



Research Paper

Digital image processing to support iridology as a diagnostic alternative: A review

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ABSTRACT

Health care has been a concern for centuries. One of the most important functions of primary medical attention is the prevention and early detection of diseases, which in the long term would reduce the costs of future treatments. Iridology is an alternative diagnostic medicine technique in which patterns, colors, and other characteristics of the iris can be examined to determine information about a patient's systemic health. This review shows iridology as a valid diagnostic tool, such that with the use of digital image processing (PDI), it will provide controlled quantitative clinical trials with acceptable results. Iridology has been misinterpreted by people that have not been updated in the field and applied technologies or simply do not have the proper education. The correlations resulted shows a high connection between the iris constitutions establish through iridological criteria and the existing pathology or long before the symptoms appear. It is concluded that, with adequate image processing, some pathologies have great possibilities of being detected by this alternative system in traditional and non-invasive medicine.

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INTRODUCTION

A biometric system is an automated method of identification and verification of a system based on the premise that each individual is unique and has individual distinctive physical features (Biometrics Static) or behavioral (Dynamic Biometrics) (Tapiador and Sigüenza, 2005; Tistarelli et al., 2009). Iris recognition is the process of recognizing a person by analyzing the random pattern of the iris. This automated method is young (Kadry and Smaili, 2010). The use of human eye in identifying individuals has led to two different biometric techniques: iris and retina, which are reliable and stable. These two types of biometric systems are completely different, both in the methods of image capture feature extraction techniques and comparison methods (Figure 1) (Lusby and Zieve, 2016).

Healthcare has always been a matter of concern. Iridology is a complementary and alternative medicine (CAM) technique whose practitioners believe that patterns, colors, and other characteristics of the iris can be examined to determine information about a patient's systemic health.

Iridologists believe this information may be used to demonstrate a patient's susceptibility toward certain illnesses, to reflect past medical problems, or to predict health problems which may be developing without symptoms (Jersen, 2005).

Iridology is a diagnostic method that examines the patterns and changes in the iris of the eye, and has been documented since the 17th century or earlier. One of the first to document was Dr. Ignatz von Peczely, an Hungarian physician (January 26, 1826 - July 14, 1911), homeopathic, considered the father of modern iridology. He, as a physician, registered systematically, patients before and after surgery and correlated them. Iridology has had many respected followers from the 19th century to the present day (Jean-Marie, 2000; Whitelaw, 2003). A set of maps have been published in the United States (Figure 2), there are others, but these are the most used.

These maps show the areas that

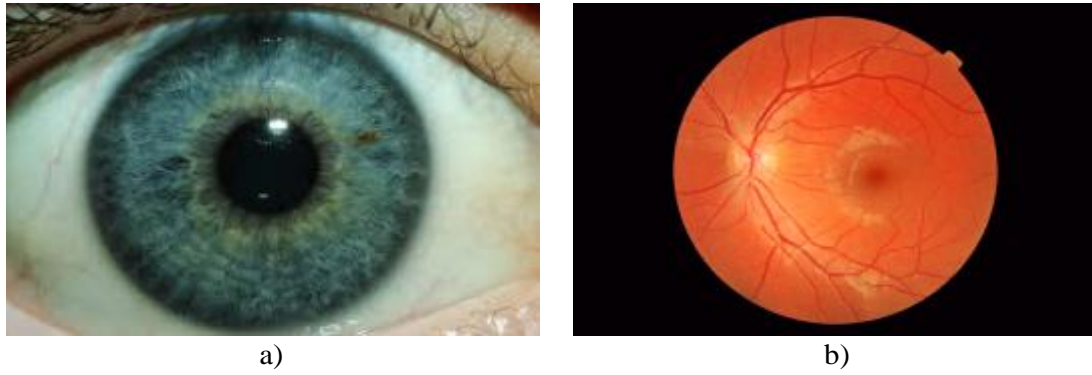


Figure 1: Human eye's biological structure: a) Iris b) Retin. Courtesy: "Hospital San José para enfermos de la vista", Guadalajara Jalisco México.

