Abstract

Objective: To identify the evidence available in the literature about the risk factors for type II Diabetes Mellitus.

Method: There was an integrative review of the literature in the following databases: PubMed, LILACS, SciELO and Scopus, using the descriptors type II diabetes mellitus and factors of risk in Portuguese and English. The research returned 504 articles from 2006 to 2016. After inclusion and exclusion criteria, one obtained 14 studies, which compose the study sample.

Results: Of the studies included in the review, 21.4% were in 2011 and 2015. Regarding the method, 57.0%, were cross-sectional studies. The prevalent Qualis was the category A. In all studies, there were factors of risk for T2DM.

Conclusion: By analyzing the studies, it was possible to identify a wide range of factors of risk found in the literature, showing what can favor the development of the disease and the possible means to build preventive and promotional strategies for groups prone to develop that problem.

Keywords
Diabetes; Type II Diabetes Mellitus; Factors of Risk.
Introduction

Over the years, due to the accelerated globalization, urbanization and population growth, there have been several changes in the lifestyle of people in society. Stress, consumerism, alcohol, smoking, sedentary lifestyle, excessive calorie diet and lack of physical activity in their lives are some of the possible factors that can trigger diseases, including diabetes mellitus (DM).

The Brazilian Society of Diabetes describes the DM as a syndrome of multiple etiology of metabolic disorders caused by the lack and/or deficiency of insulin, which causes a chronic condition that requires the person affected by DM continuous change in both the lifestyle as adapting the disease [1].

According to the International Diabetes Federation, in 2015, there were in the world 415 million adults affected by the problem, and, in 2040, there shall be 642 million people with diabetes. In addition, there are projections that one in two adults have undiagnosed diabetes, representing high risk of developing complications with higher costs, since the disease has an economic burden of US$ 673 billion in investments in health, corresponding to 12% of the total invested in health in the world. The DM also carries high mortality rates, with estimates that every six seconds a person dies from diabetes [2].

In accordance with the 2015-2016 Brazilian Guidelines for Diabetes, in 2014, 11.9 million people, aged from 20 to 79 years, were affected by DM, and estimates suggest that by 2035, this number may rise to 19.2 million [1].

Based on the ADA and the World Health Organization, the Ministry of Health classifies Diabetes Mellitus in types: I. Destruction of beta cells that produce insulin due to an error in the immune system and II. There is a defect in the secretion of insulin associated with a resistance to the substance, predominating in 90% of cases of diabetes. The gestational diabetes, not fully understood, can occur due to hyperglycemia, firstly diagnosed during pregnancy, and may disappear, or not, after delivery. There are other types characterized by genetic defects associated by disease or drugs [1].

The development of type II Diabetes Mellitus (T2DM) relates to the predominance of genetic factors associated with inappropriate lifestyle standard [3], with a prevalence of 90% to 95% of cases [1].

Obesity, physical inactivity, hypertension, hyperlipidemia, gestational diabetes history, increasing age, differences in ethnic groups and hereditary factors are factors of risk that can contribute to the development of type II diabetes mellitus [4].

Therefore, knowing the factors of risk that predispose to the development of T2DM is important to health professionals. That knowledge enables professionals who work in Basic Health Units identifying the user predisposed to develop T2DM, and reducing the possibility of the disease onset.

In Brazil, the healthcare professional from primary care is more likely to identify risk factors for DM, once their activities are performed in the first level of health assistance, promoting a longitudinal care [5].

Primary Healthcare is characterized by a set of individual and collective health actions comprehending health promotion and prevention of diseases, diagnosis and treatment that provides holistic and longitudinal care, by means of qualified multiprofessional teams acting in basic healthcare facilities [5].

The Basic Health Units (BHU) consist of a multidisciplinary team, composed by: doctor, nurse, dentist, Community Health Agents and other professionals. They use methodologies and tools for organizing the work process, such as receptiveness, spontaneous demand, and consultation of risk groups for chronic diseases, comprehensive care and home visits in order to meet the health needs of the population [6]. The nurse, as a member of that team, uses, as the main strategy, the nursing consultation, being important for health education [7].
Given the need to advance in the knowledge about factors of risk for type II diabetes mellitus, the following leading question emerged: What are the factors of risk that may contribute to the development of type II diabetes mellitus published in national and international studies? Thus, the objective of this study was to identify the evidence available in the literature on the factors of risk for type II diabetes mellitus.

