Potential role of some endocrine disruptors in the appearance of diabetes and obesity

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Abstract— To date, the revolution in industry and agriculture contributes to the increase in water pollution thus causing the appearance of serious diseases of endocrine origin. However, given the different scientific data growing, other substances are likely to occur, such as chemical pollution from endocrine disruptors, some are in widespread use. This is the case of bisphenol A and phthalates.

In addition, studies have shown that bisphenol A and phthalates act at very low doses, without following a linear dose-response relationship and has deleterious effects on the body leading to the development of obesity and diabetes.

The objective of this article is to make an inventory of the various studies on the role of bisphenol A and phthalates in the development of obesity and diabetes in prevalence worldwide and cause of death, as the important role played by chemical pollution in the onset of diabetes and obesity.

In this case, this research highlights the importance of the urgency to implement decisions to identify, treat the substances responsible for this scourge and assess chronic human exposure to these pollutants PE.

Index Terms — ENDOCRINE DISRUPTORS, OBESITY, DIABETES, BISPHENOL A, PHTHALATES.

1 INTRODUCTION

Today, the revolution of the different activities (industrial and agricultural), population growth and increased demand for consumer products are major causes behind the thoughtless modernization, development of the industrial sector contributes to the increase in pollution water is one of the causes of chronic diseases, especially endocrine diseases.

Since the late 20th century, the rise in chronic diseases has become a major and worrying problem for health and the environment in almost all countries. In 2012, statistics showed that chronic diseases cause 63% of deaths globally and 88% in Europe[1]. But in Africa, no statistics have been estimated up .On the other hand today, the World Health Organization (WHO) predicts an increase in death of 15% of chronic diseases between 2010 and 2020[2]. In 2012, 7.6% of the diseases were recorded in endocrine, nutritional and metabolic origins because of the pollution generated by industries and human activities [3]. This has been for 20 years recognition worldwide and a concern of national and international policies [4]. Similarly, a recent United Nations report for Environment (UNEP) says that more than 8% of all deaths worldwide in 2011 are related to the increasing use of chemicals, especially in countries South [5].

Indeed, over 100 people with motor disabilities, there are 15 people under 60, and 75 people aged 60 or more are reached endocrine diseases [6] Mainly due to long exposures to endocrine disruptors (PE) which are chemicals, permanently altering the hormonal functioning of living beings present in the agricultural and water consumer [7]. These chemicals, natural or artificial foreign to the body, can interfere with the endocrine system [8] Thus contributing to the increase of the frequency of certain types of cancer (breast, testes, prostate), obesity, diabetes, hypertension, cardiovascular disease and neurodevelopmental [9].

Scientific evidence, in 2012, have shown links between expo sure to PE and increasing rates of hormone-dependent cancers, diabetes, obesity, reproductive disorders or behavioral problems [10, 11.12]. Other studies have found that almost 100% of people have detectable levels of endocrine disruptors in their bodies [13].

According to WHO estimates, approximately 15% of pathologies are due to the environment and certain cancers are undoubtedly associated with the presence of biological, chemical or physical environmental pollutants [14].

Moreover, the International Agency for Research on Cancer (IARC) and the National Cancer Institute have found a causal relationship between exposure to PE and many cancers like breast, prostate and testicular [15.16].

Also, in 2014, many studies have examined more than 500 million adults 20 and over who are obese, about 13% of the world population was obese in 2014 [17] and more than 422 million people were affected by diabetes [18].

Morocco, like many developing countries, is now in full epidemiological phase where there is a considerable development of health care provision and a fight against the major epidemic plagues. These efforts have resulted in the emergence of a new distribution of mortality and burden of disease due to an epidemiological transition [19]. The main causes of death are due

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mainly to cardiovascular diseases, cancers and endocrine, nutritional and metabolic.

The prevalence of these chronic diseases is estimated, for both sexes, 20.4% in urban and 15.5% in rural areas [20].

Several mortality estimation work due to endocrine, nutritional and metabolic, showed that the total distribution of deaths increased because of endocrine diseases 5.4% to 7.6% between 2011 and 2012 [21,22]. For diabetes mortality rates, it is 5.7% of all deaths in 2009 [23].

