology used or the large size of the sample enroled, and as important or clinically relevant in terms of health-related outcomes. Case-control studies ($n = 36$) and cohort studies ($n = 18$) involving large sample were selected whereas case reports were discarded. Studies on food composition ($n = 4$) according to the dietary rules were also selected.

The prevalence of individuals identifying themselves as belonging to a religious group was reviewed. Then, an analysis of the dietary rules of the main religions was carried out distinguishing between the Abrahamic religions and the Asian religions or philosophies. Religions with few members and for which no studies reporting nutritional data were found were not included in this review. Among Abrahamic religions, the Bayáni, Druze, Samaritan and Yesidi faiths fell into that category. We also failed to find nutritional studies on the folk and traditional religions

despite the large number of people practicing them, as their rites are extremely diverse. For each reported religion the recommendations concerning breastfeeding (BF) and the dietary rules were sequentially described. For each rule the studies concerning their possible nutritional impact were analyzed and a conclusion with practical recommendations for the healthcare professional drawn. Then a global discussion about the potential benefits and risks of the religious dietary rules was conducted to propose practical recommendations to healthcare providers.

The world's major religious groups

Christians constitute the largest religious group in the world, with Islam coming in second and being the fastest-growing one, followed by Hinduism, Buddhism and Sikhism (see Table 1).[1–3] Yet <20 years from now, the number of infants born to Muslims is expected to slightly exceed that of births to Christians, according to new Pew Research Center demographic estimates.[4] The estimated religious composition of 198 different countries and territories for 2020 has also recently been provided.[1,2]

Findings by religion

Table 2 summarizes the main dietary rules religion by religion and their potential nutritional consequences.

Abrahamic religions

Abrahamic religions are monotheistic and claim they arose from Abraham. In chronological order of foundation are Judaism >3500 years ago, Christianity ~2000 years ago and Islam ~1300 years ago.

Judaism

The Torah, the foundational text of Judaism edicts the most numerous and stringent rules regarding foods and specifies which foods are adapted or not and how they should be prepared and eaten. Current Judaism can be classified into three categories of faith which differ in their views and observance of Jewish law: Orthodox community representing the most traditional practice and accounting for ~10% of American Jews and 22% of Israeli Jews; Conservative; and Reform/Liberal communities that represent the most accommodating of individualized interpretations of Jewish identity and faith.

Breastfeeding. Talmudic references recommend prolonged BF for at least 2 years.[5] Among the 720 American mothers who were surveyed, Jewish mothers were more likely to exclusively or partially breastfeed (94.5%) than Protestant (93%), Muslim (92.6%), Catholic (81.7%) or not religiously affiliated mothers (80.5%) ($P = 0.001$).[6] In the 1990s, the prevalence of BF was found to be especially high among Orthodox Jewish mothers in the UK, Germany and Israel.[7]

The Kashrut. The Jewish dietary law, called *Kashrut*, defines a *kosher* diet (Lev: 11 and 17, and Deut: 14). The rules must be observed by all devout Jews, including children, and for some, also by infants and toddlers.[8,9] The main animal products allowed or forbidden for consumption are listed in Supplementary Table S1, available as Supplementary data at *IJE* online. No obvious nutritional inadequacy can arise from these restrictions.

Allowed animals must be slaughtered, and their meat prepared in accordance with the Jewish ritual, using exsanguination (Supplementary Table S2, available as Supplementary data at *IJE* online). The quality *per se* of the meat seems unaltered; however, its iron content has not been assessed.[10] The consequences of blood withdrawing on iron intake may be of concern in people more prone to develop iron deficiency (ID) due to underlying illness or poor income. In a cross-sectional retrospective study, the prevalence of anaemia (haemoglobin concentration <11 g/dL) among 34 512 Israeli children was higher in the most religious group (18.9% vs 10.5%; $P < 0.001$).[11] In Israeli toddlers, ID (24.3 vs 14.5%, $P = 0.12$) and ID anaemia (4.5 vs 1.8%; $P = 0.35$) were, although not significantly, about twice as prevalent as in ultra-orthodox Jews.[12] Of note, the socio-economic level of the ultra-orthodox Jews in Israel is considered to be lower than the national average and could be a confounding factor. Moshe *et al.* concluded that this high prevalence reflects low iron intake due to a vegetarian and/or low meat diet together with the *kosher* meat preparation ritual.[12] They found an inverse correlation between red meat consumption and the presence of ID [odds ratio, (OR): 3.98; 95% confidence interval (CI) 1.21–13.03; $P = 0.023$]. According to Yanovich *et al.*, among 221 tested female military recruits with a mean age of 19 years, 61.4% had an ID attributed by authors to the low iron content in *kosher* meat.[13] Also, salt content has been found to be 2–6 times higher in *kosher* than in non-*kosher*-meat, especially in poultry,[10,14] even after rinsing and cooking.[10] Such excess seems to be more related to home-based preparation than to meat purchased from a *kosher* butcher.[15] Increased salt intake may impact blood pressure from a young age and increase the risk of cardiovascular and renal diseases later in adulthood.[16,17]

Milk products from an animal considered to be *kosher* are also *kosher*, except for cheese if it is produced using rennet obtained from the stomach of a non-*kosher* animal. The Torah says 'not to boil a kid in its mother milk' (Ex.

23: 19, Ex. 34: 26, Deut. 14: 21), which leads believers to understand that meat, unlike fish, eggs, fruits, vegetables and grains cannot be eaten, cooked or processed along with a dairy product. When eating meat, one should wait another 3–6 h before eating a dairy product, but one only needs to rinse one's mouth and eat a neutral solid food, such as bread, when switching from a dairy product to meat. The rule also applies for all cooking utensils, plates, dishwashers and dishcloths, implying that orthodox homes need at least two or three sets of each item, all stored in different places. Such restrictive rules may lead some families either to no longer serve meat or to eliminate dairy products from the diet. The first option would be one of the causes of the high prevalence of ID in Israeli children.[12] The second may lead to a low calcium intake, but this is rare in practice considering the high intake of dairy products in Israel.[18] No study has addressed these issues.

Assessing the association of several demographic, economic and social factors in The Netherlands on the stature of 19 year old male conscripts in an early 19th-century environment, Tassenaar and Karel concluded that food laws, among other factors, had an impact on conscript height, with the Jewish ones being shorter.[19] A recent study described the relationship between the extent of religious commitment and five health outcomes (self-rated overall physical health, chronic disease, pain, overall mental health status and depressive/anxiety emotional symptoms) as an inverse U function.[20] Israeli Jews, identifying themselves as moderately religious, have the worst health status when compared with either extreme. However, the better health status of the two edge groups cannot be solely linked to the observance of the religious rules *per se but also to their lifestyle, their general attitude and health management with differences in smoking, drinking or exercice habits*.

Yom Kippur. Yom Kippur, or the Day of Atonement, occurs 10 days after Rosh Hashanah, the New Year, and is a day of fasting (Lev: 16, 23, Number 29). All Jewish adults over bar mitzvah (13 years old for boys) or bat mitzvah (12 years old for girls) are supposed to fast, including pregnant or lactating women. People abstain from any food or drink, including water, from sundown on the eve of the holy day to sundown on the holy day. These restrictions can be lifted when there is a threat to life or health concerns. Children under the age of 9 years and delivering women (from the beginning of labour until 3 days after birth) are not allowed to fast, even if they wish to. Older children are expected to fast for a shorter length of time. Pregnant and lactating women are permitted to break the fast if they feel the need to do so. Sick people should seek advice from a physician and a rabbi. This full day of fasting is unlikely to be deleterious in healthy people despite a potential risk of mild dehydration in countries with a hot climate and during the hot season.