The justification of interests in this integrative review is the progressive increase in T2DM cases in the world, and the social impact of that disease, compromising the quality of life. The consequence of that disease results in increased demand in health services, causing high rates of visits, hospital admissions, periodic exams and availability of medication for frequent and continuous use. Considering that, prevention, treatment and control of diabetes are difficult, because they require constant care, often neglected by the health team, family or even by the own person affected by T2DM.

**Material and Method**

This is an integrative review, a type of study that examines the scientific literature with the intention to integrate and promote knowledge about a particular subject [8].

Its development occurred from May to July 2016 in the following databases: Scientific Electronic Library Online (SciELO), Latin American and Caribbean Health Sciences (LILACS), US National Library of Medicine National Institutes of Health Medical Online (PUB-MED) and Scopus. The search of the journals at the mentioned databases was performed using the terminology in health found in Descriptors in Health Sciences (DeCS).

Thus, DeCS identified the terms “Diabetes Melittus Tipo 2” or “Type 2 Diabetes Mellitus” and “Fator de risco” or “Risk factor”. Those descriptors, combined with the Boolean operator “and”, were used, conditioning their presentation in the title of the work in order to refine the studies that addressed only the selected theme. After searching in the databases there was conducted the reading of the titles and abstracts to identify whether they contemplated the objective of the review. Given the relevance of the study, the next step was to verify if the text was fully available. There was exclusion of studies that had text and abstract with relevant theme, but were not complete. Thus, it was possible to identify 504 publications.

In order to select the sample, the studies had to meet the following inclusion criteria: publications in the form of article or review with full text, having as theme the factor of risk for type II Diabetes Mellitus,
published in the period from 2006 to 2016, available in Portuguese, Spanish and English. There was exclusion of dissertations, theses and books. Thus, the exclusion of 295 studies do not contemplate the guiding question of review; 09, for being repeated in selected bases; 21 that were not fully available; 130 did not belong to the selected time limit; 35 for not being in Portuguese, English or Spanish. Thus, the study sample consisted of 14 items, as shown in Figure 1.

Therefore, the final sample consisted of 14 articles for the review analysis. Among them, six were in English, two, in Spanish, and six, in Portuguese. It is noteworthy that the commitment to the ethical aspects constitutes the citation of the analyzed authors.

In order to extract the main data, there was preparation of an instrument that had information on Journal/Year/Authors, Journal title, Objectives, Study/Qualis Design, Factor of risk and Conclusion. The results and analyzes are presented below.

**Results**

The study sample consisted of 14 publications that contemplated the factors of risk for type II diabetes mellitus within the prescribed period. Among them, 2015 and 2010 had three (21.4%) publications each, representing the highest percentage of the review; 2008, 2013 and 2014, two (14.2%), and 2011 and 2016, one (7.3%). In 2006, 2007, 2009 and 2012, there were no publications that met the criteria inclusion in this study.

Regarding the type of study, cross-sectional studies prevailed, with eight (57%) publications. Regarding Qualis, most of them belonged to category A, with seven (50%); six (42.8%) studies of the review had no Qualis and one (7.2%) belonged to Qualis B. Regarding the target population of each review article, Table 1 shows the results.