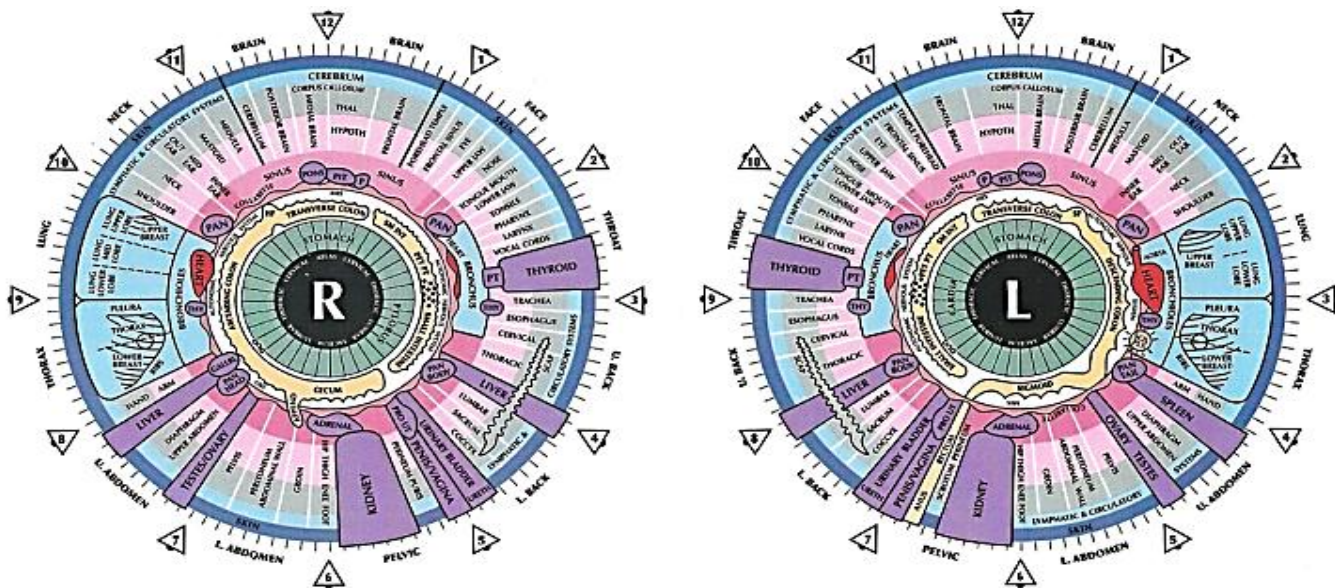


Figure 2: The iridology chart for both the right and left irises. Courtesy Dr. Bernard Jensen. This iridology chart, correlating areas of the left iris, as seen in the mirror, with portions of the left hand side of the body. Changes in color or appearance of the iris are said to indicate changes in the health of the corresponding section of the body.

correspond to different parts of the body and reflect each organ. The division in 12 h or 60 min may be the most practical and it is further used (Jersen, 2005; Brown, 2008). According to iridology, nerve fibers in the iris respond to changes in body tissues by manifesting a reflex physiology that corresponds to specific tissue changes and locations, iris reveals body constitution, it is an extension of the brain, nerve endings, blood vessels, muscle and other tissues, and is connected to every organ and tissue in the body through the brain and nervous system. These nerves display information from various organs and systems in the body to give an indication of their state of health. When examining a patient's eyes, an iridologist recognizes and identifies patterns (Jersen, 2005; Whitelaw, 2003).

The use of alternative therapies and / or diagnosis is a global concern in the field of public health. Some Primary care physicians have used the iridology with other diagnostic techniques to facilitate a full understanding of the needs of health care of their patients. In some cases, the inspection is mechanical (visual) and others very few, as they use software with high resolution to show potential health problems in some countries such as Russia that appears very high (Brown, 2008).

METHODOLOGY

The overall objective of this review is to summarize the evidence supporting the effectiveness of iridology for diagnosis and / or treatment of any medical condition. Given technological and medical advances, it became a quantitative review of the state of the art of Iridology in the last 20 years. First a differentiated description of the iris is made as reliable biometrics, making an emphasis on the iris as automatic method for identification and verification of an individual using physical characteristics as the main factor of this object of study (techniques used in PDI). As soon as the unique biometric importance of the iris is demonstrated, we proceed to make an evaluation of the works performed in iridology with PDI.