To summarize, dietary Jewish laws can be experienced as constraining, which can lead to some observant people wanting to deviate from the original spirit and suffering health risks. The potential, but probably rare, consequences are a low intake of iron and/or calcium and excessive sodium intake. Orthodox populations, especially multiparous mothers, certainly face a greater health risk.

Christianity

Breastfeeding. The prevalence of BF is influenced by Christian obedience. In several studies conducted in Europe (France, Ireland, Spain, UK) and North America, Catholic mothers are less likely to breastfeed compared with Protestant mothers or mothers with no declared faith, even after controlling for family income and size.[6,21,22] Overall, European Protestant countries have experienced in recent years a faster increase in BF prevalence.[23] For both Catholics and Protestants, attending church at least once a week is associated with a 55% increase in the odds of initiating BF.[21]

Dietary rules. Overall, Christianity did not formulate so many dietary rules and customs.

Catholicism. Catholicism can be subdivided into 23 separate Churches, or Rites—one Western (Roman or Latin-Rite, 98%) and 22 Eastern.

The Catholic Church has established abstinence and fasting for several periods of the year, especially during Lent (starting 40 days before Easter Sunday). Every Friday (commemorating the Passion of Christ), Catholics >14 years of age should not consume non-lean food, i.e. most meat. They are allowed to eat fish and seafood, which have become, in some families, the main dish on Fridays. Some observant Catholics are vegetarian on these days. Fasting has to be observed by healthy adults <60 years of age on Ash Wednesday (at the beginning of Lent) and on Good Friday.

Protestantism. Protestantism is split into many churches: Anglicanism, Baptist, Calvinism, Lutheranism, Pentecostalism, Methodism and Seventh-day Adventists, to name a few.

Most Protestants have no set food laws, question the restrictions on meat and reject the distinction between fat days and lean days.

The Seventh-day Adventists follow mostly a lacto-ovo-vegetarian diet, which, if well balanced, has no adverse nutritional impact,[24] and they advocate adherence to *kosher*

laws. A study conducted on 650 non-Hispanic White Adventists aged ≥30 years showed lower adjusted prevalence ratios for hypertension, high total cholesterol and high low density lipoprotein-cholesterol (LDL-C), obesity, abdominal adiposity and cardiovascular disease in all vegetarian groups (lacto-ovo-vegetarians, pesco-vegetarians and vegans) as compared with non-vegetarians.[25] Overall Adventists had a lower body weight than other believers.[26] Some Adventists often consume the last of their two daily meals in the afternoon, which results in a long overnight fast that may result in some weight loss and reductions in baseline plasma glucose and insulin concentrations.[27]

Orthodox Church. Orthodox Church includes various regional forms (e.g. Ethiopian Tewahedo, Greek Orthodox, Russian Orthodox, Serbian Orthodox, Ukrainian Orthodox). Practicing Orthodox Christians more regularly and strictly follow the days of abstinence for 180–200 days each year, including two Lent periods, before Christmas and before Easter.

The Greek Orthodox abstain from meat, fish, dairy products, olive oil and eggs during these periods, with the diet consisting mainly of bread, fruits, legumes, nuts, seafood, snails and vegetables. This results in a lower body mass, total cholesterol, LDL-C and LDL-C/high density lipoprotein (HDL)-C ratio.[28] The consumption of strangled animals and blood is forbidden by the Greek Orthodox Church.

In Ethiopia, ∼44% of the population belongs to the Orthodox Tewahedo Christian religion and have to observe >200 days of fasting or abstinence per year. This consists of abstaining from all food from animal sources, and sometimes all food and water. Even though lactating mothers are exempted from these rules, some, nevertheless, follow such rules. In a recent study, including 30% of fasting mothers, the prevalence of underweight, i.e. a body mass index (BMI) <18.5 kg/m^2, in fasting mothers was 50.6 vs 25.9% in non-fasting mothers ($P < 0.05$).[29] Moreover, although children are exempted from fasting, some mothers exclude food from animal sources from their cooking, for fear of contaminating utensils for cooking family foods. Accordingly, the weight-for-height and height-for-age Z-scores for 6–23-month-old children of fasting mothers were significantly lower ($P < 0.01$) than those of non-fasting mothers.[30]

Other obediences. In the Church of Jesus Christ of Latter-day Saints, around one-third of the Mormons follow routine fasting and exhibit significantly lower body weight and lower fasting glucose and a lower prevalence of diabetes and coronary artery disease.[27]

Dietary restrictions for the Jehovah's Witnesses include a ban on blood or dishes made from blood, raw or rare meat.

Rastafarian beliefs are based on Judaism and Christianity and forbid pork and crustaceans, alcohol and, in some cases, tea and coffee. Most Rastafarians are vegetarian or vegan. Foods should not contain any artificial colouring product, flavour or preservative.

In summary, the vast majority of Christians' food practices are not restrictive and, therefore, do not pose any nutritional risk apart from prolonged fasting or abstinence.

Islam is based on the Quran

Tahneek is not strictly a religious requirement, but rather a tradition of prelacteal feeds following the practice of the Holy Prophet.[31,32] This consists of rubbing a bit of a softened date on the hard palate of the newborn's mouth with a clean finger. Sometimes honey is used instead, and a large quantity can be put in the baby's mouth, aware of the possible risks of, in particular, botulism.[33] Furthermore, honey supplements are often provided during the first few days of life.[31]

Breastfeeding and milk bank.. BF is strongly encouraged (sura 2: ayat 233). Among all believers, Muslims are the most likely to breastfeed.[6,21,34] Mothers should breastfeed for 2 lunar calendar years (sura 2: ayat 233), but nothing is said about weaning. In some communities, adding complementary foods to breastfed infants is delayed well beyond 6 months of age. These infants may be at risk of energy, iron and vitamin D deficiency, especially if they have other risk factors.[31,32]

A woman who breastfeeds more than five times a day a child who is not hers before the age of 2 years becomes a 'milk mother' for this child, who is then acknowledged as a full sibling to the foster-mother's other children. This prohibits any possibility of subsequent marriage between them (sura 4: ayat 23). These rules have implications for human milk banking in Islamic countries. A pilot programme of a milk bank in Turkey was quickly halted due to religious concerns.[35] Kuwait and Malaysia introduced personalized human milk donation as an alternative, but these programmes did not cover the significant need for donated milk.[36,37] One recent proposal was to create a milk bank where both the donor and recipient's identities are accessible to all parties through a voluntary registry, with milk-pooling limited to three milk donors.[35]

Dietary laws. Islamic jurisprudence, derived from commandments found in the Quran (sura 2: ayat 173, sura5: ayat 5, and sura 6: ayat 118–119, 121), specifies which foods are *halal* ('lawful') or not (*haram*).[38] All vegetarian