**Table 2** shows the results of the synthesis of the articles selected for the integrative review.

**Table 1.** Distribution of the population found in the scientific production, by articles and databases. João Pessoa, Paraiba, Brazil, 2006-2016.

| Population of the Study | Quantity of Articles | Databases          |
|--------------------------|----------------------|--------------------|
| Children                 | 02                   | LILACS, SCIELO, Scopus |
| Adolescents              | 01                   | SCIELO, Scopus      |
| University students      | 02                   | LILACS, SCIELO, Scopus |
| Nursing workers          | 02                   | LILACS, SCIELO, Scopus |
| Outpatients              | 01                   | Scopus              |
| Users of the FHS*        | 01                   | SCIELO, Scopus      |
| Employees of a metal products factory | 01           | Scopus              |
| Adults                   | 04                   | LILACS, SCIELO, Scopus |

**Source:** LILACS, SCIELO, SCOPUS, 2006-2016.

*: Family Health Strategy

| Journal/Year/Authors       | Title of the journal                                    | Objectives                                                                 | Study design/ Qualis | Risk factors for DM2 | Conclusion                                                                 |
|---------------------------|---------------------------------------------------------|------------------------------------------------------------------------------|----------------------|----------------------|---------------------------------------------------------------------------|
| Cuban Journal of Endocrinology/2016/Yadicelis Llorente Columbié, Pedro Enrique Miguel-Soca, Daimaris Rivas Vázquez, Yanexy Borrego Chi [36]. | Risk factors associated with the coming of Diabetes mellitus type 2 in adults | To determine the risk factors associated with the coming of Diabetes mellitus type 2 in adults. | Case control/ Without qualis | Family history of Diabetes/Obesity/ Hypertension | The knowledge about the risk factors in patients at high risk is the first step in the design and implementation of preventive measures. |
| Journal/Year/ Authors                                      | Title of the journal                                                                 | Objectives                                                                 | Study design/ Qualis          | Risk factors for DM2                                                                 | Conclusion                                                                                     |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Asia-Pacific Journal of Public Health/2015/Chung T. Nguyen, Ngoc Minh Pham, Andy H. Lee, and Colin W. Binns [35]. | Prevalence and risk factors for Diabetes Mellitus type 2 in Vietnam: a systematic review | To examine the prevalence of DM2 and to identify the risk factors among adults in Vietnam | Systematic review/ Without qualis | Advanced age, urban residence, high levels of body and abdominal fat, sedentary lifestyle, genetic factors and hypertension. | A fast increase in the prevalence of DM2 in Vietnam suggests that the extra effort is needed to prevent and control this disease. |
| The Nursing Clinics of América/2015/Michele Montgomery, Paige Johnson, Patrick Ewell [12]. | The Presence of Risk Factors for Type 2 Diabetes mellitus in Underserved Preschool Children | To determine the presence of selected risk factors for the development of the DM2 (high-risk racial/ethnic group, obesity, high blood pressure, the occasional high blood glucose, total cholesterol, and the presence of Acanthosis nigricans) in preschool children from low-income families in Tuscaloosa, Alabama, with or without a family history of diabetes | Cross-sectional/ A1 | Family history of diabetes mellitus, high body mass index, and high blood pressure. | This study allowed the identification of the importance of early screening for diabetes in low-income children and preschool age. |