The Iris is a biometric identifier used in effective comparison methods from the first developed (Bhattacharjee, 2013; Bowyer, 2012; Yogeshwari, 2012; Muñoz, 2014; Wildes, 1997), most robust and recent algorithms implemented, ranging from implementation of prototypes based on DSPs and transformation of discrete Fourier (Miyazawa, 2006), with images of Purkinje (reflections from objects in the structure of the eye) to obtain a good performance detection algorithm (Lee, 2006; Eskandari, 2017; Nedjah, 2017), with approaches for locating the pupil (inner) and limbic (outer) boundaries of the iris using local statistics like Kurtosis (Kennell, 2006), with biometric keys from binary biometric templates (Rathgeb, 2011) to textures (Ma, 2009).

Iridology analyzes the health status based on examination of the iris of the eye of patient. The prevalence of complementary medicine in most industrialized

countries is impressive and increasing. At the beginning, this type of diagnosis was empirical and visual. With the advancement of technologies, this has meant a change and tried to be more quantitative as summarized in this review. The extraction of iris map is of great importance to computer-aiding. Iridiagnosis technologies (He, 2002; Ethrog, 2011) results in 9.1 million of Algorithms developed for eye images during trials in Britain, the USA, Japan, and Korea (Daugman, 2004; Daugman, 2004).

Digital image processing (PDI) has become an essential tool in modern medical science (to register, store, analyze and process medical imaging). At the beginning, it is not very encouraging (Buchanan, 1996; Ernst, 1999; Edzard, 2000), to manage diseases such as kidneys diseases, heart diseases, diabetes-morphological, fractal and cluster analysis (Martyshevsky, 1996), diagnosing the cancers (Münstedt et al., 2005; Herber, 2008), Hearing Loss (Stearn, 2007), and appendectomy (Frank, 2013), due to lack of technology. Iridology technique and PDI methods could be documented to give a more methodological support for clinical diagnosis (Hussain, 2017; Miller, 2016; Poonguzhali, 2017; Myr, 2016). Table 1 shows briefly the implementation of algorithms for the non-invasive diagnosis in last 20 years, such adrenal area glands (Sitorus, 2015), heart and aorta (Lumpu, 2009; Ramlee, 2011; Bhangdiya, 2014), solar plexus, kidneys (Perdana, 2009; Hussein, 2013; Prayitno, 2016), and pancreas (Bansal, 2015; Pergad, 2015; Banzi, 2015; Samant, 2017; Diwakar, 2017), etc.

RESULTS

The iris of a human is not just only relevant for biometry; it could also be for diagnosis of health. Combination of Iridology with PDI gives a more methodological support for clinical diagnoses.

More than 150 articles were reviewed, where organic, nutritional, metabolic, nervous, and hormonal etc. It is worth mentioning that imaging has become an essential tool in modern medical science as powerful platforms to register, store, analyze and process medical imaging. Figure 3 shows a latent concern for iridology and the increase in the development of valid algorithms that support this tool. The 1996-1996 records shows 50% unfavorable to the use of iridology as a biomarker, this trend changes over time as will be seen hereafter

The areas of iridology consist of a graphic representation of each organ, system or region of the human body. From the pupil, seven zones can be determined in the iris (1 Stomach area, 2 Intestinal area, 3 Adrenal glands, heart and aorta, solar plexus, kidneys, pancreas, 4 Bronchial tubes, pituitary gland, pineal gland, 5 Brain and reproductive organs, 6 Spleen, thyroid, liver, 7 Skin, lymphatic and circulatory systems, sweat glands, motor and sensory nerves). In Figure 4, it can be observed the increase in research in area 3.

Table 1: Summary of research with iridology.