Table 2 Overview of the main religious rules and their potential consequences

Religion	Main dietary rules	Nutritional potential effects
Judaism	Breastfeeding up to at least 2 years	Beneficial if not exclusive after 6 months
	Kosher diet	
	Animal restriction[a]	None
	Slaughtering rules[b]	Iron deficiency, anaemia
	Meat preparation[b]	None or excess salt intake
	Dairy product restriction.	None or low calcium intake
	Yom Kippur (One day fasting)	None or mild dehydration
Christianity	Very few rules	
	Promotes breastfeeding without formal rules	
Catholicism	Short abstinence and fasting periods	None
Protestantism	None or lacto-ovo-vegetarian for the Seventh-day Adventists	None if well balanced vegetarian diet
Orthodox Church	Long abstinence and fasting periods	May have some health benefit but may lead to undernutrition if prolonged
Mormon Church	Routine fasting	May have some health benefit
	Discourages alcohol consumption	Beneficial
Jehovah's Witnesses	Ban dishes containing blood	None
	Forbid alcohol	Beneficial
Rastafarian Church	Most are vegetarian or vegan	None if well balanced vegetarian diet, malnutrition (iron, vitamin B12) if vegan.
Islam	Breastfeeding up to 2 years	Beneficial if not exclusive after 6 months
	Halal vs *haram* diet	
	Prohibition of alcohol	Beneficial
	Food restrictions[c]	None
	Slaughtering rules	Iron deficiency, anaemia
	Ramadan (a month of daytime fasting)	Small weight loss with return to initial value afterwards
		Risk of dehydration
		Risk of diabetes complications
		Risk of noncompliance with treatment
		Dyspepsia and/or weight gain if excessive eating during night
Hinduism	Promotes breastfeeding without formal rules	Beneficial if not exclusive after 6 months
	Most Hindus are lacto-vegetarian	None if well balanced vegetarian diet
		Iron and vitamin B12 deficiency otherwise
	Discourages alcohol consumption	Beneficial
Sikhism	Most Sikhs are lacto-vegetarian	None if well balanced vegetarian diet
		Iron and vitamin B12 deficiency otherwise
	Alcohol prohibited	Beneficial
Buddhism	Breastfeeding up to at least 2 years	Beneficial if not exclusive after 6 months
	No set dietary prescriptions	
	Many Buddhists are lacto-vegetarian	None if well balanced vegetarian diet
		Iron and vitamin B12 deficiency otherwise
	Discourages alcohol consumption	Beneficial if not exclusive after 6 months
Chinese philosophies	Breastfeeding highly recommended	Beneficial if not exclusive after 6 months
	No specific rules but generally promotes a balanced diet	No data directly related to these beliefs
Folk religions	No formal creeds or sacred texts	No information

[a]See Supplementary Table S1 for details.
[b]See Supplementary Table S2 for details.
[c]See Supplementary Table S3 for details.

dishes and *kosher* meat products are *halal*. The prohibited foods including alcohol are listed in Supplementary Table S3, available as Supplementary data at *IJE* online.

Consuming something that is otherwise unlawful, such as pork meat, is not considered a sin when the lack of any alternative creates an imperious necessity (sura 2: ayat 173). The animal must be slaughtered quickly while mentioning the name of God by anyone from the People of the Book (Muslim, Jew or Christian) and only by using a well-sharpened knife. The carcass should be hung upside down for long enough to be free of blood. Blood losses following this procedure in sheep are estimated to be ~1.9 kg, i.e. 4% of their live weight. This corresponds to ~80% of the blood volume,[39] but would be close to losses observed with other slaughtering methods.[10] Chicken meat from Islamic slaughtering methods showed a significant lower haem and non-haem iron content than meat obtained from conventional methods.[40] The same issue, albeit to a lesser extent than for Kashrut, arises as regards iron intake. To our knowledge, no study has investigated this issue. As a result, a recent multivariate regression analysis found that religious observance plays a negative role regarding meat consumption per capita in the Muslim population across the world.[41]

Vitamin D. Unrelated to dietary prescriptions, but to the Quran dressing code, women's vitamin D status may be of concern (sura 7: ayat 26, sura 24: ayat 31).[33] Among 1981 Chinese lactating women, Muslims were 13.4 times (95% CI: 5.8–30.7, $P < 0.001$) more likely to be deficient in vitamin D than Hans.[42] The prevalence of vitamin D deficiency in veiled Turkish female students was 55 vs 20% for unveiled students ($P < 0.01$), with higher BMI values in the covered group (24.0 ± 4.0 vs 22.3 ± 3.1 kg/m^2, $P = 0.02$).[43] In Turkish women, 25 (OH) D serum concentrations correlated negatively with the duration of being veiled ($r = -0.369$, $P < 0.01$).[44] In France, Muslim veiled women were also shown to have lower 25 (OH) D serum concentrations (20.1 vs 38.9 nmol/L, $P < 0.001$) compared with their non-veiled counterparts.[45] In Saudi Arabia, almost 85% of pregnant women and 88% of neonates had a vitamin D deficiency [25(OH)D < 50 nmol/L].[46] In 38% of the women, obesity (BMI >30 kg/m^2) may contribute to vitamin D status alteration.[47]

Ramadan. Ramadan, the 4th pillar of Islam, is the ninth month of the lunar calendar and is followed by Muslims worldwide as a month of daytime fasting (sura 2: ayat 183–185), provided they are post-pubertal and in good health, as assessed by a physician, and not menstruating. Exemptions to daytime fasting include travelling, any health concern requiring specific and continuous treatment, pregnancy and BF. Missed fasting days, regardless of the reason, must be compensated for unless there is a permanent illness. In such a case, the alternative is feeding one poor person for each day missed. While fasting, Muslims refrain from consuming food and drinks, and smoking from dawn until sunset. During Ramadan, they take two meals per day, one at *iftaar* (evening meal after breaking the fast) and another at *suhoor* (meal consumed early in the morning). The daily duration of fasting differs as per geographical location and season. A meta-analysis enrolling participants aged from 18 to 58 years showed that weight loss during Ramadan was small (−1.24 kg) and lasted no longer than 2 weeks after Ramadan.[48] Two subsequent studies confirmed these results with a slight decrease in BMI (−1.9%, $P < 0.001$; -0.36 ± 0.371 kg/m^2, $P < 0.001$) and body fat (−0.6%, $P = 0.9$; -0.484 ± 0.597 kg, $P < 0.001$) but not in lean body mass, and a restoration of initial levels within a few weeks.[49,50] In 9 pre-teen and 9 teenage boys, weight and BMI increased significantly during Ramadan and 2 weeks afterwards (37.9 ± 7.9 vs 36.8 ± 7.4 kg, $P < 0.01$ and 55.9 ± 10.5 vs 53.9 ± 10.5 kg, $P < 0.01$), and was related to slightly higher energy intake and higher fat intake at *iftaar*, less physical activity and shorter sleep duration.[51] Excessive eating during *iftaar* or *suhoor* meals can lead to symptoms of dyspepsia, heartburn and acute pancreatitis (OR: 2.15; 95% CI: 1.23–3.8; $P = 0.01$).[52,53] Dehydration during fasting should be avoided, especially when Ramadan occurs in hot seasons and in physically active people or children, by drinking an ample amount of fluids between *iftar* and *suhoor*.[50,54–56] Dehydration and hyperviscosity could explain the increased incidence of cerebral venous sinus thrombosis during Ramadan fasting (1.4 times more frequent, $P = 0.03$).[57] Although most often mild (<2%), the dehydration may raise a concern in patients with underlying kidney disease. However, there is no evidence of the deleterious role of Ramadan in patients with chronic kidney disease or in renal stone formation.[52,55,58] Despite exemptions from fasting, many patients with medical conditions still choose to fast, which may adversely affect their health. This is particularly true in the case of diabetic patients for whom several guidelines of management have been published.[59–61] A prospective study conducted in Saudi Arabia enrolled 400 patients with either type 1 ($n = 40$) or type 2 ($n = 360$) diabetes who are used to fasting during Ramadan.[62] Hypoglycaemia occurred in 65% of type 1 diabetic patients and 14.7% of type 2 patients. During hypoglycaemia, 15.4 and 29.3% respectively of type 1 or type 2 diabetic subjects continued fasting. A cross-sectional multicountry observational study reported hypoglycaemia in 16.8% of 1759 diabetic patients, most of whom had type 2