Given these facts, many eyes have been focused on the factors of the environment, particularly on anthropogenic origins chemicals most frequent are bisphenol A, phthalates, to which people are exposed and alarmingly increasing since the mid-20th century. These compounds are produced in very large quantities and have very wide use and / or consumption. They therefore induce toxic effects on aquatic organisms even at low levels [24] and accumulate in organisms that ingest the plastic [25, 26], with unknown consequences on the marine food chain, human health and the environment.

To jour, yet no study has described the chemical nature and endocrine its interrelationships with are borne diseases in endocrine Morocco. Hence the importance of our work, which has a share of data description endocrine disruptors and their impacts on the environment and on health and the risks associated with exposure to these substances. On the other hand, it brings together the work on the main pollutants in endocrine character, their identifications, and the proposed regulations worldwide.

In order to reduce exposure to endocrine disruptors, the science of growing were highlighted in prevalence worldwide and cause of death, as the important role played by chemical pollution in the onset of diabetes and obesity.

2 Material and method

2.1 Data on endocrine disruptors

In recent years, it is found renewed attention for chemicals classified as endocrine disruptors. Indeed, pollutants classified as endocrine disruptors refer to substances capable of inducing adverse effects on humans and animals through their hormonal properties [27]. Studies suggest a link between dietary exposure to endocrine disruptors and the prevalence of certain metabolic nutritional diseases such as obesity and type 2 diabetes which interact many hormones involved in metabolism of fats and sugars in the satiety and regulating food intake and the development of fatty tissue [28, 29].

Between 2002 and 2012, numerous scientific studies have been published on the EP, their effects on humans and their toxicity [30,31] At the end of this period (2012), the World Health Organization (WHO) and the United Nations Environment Program (UNEP) published a new report on the state of science filling out the report 2002 thus treating the effects of PE chemicals on the environment and human health, and calling this group of substances "global threat", because of their toxicity to the general population [32].

Internationally, several studies were conducted on the harmful effects of certain substances in the environment, reproductive and development organizations; which has aroused strong concern in the scientific community to highlight environmental exposure to chemicals and nutritional imbalance as factors responsible for many major diseases and functional impairment [33] Including plasticizers such as phthalates, bisphenol A because of their very large quantities and their very wide uses in industrial activities. In fact, several researchers have shown that bisphenol and phthalates have chronic effects are suspected in causing obesity, diabetes, thyroid dysfunction and even reproductive disorders [26, 34, 35].

Many studies between 2008 and 2012 converge there is a positive association between BPA and the development of diabetes and obesity [36, 37, 38]. Other studies report that exposure to phthalates could favor the occurrence of glucose and lipid metabolism disorders (diabetes, obesity), and other conditions [39].

2.2 Causes of Mortality Data

Chronic diseases especially diabetes, obesity are considered among the leading causes of death worldwide [40]. In 2008, WHO has produced a report and reported that chronic diseases are responsible for millions of deaths worldwide each year [41]. And in 2012, it found that the mortality rate was directly due to diabetes [42].

2.3 Data on the prevalence of certain endocrine Diseases

2.3.1 At the International scale

Numerous epidemiological studies linking exposure to pollutants and the prevalence of obesity and diabetes [36, 43]. In addition, in 2009, a ObEpi-Roche survey conducted on adults, shows an alarming increase of obesity in all age brackets in France [44].

The WHO estimates that by 2025 the most significant increase in the prevalence of diabetes will be saved 40% in developing countries, while it will be 170% in developing countries (PVD). We will in 2000 171 million people to 366 million by 2030, a prevalence of 2.8% to 4.4% in the favorable assumption that obesity does not progress [45].

Given these facts, it was clear that these disruptors are everywhere in our body; and as many studies have shown, there is a PE increase internationally in recent decades after much procrastination.

2.3.2 At the national scale

The latest survey was nation wide in 2000. Another survey was conducted by the Ministry of Health, on the risk factors of NCDs showing that the prevalence of diabetes is about 1.300000 diabetics with urban predominance. It affects, in particular, the elderly. It is, in fact, responsible for metabolic and endocrine diseases [46].

Moreover, the Ministry of Health (MOH) conducted for over 3 decades of surveys on household and population health between November 2010 and March 2011. He conducted the 5th national survey on population and family health ENPSF to assess the prevalence of chronic disease in Morocco; this is a sample survey, representative at national level by the middle and for large regions. Sampling was done with stratification of about 16,000 households selected to conduct the investigation and to collect information on the socio-demographic characteristics, living conditions, the prevalence of chronic diseases, etc. [47].