Year	Type	Ref
1996-2000	Biometric PDI Support Iridology	(Muroò, 2000; Wildes, 1997; Negin, 2000) (Jean-Marie, 2000; Martyshevcky, 1996; Hohla, 2000)
2001-2005	Biometric PDI Support Iridology	(Tapiador and Sigüenza, 2005; Daugman, 2004; Daugman, 2004; Daugman, 2003) (Jensen, 2016; Jia-feng et al., 2002; Spitalul, 2002; Huedin, 2002; Andrews, 2003; Lezaun, 2004; Kong, 2001; Kong, 2003) (Lee, 2002; Kang, 2003; Um, 2004b; Um, 2005; Um, 2004b; Jae-Young, 2005)
2006-2010	Biometric PDI Support Iridology	(Tistarelli et al., 2009; Ganorkar, 2007; Gulmire, 2009; Perner, 2009) (Brown, 2008; Kadry and Smaili, 2010; Lee, 2006; Miyazawa, 2006; Ma, 2009; Purnomo, 2006; Han, 2008; Ma, 2008; Lodin, 2009; Lodin, 2009; Othman, 2010; Junhui, 2010; Shen, 2007; Guo-dong, 2006; Salles, 2008) (Stearn, 2007; Wibawa, 2006; Purnomo, 2006; Yu, 2007; Yoo, 2007; Discant, 2007; Cho, 2008; Salles, 2008; Lumpu, 2009; Perdana, 2009)
2011-2015	Biometric PDI Support Iridology	(Bhattacharjee, 2013; Bowyer, 2012; Yogeshwari, 2012; Rathgeb, 2011; Ethrog, 2011; Habsara, 2013; Yuan, 2013) (Muñoz, 2014; Mehrotra, 2013; Perner, 2013; Ma, 2013; Anitha, 2013; Liao, 2014; Jogi, 2014; Durga, 2014; Perner, 2015; Yu, 2015; Bansal, 2015; Malcolm, 2011; Miriam, 2014) (Nor'aini, 2015; Lesmana, 2011; Ramlee, 2011; Chaskar and Sutaone, 2012; Chaskar, 2012; Miller, 2012; Valentine, 2012; Sivasankar, 2012; Bansal, 2012; Hussein, 2013; Salles and da Silva, 2013; Lim, 2014; Passarella, 2013; Bhangdiya, 2014; Rani, 2014; Sulistiyo, 2014; Weiqi, 2014; Bansal, 2015; Pergad, 2015; Jamal, 2015; More, 2015; Adi, 2015; Salles, 2015; Putra, 2015; Banzi, 2015; Sitorus, 2015; Najmeh, 2015; Yulianton, 2013; Miller, 2016)
2016-2018	Biometric PDI Support Iridology	(Nedjah, 2017; Eskandari, 2017) (Hussain, 2017; Miller, 2016; Martiana, 2016; Meza, 2016; Perner, 2017; Poonguzhali, 2017; Myr, 2016; Perner, 2017; Cho, 2017) (Oginawati, 2016; Prayitno, 2016; Samant, 2017; Songire, 2016; Wibawa, 2016; Martiana, 2016; Dewi, 2016; Lim, 2016; Diwakar, 2017; Adelina et al., 2017; Saputra, 2017; Nguchu, 2017; Hernandez, 2018; Kusumaningtyas, 2018; Samant, 2018; Poonguzhali, 2018; Subhashini, 2018)

Diabetes, a chronic degenerative disease, is a global public health problem that is on the increase, including in children (WHO, 2017; Fernandes, 2017). Figure 5 shows that most of these works are focused on diabetes and that it can be a determinant at the time of early diagnosis of the disease in primary health care.

The development of iridology with new technologies, including mobile applications, brought patent authoring, since Patent to Detection and Interpretation of the Iris Structure is used for Determining the conditions of a person (Perner, 2009), and temperament characteristics (Saputra, 2017). Patent to Iris recognition (Sharath, 2014; Malcolm, 2011) or Patent to Computerized iridodiagnosis (Miriam, 2014) includes Mobile device-embedded system in 2016 (Myr, 2016). PDI has become an essential tool in modern medical science. PDI is a set of techniques that are applied in order to Improvement and / or visual modification of the

image for the human eye, Preparation of images to measure some structures present and Cost.

Iridology has been misinterpreted due to people that have not been updated in the field of applied technologies or simply do not have the proper education (Caradonna, 2002; Muroò, 2000).