diabetes.[63] Hypoglycaemia occurred more often in type 1 diabetic patients and led to the interruption of fasting in only 67% of the patients. Ramadan could be an important reason for non-compliance with prescribed medications. Therefore, it may be advisable to take the medication during non-fasting hours or to choose long-acting formulation.[52,64] Although exonerated, many pregnant Muslim women fast during Ramadan. A meta-analysis of 22 studies including 31 374 pregnancies, of which 60.3% were exposed to Ramadan fasting, showed that neither birth weight nor the rate of preterm births were affected by maternal fasting.[65] In Ankara, 52% of lactating mothers fast during Ramadan.[66] In another Turkish study, the daily intake of energy and most nutrients of fasting lactating mothers was below the dietary reference values for this specific population, except for protein and vitamins A and C.[67] No effect on infant growth was observed. The concentrations of magnesium, zinc and potassium in breast milk decreased significantly, most often below the usual values.

To summarize, Islamic dietary law may increase the risk of inadequate iron intake. When assessing these risks one should also consider the socio-economic level of the subjects. Vitamin D deficiency secondary to less sun exposure may be of concern. Although fasting during Ramadan is an obligation only for healthy post-pubertal adolescents and adults, many Muslims with acute or chronic medical conditions choose to fast, which may adversely affect their health.

Asian religions or philosophies

Indian religions (founded in the Indian subcontinent) include mainly Hinduism, Buddhism and Sikhism. They are classified as the dharmic religions, as they are all based on « *dharma* », a specific set of laws and duties.

Hinduism

Hinduism is thought to be one of the most ancient of still-active religions, starting between 2300 and 1500 BC, and includes dozens of separate philosophies amalgamated as Sanātana Dharma, among which are Vaishnavism and Shaivism.

Breastfeeding. In India, the percentage of mothers who breastfeed has been reported to be the same (90–95%) regardless of the mother's education, caste/tribe, place of birth and place of residence (rural/urban).[68] In New Delhi, exclusive BF declined in recent years to 74% at 1 month and 46% by 4 months. Although the overall median duration of BF was slightly >2 years, complementary feeding began early. The median duration of exclusive BF was only 1.4 months, and the median duration of predominant BF (BF + water) was 4.7 months. As Hindu mothers believe that colostrum is deleterious to the child, 25–50% discard it and feed their newborn cow's milk, water or honey during the first few days of life.[68] Honey and clarified butter (ghee) are thought to help evacuate meconium. The risk of administering honey to newborns has already been mentioned.

Dietary habits. Hindu diet varies according to several different traditions. Hindus believe that all living beings are equal; therefore, many of them avoid eating meat, fish and eggs. Milk products are allowed and encouraged, favouring lacto-vegetarianism. Cows must not be eaten because they are sacred to the Hindu goddess *Bhoomi* and treated as a motherly, giving animal and as a family member. If appropriately planned, the vegetarian diet can be nutritionally adequate for adults and children, raising, however, a potential issue with regard to vitamin B12, iron, zinc, selenium and *n*-3 fatty acids intake.[24,69–71] Some communities have many fasting days and periods in the calendar with restrictions, such as eating only plants. A national survey conducted in India on 641 642 adult non-pregnant women showed that the prevalence of undernutrition (BMI < 18.5 kg/m^2) and ID anaemia (haemoglobin level $<$ 12 g/dL) was higher ($P < 0.01$) in Hindus (respectively 24.2 and 53.2%) than in Muslims (21, 50.3%), Christians (11.4, 37.8%) or others (14.1, 50.5%).[72] No evidence on the role of the exclusion of animal protein or milk and curds consumption could be shown. A previous study showed that communities with the most restrictive vegetarian diet were more likely to develop ID anaemia than others or than Muslims who eat *halal* meat ($P < 0.05$).[73] Vitamin B12 deficiency (<150 pmol/L) and impaired vitamin B12 status, with serum methylmalonic acid concentrations >0.26 μmol/L in 43%, was found in 51% of pregnant Hindu women. Vitamin B12 deficiency was present in 44% of their infants at 6 weeks of age.[74]

Sikhism

Sikhism is a monotheistic Indian religion that originated in the Punjab region around the end of the 15th century. Sikhs are free to choose whether to adopt a meat diet or not, but they do not eat cows and are strictly forbidden from eating ritually-slaughtered meat such as *halal* and *kosher* meat. Most of them are lacto-vegetarians and alcohol is prohibited.

Buddhism

Buddhism, founded in the 6th century BC, encompasses a variety of traditions, beliefs and spiritual practices largely based on teachings attributed to Buddha. Two major extant branches of Buddhism are generally recognized:

Theravada ('The School of the Elders' and 'Lesser or Inferior Vehicle') mainly in Sri Lanka and Southeast Asia, and Mahayana Buddhism (or the 'Great Vehicle') prominent in China, Japan, Korea and Vietnam. Vajrayana Buddhism first appeared in India and is most prominent in the Himalayan regions (Tibetan Buddhism) as a part of Mahayana.

Breastfeeding. BF is a strong practice among Buddhist mothers and is often continued beyond 2 years of age.[75]

Dietary habits. There are no set prescriptions for food restrictions in Buddhism, except that monks and nuns should not eat after noon. Under the concept of doing no harm, many Buddhists follow a lacto-vegetarian diet, and alcohol is strongly discouraged. In a study comparing body composition and nutrient intake in 54 Korean Buddhist vegetarian nuns and in 31 omnivorous Catholic nuns, significantly higher values were found for body weight, fat free mass (44.5 vs 41.8 kg, $P = 0.013$), body fat (13.8 vs 11.7 kg, $P = 0.037$) and BMI (22.6 vs 20.7 kg/m^2, $P = 0.10$) in the Buddhist nuns.[76] This association may be due to a confounding factor as body fat was inversely correlated with the duration of vegetarianism (P for trend = 0.043). There was no difference in vitamin B12 and iron status.[77] Postmenopausal Taiwanese women who had been long-term practitioners of vegan Buddhism were at a higher risk of exceeding the lumbar spine fracture threshold (adjusted OR = 2.48, 95% CI = 1.03–5.96) and being classified as having osteopaenia as assessed by measuring bone mineral density of the femoral neck using dual-photon absorptiometry (adjusted OR = 3.94, 95% CI = 1.21–12.82).[78] Conversely, in a Vietnamese study, no significant difference in bone mineral density was found between vegan Mahayana Buddhist nuns and omnivorous postmenopausal women, although vegans had a much lower dietary intake of both calcium and protein.[79]

In summary, the potential nutritional inadequacy of dietary practices in Indian religions is linked to the degree of food restriction in the vegetarian diet. Lacto-ovo-vegetarian and lactovegetarian diets have, except for iron intake, no adverse health effects, if well balanced, whereas a vegan diet can lead to several deficiencies mainly in calcium, iron and vitamin B12.