At the regional level and in the register of data on diabetes authorized and collected by the Regional Directorate of Epidemiology and Health Surveillance Fez, it was shown that Fez is affected by diabetes as a major endocrine disease [48]. Its annual incidence rate in the Fez-Meknes region increased between 2010 and 2016 [48].
The disease that was recorded after several visits health centers and discussion with specialists doctoral recent report that one of the causes of this disease is the pollution of the environment and the food chain reach man, but no record has been developed on other diseases endocrine [49].
Due to the enormous use and toxicity of phthalates and bisphenol A, they were the subject of intensive research and appropriate regulations for their potential effects on health and the environment and are among the most studied chemicals.

3 Results

3.1 Phthalates, BPA and the development of diabetes and obesity

The increased rate of endocrine diseases is contemporary of increased production of chemicals. World production of plastics is 322 million tonnes in 2015, a rate of 28% encrypted by the professional association of producers Plastics Europe [50].Also in Europe, it increased from 1.5 million tonnes in 1950 to 230 million tonnes in 2009 [51] About an increase of 4 million tonnes per year.
Phthalates are used for 50 years and more than 3 million tons per year are produced today [52].They are among the ten most frequently quantified substances under the action of Research and Reduction of Hazardous Substance Releases to water (SRED) [53].
A study by researchers at Brigham and Women's Hospital, demonstrates a link between increased concentrations of phthalates in the body and an increased risk of diabetes in women [54].They analyzed the concentrations phthalates in the urine of 2,350 US women aged 20 to 80 years who participated in the National Health and Nutrition Examination Survey (NHANES) from 2001 to 2008 and found that women with the highest levels of metabolites phthalates in their urine were as likely to have diabetes.
Another study highlighting various metabolic disorders, leads one to think that BPA and some phthalates may play a role in the genesis of diabetes [55].

3.2 Prevalence of certain endocrine diseases internationally

In 2013, according to the WHO, chronic diseases are responsible for over 36 million deaths worldwide each year, including nearly 17.3 million are attributed to cardiovascular disease, 7.6 million cancers, 4, 2 million respiratory diseases and 1.3 million in diabetes [56]. And in 2012, it estimated that 1.5 million deaths were directly due to diabetes, and expects that in 2030, diabetes is the seventh leading cause of death worldwide [57]. To the death rate due to diabetes, it is 5.7% of all deaths in 2009 [41].
Globally, the WHO estimated that 422 million adults living with diabetes, when the global prevalence increased from 4.7% in 1980 to 8.5% in 2014 [58] And more of an adult over 18 years in three was overweight and more than one in 10 was obese [59].
According to ObEpi study published in 2009 in France, 32% of over 18 years, 14 million people are overweight and 14.5%, 6.5 million meet the criteria for obesity and 2012 touched 15%. The share of French with obesity almost doubled between 1997 and 2009, especially among women than men and before age 55 [44].

3.3 Prevalence of certain endocrine diseases nationwide

The latest survey was nationwide in 2000, a national survey conducted by the Ministry of Health showed that 6.6% of the Moroccan populations have diabetes. The prevalence of diabetes was approximately 1.300000 diabetics (918000 to 1.458000) with an urban predominance especially those aged between 55 and 64 years. Indeed, this disease is responsible for metabolic and endocrine diseases at the health ministry and 10% older than 25 years are diabetic Moroccan [46].
In addition, the results of the National Survey of Population and Family Health (ENPSF) in 2011 show that 18.2% of the Moroccan population is suffering from a chronic (against 13.8% in 2004), an increase of 4.4 % in 7 years [47].
Currently, diabetes causes more than 24,000 deaths annually in Morocco. Between 2011 and 2015, the number of diabetics in Morocco increased from 1.5 million people to more than 2 million aged 20 and over, 25% more in 5 years. In addition, 55.1% of the population is overweight and 21.7% are obese, said Yves Souteyrand, WHO representative in Morocco [60].
At the regional level, including the city of Fez is affected by diabetes as a major endocrine disease. Its annual incidence rate in the region Fez-Meknes increased between 2010 and 2016 from 4.07% to 7.51%, and the city of Fez, it rose from 2.24% to 3.98% [48].