| Diabetes Research and Clinical Practice/2015/Din Ding, Shanley Chong, Bin Jalaludin, Elizabeth Comino, Adrian E. Bauman [33]. | Risk factors of incident type 2 Diabetes mellitus over a 3-year follow-up: Results from a large Australian sample | To describe the incidence of DM2 among middle-aged and older adults. | Cross-sectional /A2 | Gender, advanced age, hypertension, dyslipidemia, family history of DM2, overweight and obesity | The risk factors for DM2 incident can facilitate the identification of populations at risk and thus, develop preventive strategies to fight the epidemic of diabetes |
| Acta Biochemical Clinics Latin-american/2014/Mónica Natalia Lovera, María Susana Castillo Rascon, Cristina Malarzuk, Carlos Castro Olivera, Graciela Alicia Bonneau, Blanca Haydee Ceballos, et al. [23]. | Incidence of type 2 Diabetes mellitus and associated risk factors in a cohort study with health workers | To measure the incidence and associated risk factors in a cohort study with hospital workers in the city of Posadas, Misiones, since 2001 until 2012 | Cohort/ Without qualis | Age, metabolic syndrome, obesity | These findings serve as a support for public health authorities to implement a program of prevention of DM2 in this sector |
| Journal/Year/ Authors | Title of the journal | Objectives | Study design/ Qualis | Risk factors for DM2 | Conclusion |
|-----------------------|-----------------------|------------|----------------------|---------------------|------------|
| Latin-American Nursing Journal /2014/Adman Câmara Soares Lima, Márcio Flávio Moura Araújo, Roberto Wagner Júnior Freire de Freitas, Maria Lúcia Zanetti, Paulo César de Almeida, Marta Maria Coelho Damasceno [18]. | Risk factors for Diabetes mellitus type 2 in university students: Association with sociodemographic variables | To identify the modifiable risk factors for diabetes mellitus type 2 in university students and associate these factors with the sociodemographic variables | Cross-sectional / A1 | Sedentarism followed by overweight, central obesity, fasting plasma glucose and high blood pressure | Different risk factors were present in the population investigated, especially the sedentary and overweight. |
| Family history of diabetes, lifestyle factors, and the 7-year incident risk for type 2 Diabetes mellitus in middle-aged Japanese men and women | | | | | |
| Journal of Diabetes Investigation/2013/ Masaru Sakurai, Koshi Nakamura, Katsuyuki Miura, Toshinari Takamura, Katsushi Yoshita, Satoshi Sasaki, et al. [32]. | Risk for DM2 and associated factors | To assess the risk for type 2 Diabetes mellitus and its association with clinical and socio-demographic variables. | Cross-sectional/ A2 | Sedentary lifestyle, BMI, waist circumference increased, gender, age and family history of diabetes. | There was a significant association between the risk to develop Diabetes mellitus type 2 and the clinical variables of the study. |
| Acta Paulista of Nursing/2013/ Nicanie Bandeira Pessoa Marinho, Hérica Cristina Alves de Vasconcelos, Ana Maria Parente Garcia Alencar, Paulo César de Almeida, Marta Maria Coelho Damasceno [4] | Risk for DM2 and associated factors | | | | |
| Latin-American Nursing Journal /2013/ Vitória de Cássia Félix de Almeida, Maria Lúcia Zanetti, Paulo César de Almeida, Marta Maria Coelho Damasceno [24]. | Occupation and risk factors for type 2 diabetes: Study with nursing workers | To analyze the interrelationship between occupation and prevalence of risk factors for type 2 diabetes | Cross-sectional / A1 | Abdominal obesity, waist/hip, sedentary lifestyle | Nursing workers presented a higher risk to develop diabetes mellitus than other health professionals. |
| Latin-American Nursing Journal /2010/ Suyanne Freire de Macedo, Márcio Flávio Moura de Araújo, Nicanie Pessoa Bandeira Marinho, Adman Câmara Soares Lima, Roberto Wagner Freire de Freitas, Marta Maria Coelho Damasceno [13]. | Risk factors for diabetes mellitus type 2 in children | To identify the risk factors for type 2 diabetes mellitus in a population of public school children in Fortaleza, CE, Brazil | Cross-sectional / A1 | Body mass index, blood pressure, capillary blood glucose and waist circumference. | Nursing can act in schools through health education, encouraging the adoption of healthy lifestyle habits and in identifying children at risk for type 2 diabetes mellitus. |
Discussion