Chinese culture

This culture includes the syncretism of Buddhism, Confucianism, Taoism and the theory of Yin and Yang.

Breastfeeding. BF is highly recommended. In a recent survey, 58% of infants aged 6–8 months, 35% of infants aged 9–11 months and 18% of infants aged 12–14 months received breast milk.[80] Infant formula was also given to 46% of them.

Dietary habits. In China, food is thought to play a vital role in preventing and treating diseases and addressing certain health conditions. The traditional Chinese diet is rich in starch (rice, noodles), legumes and vegetables and has smaller quantities of various meats (mainly pork), poultry and seafood. If the principles derived from these philosophies are properly followed, they should not cause any health threats. However, the structure of the Chinese diet has been shifting from the traditional diet towards a high-fat, low-carbohydrate and low-fibre diet.[81] A majority of Chinese children have an inadequate intake of calcium, iron, zinc, selenium, vitamin A, thiamine, riboflavin and vitamin C.[82] After 6 months of age, rice is generally the first grain food consumed (up to 88%); eggs and pork are the most commonly consumed protein sources, whereas ~50% of infants do not consume any fruits or vegetables.[80] Iron deficiency is also common in pregnant Chinese women.[83]

Folk or traditional religions

In addition, >400 million people (6%), mainly in the Asia-Pacific region, practice various folk or traditional religions (Table 1).[4] Folk religions are closely tied to specific populations, ethnicities or tribes. In some cases, elements of other world religions are blended with local beliefs and customs. These faiths often have no formal creeds or sacred texts. Some are characterized by shamanism, animism and/or ancestor worship. To our knowledge, no information is available on the health consequences of these diets.

Discussion

Global migration is increasing the variety of cultural and religious rituals in populations, leading health professionals to be increasingly attentive to potential health consequences, especially in terms of nutrition. The evidence reviewed in this paper supports the hypothesis that religious dietary rules may have some nutritional consequences. Most religious dietary rules do not bear any nutritional hazard, some may be beneficial and some might be deleterious. This comes as no surprise given the ancient history of the rules, having mostly been set for millennia, in extremely different environmental circumstances; albeit with varying levels of compliance. Whatever the origin of these rules, their actual health impact remains a matter of debate,[20,26,84,85] especially nowadays since they are more or less strictly respected according to the degree of religiousness. In some religions (Orthodox Jews, Ethiopian

Orthodox Christians, most strictly observant Muslims), the most observant subjects are the most exposed to possible nutritional inadequacies. In contrast, if a large part of the world population claims a religious affiliation, the level of observance is difficult to assess. Most religiously affiliated people likely believe in more than practice their religion. In a recent Pew Center analysis in the USA and 28 other countries around the world, the actively religious people, i.e. people identifying with a religious group and attending services at least once a month, vary from 11 to 71% of the population.[85] In a 2015 European survey, with 9707 respondents, 53% declared to be Catholic, 29% Protestant, 2.6% affiliated to other religions and 15.3% unaffiliated.[86] In the religiously affiliated people, 10% were considered as the more religious since reporting praying, taking part in a religious organization and being raised religiously. Still, the degree of religiosity hardly predicts observance of dietary rules.

In addition, observational studies do not establish a causal relationship between dietary rules and nutritional imbalances. Many studies underline an increased risk of nutritional inadequacies in some religious groups, but also the existence of some confounding factors, mainly the interference of the socio-economic status of the populations and co-morbidities (obesity or others). Worldwide, religious affiliation is associated with socio-economic status, with group differences in education and wealth, depending on the national context;[86] a US survey, conducted in 1970, indicated that the socio-economic status was not shown to be an important determinant of religious participation.[87] In general, a low socio-economic status is a major determinant not only of malnutrition and undernutrition, but also of obesity in the developed countries, and is generally associated with poor compliance to national dietary recommendations.[88–91] These interrelationships are relatively complex to dissect. For instance, in rural India the poorest children and women are 2.9 times more likely to be malnourished than children or women from the highest wealth quintile. However, for a given level of wealth, Hindus and even more Muslims are more likely to be malnourished than the rest of the religious categories.[92]

Among the potential risks of nutritional inadequacies or malnutrition, ID is a nutritional hazard in some believers as a consequence of too strictly respecting vegetarianism and especially veganism. ID can result from the consumption of bloodless meat and even more from the lower consumption of meat, fish or poultry, especially in poor people. Religion, per capita income and both play a role in meat consumption.[41] Interestingly, negative consequences seem more linked to deviations from the rules laid down owing to ignorance of the real rules or to preference of easy solutions to apply these rules.

Benefits may occur. Prolonged breastfeeding recommended by most religions is beneficial for children and mothers.[93,94] Avoidance of alcohol (Mormon Church, Islam, Hinduism, Sikhism) has personal and public health benefits.[95] Mixed outcomes are possible. Eating an improperly balanced vegetarian or vegan diet endows a risk of decreased iron and vitamin B12 intake and decreased bone mineral density. In contrast, in the long term, a vegetarian diet might reduce increased blood pressure, body fat mass, blood glucose or plasma lipids, albeit increasing the risk of stroke.[96–99] Meat is an important source of high-quality dietary protein and largely contributes to the intake of iron, zinc, selenium, vitamin B12 and others, all of them available in sufficient amounts without eating meat. Excessive meat consumption is often associated with overconsumption of energy and fat and may predispose to colorectal cancer.[100–101]

Fasting periods are undertaken for religious or spiritual purposes. Fasting with no calories consumed should be distinguished from abstinence, the refraining from some types of food, mainly meat. In the Greek Orthodox cult, long periods of abstinence offer the same benefits as a balanced vegetarian diet. Short periods of fasting (Judaism) or alternate day fasting (Catholicism) have little nutritional impact.[27,28] Islamic fasting during Ramadan does not require energy restriction and has a moderate or reversible impact.[27,28,102] Routine fasting may have some beneficial health effect (Seven-day Adventist, Mormon Church).[27] However, prolonged periods of fasting may lead to malnutrition or undernutrition as shown in the Ethiopian Orthodox Church.[29,30]

Practical recommendations

Knowing and understanding of the various religious dietary rules and their potential health impact may guide health professionals in the care of populations. Inquiring about the exact religious practice of a patient and any nutritional consequences is advisable but should be done without in any way interfering with one's own faith convictions. Gathering individual dietary data allows guiding management, with special attention to mothers and children. Evaluation of nutritional status by clinical examination, weighing and determination of BMI are essential steps before giving any nutritional advice. Balanced vegetarian diets have to meet energy requirements on a wide variety of plant foods and pay attention to some critical nutrients, such as protein, fibre, omega-3 fatty acids, iron, zinc, iodine, calcium, vitamin D and vitamin B12.[103] In any case, when a deficiency in nutrients seems possible, such as for iron, vitamin B12 or D, measurement of the appropriate biomarkers may help to guide the prescription of appropriate supplements.