4 DISCUSSIONS

4.1 Phthalates, BPA and the development of diabetes and obesity

Because of their high production ubiquitously, phthalates and bisphenol are chemicals spread and widespread in the environment primarily used in the manufacture and production of plastics [61, 62].
Global demand for BPA was above 6.5 billion tons in 2012 and is estimated to increase at a rate of 5% by 2019 [63]. Because of this huge use of these products, BPA is dispersed in multiple environments (soil, sea water, landfill leachate, waste treatment plants sewage [64].

4.2 Prevalence of certain endocrine diseases internationally and nationally

In developing countries, we are witnessing a real epidemiological transition from communicable diseases to non-communicable diseases, especially diabetes.
The WHO predicts global growth of the prevalence of diabetic patients, mostly type 2 diabetes, 135 million in 1995 to 300 million in 2025. This trend is more pronounced in developing countries [65].

The rapid growth in the prevalence of diabetes in developing countries and sub-Saharan Africa in particular, is both a reality and a threat as illustrated by the recent editorial Hossain et al [66].However, in Morocco, the number of diabetics has increased to more than 2 million aged 20 and over, 25% more in 5 years, and at the city of Fez, the annual case number recorded in 2016 has seen a remarkable increase reaching 109,985 cases [49].

Many studies have shown that in 2013 the prevalence of diabetes was highest in the Americas (11%), as well as the Eastern Mediterranean region; the lowest was observed in parts of Europe and the Western Pacific (9%) [67, 68, 69]. In fact, WHO also reports of increasing prevalence in the Eastern Mediterranean (42.6 million) and Africa (18.2 million) and a prevalence of 9.1% by 2025 [70].

For obesity, WHO had nearly 700 million are obese in 2015, with an increase of 75% in 10 years [56].

In terms of the state of health of the Moroccan population surveyed, the ENPSF-2011 showed that almost two Moroccan in ten (18%) suffer from at least one chronic disease with the highest prevalence in the elderly population 60 years and over (57.5%) and women (21.3%) against (14%) in men [47].

Although many scientific studies conducted and evidence on endocrine disruptors, have proven serious effects on human health and the environment. To this end, several programs of research and regulations concerned with PE worldwide have been developed to improve identification and assessment of their risks.

4.3 Law at the International scale

The question of the effect of endocrine disruptors on humans and their role in the resurgence of certain chronic diseases (diabetes), concerned scientists and public authorities. This concern had repercussions in regulation, leading the European Commission to define a common strategy and develop a state of the art on the assessment of endocrine disruptors. At the Stockholm Convention in 2001, Non Governmental Organizations (NGOs) and industry have established the first list was then listed among the substances produced in high volume, over 553 potential endocrine disruptors (estrogens, phytoestrogens, natural hormones and synthetic chemicals, pesticides, pharmaceuticals...)[71,72].

BPA is classified as dangerous. Some countries, including Canada and France, have banned its marketing [73]. Also, other phthalates have already been banned in toys meant for small children [74].

In 2012, the French Parliament voted to suspend the manufacture, import, export and placing on the market or without consideration of any packaging containing bisphenol A and intended to come into direct contact with food [75]. Belgium and Sweden have adopted similar provisions for food products intended for children under three years, after Denmark, the first country to legislate in this area in 2010. Beyond the borders of the European Union, the United States and China are also beginning to regulate the use of this substance [75].

The National Agency for Sanitary Security of Food, Environment and Labor (ANSES) published the health risks associated with BPA [76].

Furthermore, the results of the national nutritional health study (ENNS), conducted by the Institute of Health Surveillance (VS) in 2006-2007, as attested in the prevalence of exposure to chemical agents (phthalates, BPA, dioxins, PCBs, organophosphate or organochlorine pesticides, pyrethroids, etc.) and to levels observed in France for certain substances, relatively high compared to other countries [77].

In addition, the National Security Agency for Medicines and Health Products of the (ANSM) and ANSES were evaluated in 2014 and propyl paraben several phthalates (dibutyl phthalate (DBP), di-ethyl phthalate) (DEP), Polyvinyl acetate phthalate (PVAP), Hydroxypropylmethylcellulose phthalate (HPMCP) and cellulose acetate phthalate (CAP)) in pharmaceutical products [78].In 2015, they also continued its work on substances suspected of PE in medical devices within the framework of the law n ° 2012-1442 of 24 December 2012 concerning the suspension of the manufacture, importation, export and marketing of any packaging for food purposes containing bisphenol A [78].