The Ministry of Health uses, in the screening of asymptomatic adults for type II diabetes mellitus, the following factors of risk: age>45 years, overweight (Body Mass Index BMI>25), central obesity (waist circumference>102 cm for men and >88 cm for women measured at the height of the iliac crests), family history [mother or father] of diabetes, high blood pressure (>140/90 mmHg), HDL d’“35 mg/dL and/or triglycerides e”150 mg/dL, macroversity or gestational diabetes history, previous diagnosis of polycystic ovary syndrome and cardiovascular, cerebrovascular or peripheral vascular disease [9]. In T2DM, the most common factors of risk in adults are overweight and family history of DM [10]. The International Diabetes Federation advert that the factors of risk responsible for the development of type II diabetes mellitus are overweight, family history of diabetes, unhealthy diet, increasing age, high blood pressure, ethnicity, physical inactivity, glucose intolerance, gestational DM history and malnutrition during pregnancy [11]. There is no unified standardization for the risk fac-

| Journal/Year/ Authors | Title of the journal | Objectives | Study design/ Qualis | Risk factors for DM2 | Conclusion |
|------------------------|----------------------|------------|---------------------|---------------------|------------|
| USP Nursing School Journal/2010/Hércia Cristina Alves de Vasconcelos, Márcio Flávio Moura de Araújo, Marta Maria Coelho Damasceno, Paulo César de Almeida, Roberto Wagner Júnior Freire de Freitas [16] | Risk factors for type 2 diabetes mellitus among teenagers | To identify risk factors for DM2 in a population of adolescents in private schools from Fortaleza | Cross-sectional / A1 | High blood pressure, excess weight, high blood glucose capillary, sedentary lifestyle, family background DM | Most of the risk factors for DM 2 identified in this study are modifiable, so amenable to preventive interventions in the school context |
| Afr J Prm Health Care FamMed/2010/ Masemiano P. Chege [22]. | Risk factors for type 2 diabetes mellitus among patients attending a rural Kenyan hospital | To describe the risk factors for type 2 diabetes mellitus among patients seen in clinics in a rural hospital in Kenya | Case-control/ Without qualis | Advanced age, history of kinship in the family of DM, abdominal obesity, hunger and malnutrition in childhood. | The risk factors for diabetes mellitus type 2 described in this rural population include the advancement of age, diabetes in a relation of the first degree and central obesity. |
| Anna Nery School/2008/ Rosa Maria Fernandes Vilarinho, Márcia Tereza Luz Lisboa, Priscila Katzer Thiré, Priscila Vieira França [19] | Prevalence of nature modifiable risk factors for the occurrence of type 2 diabetes mellitus | To investigate the risk factors for type II diabetes mellitus in nursing college students | Cross-sectional/ B1 | Family history of DM, hypertension, sedentarism, overweight, obesity. | The data collected point to the need for investments in health promotion and preventive measures within the training unit. |
| European Journal of Internal Medicine/2008/ Thomas Almdal, Henrik Scharling, Jan Skov Jensen, Henrik Vestergaard [34]. | Higher prevalence of risk factors for type 2 diabetes mellitus and subsequent higher incidence in men | To investigate the risk factors and the incidence of type 2 DM in the European population. | Cohort/ Without qualis | High triglyceride, high BMI, hypertension, gender | Indicates that men have a higher risk of developing type 2 DM than women. |

Source: LILACS, SCIELO, SCOPUS, 2006-2016.
tors of DM2 used in practice, in this review the objective was to discuss the factors found, emphasizing the population in each study.

Given the studies analyzed in the review of T2DM, two addressed the factors of risk in children. The first [12] brought as a factor of risk a family history of type 2 diabetes, high BMI and high blood pressure. On the other hand [13], in line with the first, investigated overweight and high blood pressure; however, it did not investigate family history with DM as a risk factor. Those results corroborate the ones standardized by the American Diabetes Association (ADA) [12]. The Ministry of Health calls attention to the increasing number of cases of T2DM in children and adolescents [10]. This reality is not only Brazilian, but worldwide [14-15].

Regarding adolescents, a study identified the following factors of risk for T2DM: high blood pressure, overweight, high blood glucose, physical inactivity and family history of DM in a population of adolescents in Fortaleza, Brazil, showing that 39% had at least two factors of risk for T2DM [16]. That was the only study found on this population based on the data used in this review. However, an intervention study with adolescents at risk for T2DM detected those same factors, which promoted a discussion about the importance of educational actions in health instead of promoting knowledge for the target audience, contributing, thus, to changes in lifestyle of that risk group [17]. Thus, this review suggests there are still few publications on T2DM in children and adolescents, but the progression of the disease becomes a major concern worldwide.