Conclusion

The impact of religious practice on health remains controversial and studies on this issue are scarce.[20,26,84] More or less closely followed for several centuries or even millennia, most dietary religious precepts are neutral and/or have no health consequences, when carried out according to the rules. Some, such as BF or alcohol avoidance are beneficial. Nevertheless, specific practices may lead to dietary inadequacies, particularly in populations with low socioeconomic status, mainly as a result of the non-consumption of meat and/or poor dairy product intake. Healthcare providers should have a basic knowledge and understanding of how spirituality, religiosity and personal beliefs are relevant social determinants that affect patients' health behaviour and compliance to treatments and dietary advices. This is all the more useful as there is an increase in the number of migrant populations in many countries of the world that are likely to introduce religions that were previously absent. This should help health professionals adopt an individualized approach to decide on the advisability of supplementation, especially with iron, calcium, vitamin D or vitamin B12, particularly among children and women of childbearing age.

Supplementary Data

Supplementary data are available at *IJE* online.

Data Availability Statement

The data analysed in this review all correspond to the indexed references and are available in PubMed, Medline, CNRS/Pascal-francis.inist, Google or Google Scholar databases. They can also be accessed by using the DOI link given for each reference, when available, or by using the internet link.

Acknowledgements

We are very grateful to Lord Bruno Feillet, Auxiliary Bishop of Reims (Christianity), Dr Alain Morali (Nancy, Judaism) and Dr Farid Boubred (Marseille, Islam) for their kind help in reviewing and commenting on selected sections.

Author Contributions

J.P.C. had the idea for the paper, did the literature search and analysis and wrote the manuscript. D.T., A.Br., D.D. and C.D. helped with the interpretation of the data, and contributed to writing the manuscript. Other authors of the Committee on Nutrition revised the manuscript equally, bringing complementary information, and approved the final version.

Conflict of Interest

None declared.

References

1. Pew research Center. *Religious Composition by Country 2010–2050*. https://www.pewforum.org/2015/04/02/religious-projection-table/2020/number/all/ (08 March 2020, date last accessed).
2. Central Intelligence Agency. The World *Factbook 2020, Religion*. https://www.cia.gov/library/publications/resources/the-world-factbook/fields/401.html (08 March 08 2020, date last accessed).
3. Swihart DL, Martin RL. Cultural religious competence in clinical practice. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing, 2019..https://www.ncbi.nlm.nih.gov/books/NBK493216/ (13 September 2019, date last accessed).
4. Pew Research Center. *The Changing Global Religious Landscape*. 2017. http://www.pewforum.org/2017/04/05/the-changing-global-religious-landscape/pf_17-04-05_projection supdate_muslimchristianbabies310px/ (08 March 08 2020, date last accessed).
5. Eidelman AI. The Talmud and human lactation: the cultural basis for increased frequency and duration of breastfeeding among orthodox Jewish women. *Breastfeed Med* 2006;**1**:36–40.
6. Pierro J, Abulaimoun B, Roth P, Blau J. Factors associated with supplemental formula feeding of breastfeeding infants during postpartum hospital stay. *Breastfeed Med* 2016;**11**:196–202.
7. Ineichen B, Pierce M, Lawrenson R. Jewish and Celtic attitudes to breast feeding compared. *Midwifery* 1997;**13**:40–43.
8. Wagschal S. *The New Practical Guide to Kashruth*. Jerusalem, Israel: Feldheim, 1991: 184 p. ISBN-10: 0686762479, ISBN-13: 978–0686762478.
9. Eliasi JR, Dwyer JT. Kosher and Halal: religious observances affecting dietary intakes. *J Am Diet Assoc* 2002;**102**:911–13.
10. Farouk MM, Al-Mazeedi HM, Sabow AB *et al.* Halal and kosher slaughter methods and meat quality: a review. *Meat Sci* 2014;**98**:505–19.
11. Meyerovitch J, Sherf M, Antebi F *et al.* The incidence of anaemia in an Israeli population: a population analysis for anaemia in 34512 Israeli infants aged 9 to 18 months. *Pediatrics* 2006; **118**:e1055–e1060.
12. Moshe G, Amitai Y, Korchia G *et al.* Anaemia and iron deficiency in children: association with red meat and poultry consumption. *J Pediatr Gastroenterol Nutr* 2013;**57**:722–27.
13. Yanovich R, Merkel D, Israeli E, Evans RK, Erlich T, Moran DS. Anaemia, iron deficiency, and stress fractures in female combatants during 16 months. *J Strength Cond Res* 2011;**25**: 3412–21.
14. Burns ER, Neubort S. Sodium content of koshered meat. *JAMA* 1984;**252**:2960.
15. Glick SM. Salt content of kosher meat (Letter). *JAMA* 1985; **254**:504.
16. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ. Effect of lower sodium intake on health: systematic review and meta-analyses. *Br Med J* 2013;**346**:f1326.
17. Girardet JP, Rieu D, Bocquet A *et al.* Comittee on Nutrition of the French Society of Paediatrics [Salt intake in children]. *Arch Pediatr* 2014;**21**:521–28.