Based on other work developed a national strategy on endocrine disruptors was developed and adopted by the Government April 29, 2014 in order to appraise the substances by launching including analysis of at least 8 per year for chemicals evaluate their potential endocrine disruptor character eliminate BPA from receipts and receipts from credit cards (thermal receipt) and target controls on phthalates in toys especially imported toys and accelerate the replacement of bisphenol A [79].

Moreover, ANSM was to assess propyl paraben and several phthalates (DBP, DEP PVAP, HPMCP and CAP) in pharmaceutical products [79, 80].

4.4 Law at the national scale

In light of international events and awareness about the danger of chemicals particularly pesticides [81], they are regulated by a ministriel stopped farming since 1984 to control the registration, purchase and use of pesticides in agriculture. But for now, no study has been conducted in terms of other pollutants effect of endocrine disruptors.

In Morocco, no study has been conducted on the chemical endocrine effect as it is not yet conscious of the alarming problem, the World of the pollutants epidemic. With the exception of bills that have been established to protect citizens and the environment of these substances, the 11-03 law of 2003 on the protection and enhancement of the environment that defines the list of harmful substance for the environment, the 12-03 law of 2003 on impact assessment on the environment and the 13-03 2003 law on the fight against air pollution. Morocco has also ratified the Stockholm Convention in 2004 and therefore it has developed a national implementation plan for the implementation of the clauses of this agreement [81].

A countdown of ideas internationally, Morocco, strategies and programs implemented by the Ministry of Health focused on diabetes and obesity and other non communicable diseases [82] .In fact, the Ministry allocates an annual budget of over 145 million Dirhams for the purchase of medicines. It supports nearly 610000 diabetics whose insulin is 260000 [83] .Thus, the disease is considered one of the priorities listed in the Health Sector Strategy 2012-2016. The involvement of the Ministry of Health in the fight against diabetes has allowed it to benefit

from WHO's support in the context of the biennium 2014-2015 and that of the European Union and the World Bank under the Health Program II [84, 85].
For better adhesion of citizens to the strategy, the Ministry has for June 22, 2015, in partner ship with ANAM and CNOPS, a communications major campaign and awareness about diabetes and its complications for the population at risk and diabetes [86].

5 Conclusions

The endocrine system is essential to maintaining biological balances necessary for life. This explains why we question a lot today about the consequences of a possible break this balance by environmental contaminants, the most marked endocrine disruptors, even at low doses, are BPA, phthalates, pesticides, polycyclic aromatic hydrocarbons (PAHs), ... alkylphenols, the use of these products induces vigilance.

Although it is still necessary to develop research on this issue, however the data are sufficient to consider chemical pollution as a complementary axis of the two axes typically retained in understanding the epidemic of obesity and diabetes.

Our study has provided additional important elements to do more without fee for advocacy with policy makers at the national level, including Morocco, which is not currently concerned about the worrying problem of the global epidemic of these endocrine disruptors including social and economic human health consequences are devastating. There must be a thorough assessment of these pollutants.

In this respect, this research highlights the importance of the urgency to implement decisions to identify, treat the substances responsible for this scourge and assess chronic human exposure to these pollutants PE. Also, to estimate their effects on human health and eventually reduce pollution from industrial and agricultural activities with a potential endocrine disruptor or by inhalation, ingestion or contact.

To be aware of this alarming situation, stakeholders and scientific communities are set as main objectives, to provide a synthesis of scientific knowledge, to support research on the future of PE in the body and in the environment (water, soil, air and food), to promote understanding of their health effects and identify hazards and assess risks linked to exposure to these substances to make reasoned and societal decisions on endocrine disruptors.

ACKNOWLEDGMENT

The authors would like to acknowledge the Laboratory of Electrochemistry, Modeling and Environment Engineering (LIEME), Laboratory of Biotechnology of the Faculty of Sciences Dhar El Mahraz, for the contributions made to this article, Laboratory of Natural Resources and Environment, Faculty Poly Disciplinary-Taza, Laboratory of Epidemiology, Clinical Research and Community Health, Faculty of Medicine and Pharmacy-Fez, Sidi Mohamed Ben Abdallah University.

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