As for college student, there were several factors of risk for T2DM [18-19]. Stressing [18] physical inactivity, overweight, obesity, high blood glucose and arterial hypertension, pointing to physical inactivity as the most prevalent risk. Lately, one may observe that university students have a vulnerability to develop T2DM caused by a sedentary lifestyle, overweight, limited physical exertion, due to the use of technologies and adherence to fast and few healthy food habits [20]. Another study [19] reveals that physical inactivity was a risk factor responsible for 75% of the sample, the most prevalent, validating the previous data. For other risk factors investigated in college students through two studies, only one study [19] pointed out the family history of diabetes in 45% of the sample; whereas other study [18] did not investigate that risk factor. Having a first-degree relative with diabetes means a risk ten times greater of developing T2DM [21]. In another study, that factor represented a double risk in the development of T2DM [22].

From the point of view of the prevalence of factors of risk in health workers, studies [23-24] indicate nursing as the most vulnerable profession to develop T2DM. Articles attribute this to workload, which hampers both the practice of healthy eating habits, as the incorporation of physical activity [22-23]. Statistically significant risk factors were overweight/obesity in a study [23] and abdominal obesity, physical inactivity and abnormal waist circumference [24], factors observed in other studies [4,25]. On the other hand, an international study with health workers observed that the risk for T2DM in nurses was relatively low, due to health and lifestyle knowledge acquired in their educational background [26].

A study with patients of an emergency room found that advanced age, heredity and abdominal obesity are risk factors for T2DM [22], also found in other studies [27-28], which point to hunger and malnutrition in childhood as possible reasons for T2DM, different from those found in the literature [22]. The International Diabetes Association points out the bad nutrition in pregnancy as a factor of risk for T2DM, but does not refer to that nutrition during childhood [11].

A study with FHS users found that 10.3% had high risk to develop T2DM [4]. In Amarante, Portugal, the risk was similar, 11.3% [29]. On the other hand, in southern Brazil, the high risk was 17%, almost the double [30]. All those studies used the
FINDRISC instrument [Finnish Diabetes Risk Score] as a predictor to evaluate the T2DM risk. It assesses the risk based on the following factors: age, BMI, waist circumference, dietary habits, physical activity, antihypertensive use, a history of hyperglycemia and family history of T2DM [4]. Other studies have widely used that tool [27, 30-31]. The International Diabetes Federation recommends the use of that tool for it is practical and quick in the screening of the risk for T2DM [11].

A study with Japanese industrial workers found that participants with a family history of T2DM had 80% of risk to develop the disease compared to those without a heredity history, so there is no association of that risk with obesity and physical inactivity [32]. A study with workers at a Brazilian industry showed that the sedentary lifestyle, poor diet, weight gain and the history of T2DM in the family represented the most striking factors of the study for the development of T2DM [25].

Studies [33-36] analyzed the factors of risk in a population of adults and observed that the risk for developing T2DM mainly relates to gender, age, family history of T2DM, physical inactivity, hypertension, high BMI, modified triglycerides, obesity/overweight and urban residence, factors also found in the Arab population described in an integrative review [14]. This review identified and discussed most of those factors; however, two must have a better emphasis. Living in urban areas is a higher risk for T2DM, compared to rural population due to the fact that their populations have sedentary lifestyles and unhealthy eating habits [14]. Nevertheless, a study with the rural population identified that participants had 21% of high risk of developing T2DM [28], which leads us to infer that there is also a vulnerability in that population. Regarding the high level of triglycerides, it is a parameter that can only be confirmed in laboratory tests, being modified by changes in lifestyle; thereby another study also mentioned triglycerides as a statistically significant risk factor for DM2 in the research [37].

Literature evinces that the risk factors of modifiable nature for DM2 are the primary responsible for the high risk of developing DM2 [28].

Conclusion

The studies on type II diabetes mellitus enabled identifying and discussing a wide range of factors of risk, clearly showing which may favor the development of the disease and the possible means to build preventive and promotional strategies to groups prone to develop the problem.

Thus, the analysis reflect relevant aspects that can guide health professionals, especially nursing professionals engaged in the Basic Health Unit who keep direct contact with patients at risk of developing such disease.

There should be development of further studies to examine the factors of risk in different populations in order to identify more associations between the analyzed factors, especially those of modifiable nature.

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