18. Israel Dairy Board. *Israel Dairy, Facts and Figures* 2016. http://www.halavi.org.il/roit-dpon_anglit.pdf (3 May 2018, date last accessed).
19. Tassenaar V, Karel EH. The power of the Kashrut: older but shorter. The impact of religious nutritional and hygienic rules on stature and life expectancy of Jewish conscripts in the early 19th century. *Eur J Clin Nutr* 2016;**70**:667–70.
20. Brammli-Greenberg S, Glazer J, Shapiro E. The inverse U-shaped religion-health connection among Israeli Jews. *J Relig Health* 2018;**57**:738–50.
21. Burdette AM, Pilkauskas NV. Maternal religious involvement and breastfeeding initiation and duration. *Am J Public Health* 2012;**102**:1865–8.
22. Bernard JY, Cohen E, Kramer MS. Breast feeding initiation rate across western countries: does religion matter? An ecological study. *Bmj Glob Health* 2016;**1**:e000151.
23. Cattaneo A, Burmaz T, Arendt M *et al.* Protection, promotion and support of breast-feeding in Europe: progress from 2002 to 2007. *Public Health Nutr* 2010;**13**:751–59.
24. Van Winckel M, Vande Velde S, De Bruyne R, Van Biervliet S. Clinical practice: vegetarian infant and child nutrition. *Eur J Pediatr* 2011;**170**:1489–94.
25. Matsumoto S, Beeson WL, Shavlik DJ *et al.* Association between vegetarian diets and cardiovascular risk factors in non-Hispanic white participants of the Adventist Health Study-2. *J Nutr Sci* 2019;**8**:e6.
26. Yeary KHK, Sobal J, Wethington E. Religion and body weight: a review of quantitative studies. *Obes Rev* 2017;**18**:1210–22.
27. Patterson RE, Sears DD. Metabolic effects of intermittent fasting. *Annu Rev Nutr* 2017;**37**:371–93.
28. Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutr J* 2010;**9**:57.
29. Desalegn BB, Lambert C, Riedel S, Negese T, Biesalski HK. Ethiopian orthodox fasting and lactating mothers: longitudinal study on dietary pattern and nutritional status in rural Tigray, Ethiopia. *Int J Environ Res Public Health* 2018;**15**:1767.
30. Desalegn BB, Lambert C, Riedel S, Negese T, Biesalski HK. Feeding practices and undernutrition in 6-23-month-old children of Orthodox Christian mothers in rural Tigray, Ethiopia: longitudinal study. *Nutrients* 2019;**11**:138.
31. Gatrad AR, Sheikh A. Muslim birth customs. *Arch Dis Child Fetal Neonatal Ed* 2001;**84**:F6–F8.
32. Shaikh U, Ahmed O. Islam and infant feeding. *Breastfeed Med* 2006;**1**:164–67.
33. Grabowski NT, Klein G. Microbiology and foodborne pathogens in honey. *Crit Rev Food Sci Nutr* 2017;**57**:1852–62.
34. Kamoun C, Spatz D. Influence of Islamic traditions on breastfeeding beliefs and practices among African American Muslims in west Philadelphia: A mixed-methods study. *J Hum Lact* 2018;**34**:164–75.
35. Alnakshabandi K, Fiester A. Creating religiously compliant milk banks in the Muslim world: a commentary. *Paediatr Int Child Health* 2016;**36**:4–6.
36. Al-Naqeeb NA1, Azab A, Eliwa MS, Mohammed BY. The introduction of breast milk donation in a Muslim country. *J Hum Lact* 2000;**16**:346–50.
37. Hsu HT, Fong TV, Hassan NM, Wong HL, Rai JK, Khalid Z. Human milk donation is an alternative to human milk bank. *Breastfeed Med* 2012;**7**:118–22.
38. Hossain MZ. What does Islam say about dieting? *J Relig Health* 2014;**53**:1003–12.
39. Khalid R, Knowles TG, Wotton SB. A comparison of blood loss during the Halal slaughter of lambs following traditional religious slaughter without stunning, electric head-only stunning and post-cut electric head-only stunning. *Meat Sci* 2015;**110**:15–23.
40. Addeen A, Benjakul S, Wattanachant S, Maqsood S. Effect of Islamic slaughtering on chemical compositions and post-mortem quality changes of broiler chicken meat. *Int Food Res J* 2014;**21**:897–907.
41. Milford AB, Le Mouël C, Bodirsky BL, Rolinski S. Drivers of meat consumption. *Appetite* 2019;**141**:104313.–
42. Pang XH, Yang ZY, Wang J. [Nutritional status and influence of vitamin D among Chinese lactating women in 2013]. *Zhonghua Yu Fang Yi Xue Za Zhi* 2016;**50**:1056–60.
43. Buyukuslu N, Esin K, Hizli H, Sunal N, Yigit P, Garipagaoglu M. Clothing preference affects vitamin D status of young women. *Nutr Res* 2014;**34**:688–93.
44. Guzel R, Kozanoglu E, Guler-Uysal F, Soyupak S, Sarpel T. Vitamin D status and bone mineral density of veiled and unveiled Turkish women. *J Womens Health Gend Based Med* 2001;**10**:765–70.
45. Le Goaziou MF, Contardo G, Dupraz C, Martin A, Laville M, Schott-Pethelaz AM. Risk factors for vitamin D deficiency in women aged 20-50 years consulting in general practice: a cross-sectional study. *Eur J Gen Pract* 2011;**17**:146–52.
46. Fouda MA, Turkestani IZ, Almusharraf S *et al.* Extremely high prevalence of maternal and neonatal vitamin D deficiency in the Arab population. *Neonatology* 2017;**112**:225–30.
47. Frelut ML, Girardet JP, Bocquet A *et al.* Impact of obesity on biomarkers of iron and vitamin D status in children and adolescents: the risk of misinterpretation. *Arch Pediatr* 2018;**25**:3–5.
48. Sadeghirad B, Motaghipisheh S, Kolahdooz F, Zahedi MJ, Haghdoost AA. Islamic fasting and weight loss: a systematic review and meta-analysis. *Public Health Nutr* 2014;**17**:396–406.
49. López-Bueno M, González-Jiménez E, Navarro-Prado S, Montero-Alonso MA, Schmidt-RioValle J. Influence of age and religious fasting on the body composition of Muslim women living in a westernized context. *Nutr Hosp* 2014;**31**:1067–73.
50. Fahrial Syam A, Suryani Sobur C, Abdullah M, Makmun D. Ramadan fasting decreases body fat but not protein mass. *Int J Endocrinol Metab* 2016;**14**:e29687.
51. Farooq A, Herrera CP, Almudahka F, Mansour R. A prospective study of the physiological and neurobehavioral effects of Ramadan fasting in preteen and teenage boys. *J Acad Nutr Diet* 2015;**115**:889–97.
52. Abolaban H, Al-Moujahed A. Muslim patients in Ramadan: a review for primary care physicians. *Avicenna J Med* 2017;**7**:81–87.
53. Drozdinsky G, Agabaria A, Zuker-Herman R, Drescher MJ, Bleetman T, Shiber S. High rate of acute pancreatitis during the Ramadan fast. *Eur J Gastroenterol Hepatol* 2018;**30**:608–11.
54. Trabelsi K, El Abed K, Trepanowski JF *et al.* Effects of Ramadan fasting on biochemical and anthropometric parameters in physically active men. *Asian J Sports Med* 2011;**2**:134–44.

55. Hassan S, Hassan F, Abbas N *et al.* Does Ramadan fasting affect hydration status and kidney function in CKD patients? *Ann Nutr Metab* 2018;**72**:241–47.
56. Maughan RJ, Shirreffs SM. Hydration and performance during Ramadan. *J Sports Sci* 2012;**30**:S33–41.
57. Javanmardi H, Safari A, Borhani-Haghighi A. Effect of Ramadan fasting in incidence of cerebral venous sinus thrombosis (Letter). *Int J Stroke* 2018;**13**:NP2.
58. Al Mahayni AO, Alkhateeb SS, Abusaq IH, Al Mufarrih AA, Jaafari MI, Bawazir AA. Does fasting in Ramadan increase the risk of developing urinary stones? *Saudi Med J* 2018;**39**:481–86.
59. Hassanein M, Al-Arouj M, Hamdy O *et al.* International Diabetes Federation (IDF), in collaboration with the Diabetes and Ramadan (DAR) International Alliance. Diabetes and Ramadan: Practical guidelines. *Diabetes Res Clin Pract* 2017;**126**:303–16.
60. Sadikot S, Jothydev K, Zargar AH, Ahmad J, Arvind SR, Saboo B. Clinical practice points for diabetes management during Ramadan fast. *Diabetes Metab Syndr* 2017;**11**:S811–19.
61. Bajaj HS, Abouhassan T, Ahsan MR *et al.* Diabetes Canada position statement for people with types 1 and 2 diabetes who fast during Ramadan. *Can J Diabetes* 2019;**43**:3–12.
62. Ba-Essa EM, Hassanein M, Abdulrhman S, Alkhalifa M, Alsafar Z. Attitude and safety of patients with diabetes observing the Ramadan fast. *Diabetes Res Clin Pract* 2019;**152**:177–82.
63. Beshyah SA, Hassanein M, Ahmedani MY *et al.* Diabetic hypoglycaemia during Ramadan fasting: a trans-national observational real-world study. *Diabetes Res Clin Pract* 2019;**150**:315–21.
64. Grindrod K, Alsabbagh W. Managing medications during Ramadan fasting. *Can Pharm J* 2017;**150**:146–49.
65. Glazier JD, Hayes DJL, Hussain S *et al.* The effect of Ramadan fasting during pregnancy on perinatal outcomes: a systematic review and meta-analysis. *BMC Pregnancy Childbirth* 2018;**18**:421.
66. Ertem IO, Kaynak G, Kaynak C, Ulukol B, Gulnar SB. Attitudes and practices of breastfeeding mothers regarding fasting in Ramadan. *Child Care Health Dev* 2001;**27**:545–54.
67. Rakicioglu N, Samur G, Topcu ALI, Topcu AA. The effect of Ramadan on maternal nutrition and composition of breast milk. *Pediatr Int* 2006;**48**:278–83.
68. Laroia N, Sharma D. The religious and cultural bases for breastfeeding practices among the Hindus. *Breastfeed Med* 2006;**1**:94–98.
69. Craig WJ. Nutrition concerns and health effects of vegetarian diets. *Nutr Clin Pract* 2010;**25**:613–20.
70. McEvoy CT, Woodside JV. Vegetarian diets. *World Rev Nutr Diet* 2015;**113**:134–38.
71. Elorinne A-L, Alfthan G, Erlund I *et al.* Food and nutrient intake and nutritional status of Finnish vegans and non-vegetarians. *PLoS One* 2016;**11**:e0148235.Erratum in: PLoS One. 2016; 11: e0151296.
72. Bharati S, Pal M, Sen S, Bharati P. Malnutrition and anaemia among adult women in India. *J Biosoc Sci* 2019;**51**:658–68.
73. Bhatti AS, Mahida VI, Gupte SC. Iron status of Hindu Brahmin, Jain and Muslim communities in Surat, Gujarat. *Indian J Hematol Blood Transfus* 2007;**23**:82–87.
74. Finkelstein JL, Kurpad AV, Thomas T, Srinivasan K, Duggan C. Vitamin B12 status in pregnant women and their infants in South India. *Eur J Clin Nutr* 2017;**71**:1046–53.
75. Segawa M. Buddhism and breastfeeding. *Breastfeed Med* 2008;**3**:124–28.
76. Lee Y, Krawinkel M. Body composition and nutrient intake of Buddhist vegetarians. *Asia Pac J Clin Nutr* 2009;**18**:265–71.
77. Lee Y, Krawinkel M. The nutritional status of iron, folate, and vitamin B-12 of Buddhist vegetarians. *Asia Pac J Clin Nutr* 2011;**20**:42–49.
78. Chiu JF, Lan SJ, Yang CY *et al.* Long-term vegetarian diet and bone mineral density in postmenopausal Taiwanese women. *Calcif Tissue Int* 1997;**60**:245–59.
79. Ho-Pham LT, Nguyen PL, Le TT *et al.* Veganism, bone mineral density, and body composition: a study in Buddhist nuns. *Osteoporos Int* 2009;**20**:2087–93.
80. Yu P, Denney L, Zheng Y, Vinyes-Parés G *et al.* Food groups consumed by infants and toddlers in urban areas of China. *Food Nutr Res* 2016;**60**:30289.
81. Zhang R, Wang Z, Fei Y *et al.* The difference in nutrient intakes between Chinese and Mediterranean, Japanese and American diets. *Nutrients* 2015;**7**:4661–88.
82. Wang H, Wang D, Ouyang Y, Huang F, Ding G, Zhang B. Do Chinese children get enough micronutrients? *Nutrients* 2017;**9**:397.
83. Ma A, Chen X, Zheng M, Wang Y, Xu R, Li J. Iron status and dietary intake of Chinese pregnant women with anaemia in the third trimester. *Asia Pac J Clin Nutr* 2002;**11**:171–75.
84. Ahrenfeldt LJ, Möller S, Andersen-Ranberg K, Vitved AR, Lindahl-Jacobsen R, Hvidt NC. Religiousness and health in Europe. *Eur J Epidemiol* 2017;**32**:921–29.
85. Pew Research Center. *Religion's Relationship to Happiness, Civic Engagement and Health Around the World*. 2019. https://www.pewforum.org/2019/01/31/religions-relationship-to-happiness-civic-engagement-and-health-around-the-world/pf_1-23-19_religion_wellbeing-17to19/. (08 March 2020, date last accessed)
86. Heaton TB. Religion and socioeconomic status in developing nations: a comparative approach. *Social Compass* 2013;**60**:97–114.
87. Mueller CW, Johnson WT. Socioeconomic status and religious participation. *Am Soc Rev* 1975;**40**:785–800.
88. Van de Poel E, Hosseinpoor AR, Speybroeck N, Van Ourti VJ. Socioeconomic inequality in malnutrition in developing countries. *Bull World Health Organ* 2008;**86**:282–91.
89. Bhutta ZA, Berkley JA, Bandsma RHJ, Kerac M, Trehan I, Briend A. Severe childhood malnutrition. *Nat Rev Dis Primers* 2017;**3**:17067.
90. Black RE, Victora CG, Walker SP *et al.* Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 2013;**382**: 427–51.
91. Alkerwi A, Vernier C, Sauvageot N, Crichton GE, Elias MF. Demographic and socioeconomic disparity in nutrition: application of a novel Correlated Component Regression approach. *Br Med J Open* 2015;**5**:e006814.
92. Sabharwal NS. Caste, religion and malnutrition linkages. *Econ Poli. Wkly* 2011;**46**:16–18.
93. Lawrence RA, Lawrence RM. Breastfeeding 8th edition. In: *Guide for Medical Profession*. Philadelphia: Elsevier, 2016, p. 992. ISBN: 978–0-323–35776-0.

94. Del Ciampo LA, Del Ciampo IRL. Breastfeeding and the benefits of lactation for women's health.. *Rev Bras Ginecol Obstet* 2018;**40**:354–59.
95. Le Daré B, Lagente V, Gicquel T. Ethanol and its metabolites: update on toxicity, benefits, and focus on immunomodulatory effects. *Drug Metab Rev* 2019;**51**:545–61.
96. Dinu M, Abbate R, Gensini GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: a systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr* 2017;**57**:3640–49.
97. Rocha JP, Laster J, Parag B, Shah NU. Multiple health benefits and minimal risks associated with vegetarian diets. *Curr Nutr Rep* 2019;**8**:374–81.
98. Glenn AJ, Viguiliouk E, Seider M *et al.* Relation of vegetarian dietary patterns with major cardiovascular outcomes: a systematic review and meta-analysis of prospective cohort studies. *Front Nutr* 2019;**6**:80.
99. Tong TYN, Appleby PN, Bradbury KE *et al.* Risks of ischaemic heart disease and stroke in meat eaters, fish eaters, and vegetarians over 18 years of follow-up: results from the prospective EPIC-Oxford study. *Br Med J* 2019;**366**:l4897.
100. Godfray HCJ, Aveyard P, Garnett T *et al.* Meat consumption, health, and the environment. *Science* 2018;**361**:eaam5324.
101. Salter AM. The effects of meat consumption on global health. *Rev Sci Tech* 2018;**37**:47–55.
102. Venegas-Borsellino C, Sonikpreet, Martindale RG. From religion to secularism: the benefits of fasting. *Curr Nutr Rep* 2018;**7**:131–38.
103. Baroni L, Goggi S, Battaglino R *et al.* Vegan nutrition for mothers and children: practical tools for healthcare providers. *Nutrients* 2018;**11**:5.