The studies were able to demonstrate their scientific basis, with a number of satisfactory results. Iridology is not only a non-invasive way of obtaining information about the body, it is a way to get a starting point for the detection of a possible medical problem.

If the diagnosis of symptomatic disease, in some cases, is difficult, what about asymptomatic disease? What about diseases like glaucoma, hypertension or aneurysms or even Alzheimer's? The right application of the test of smell to detect Parkinson's and Alzheimer in advance (Marisa, 2016; Tarbet

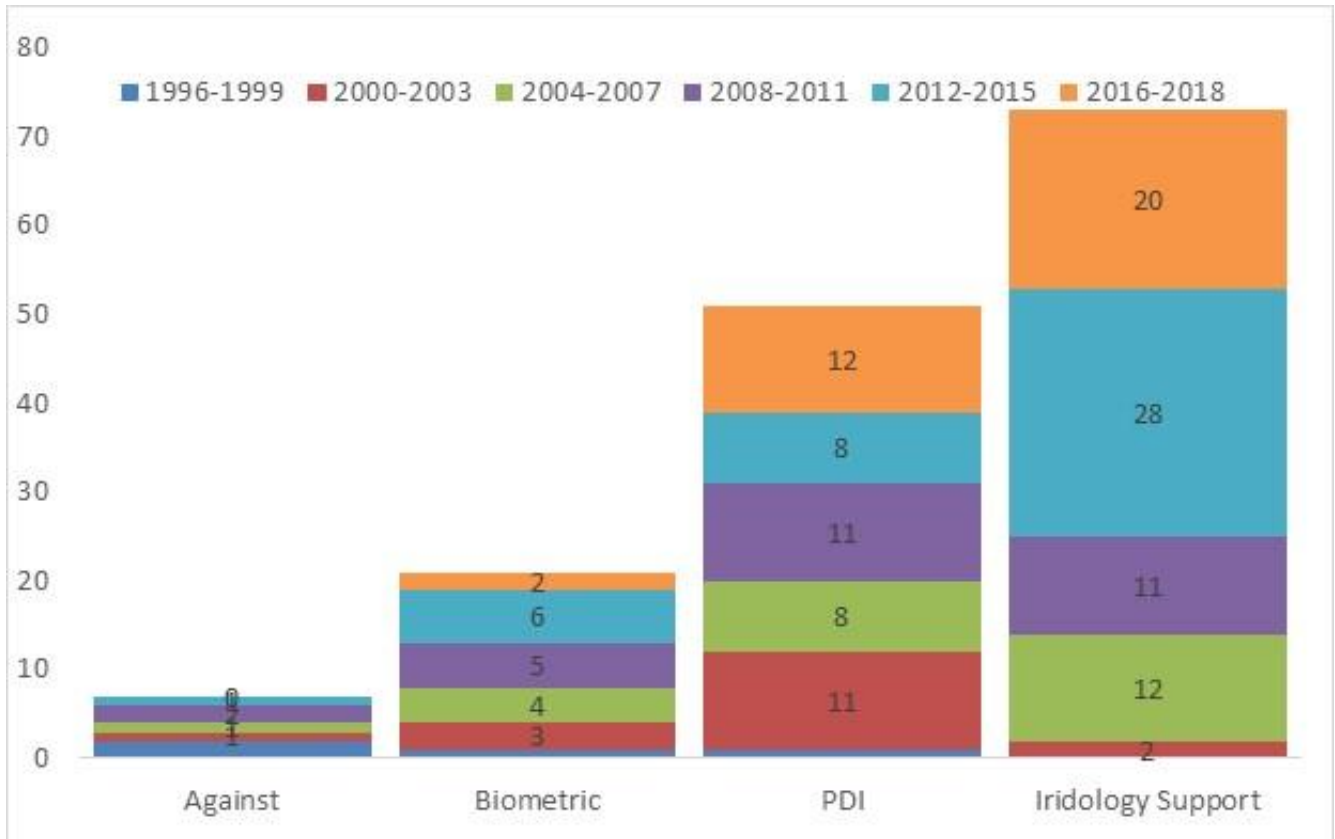


Figure 3: 1996 - 2018 PDI Research numbers. In the last 3 years, the tendency to accept iridology as a science-based methodology has increased.

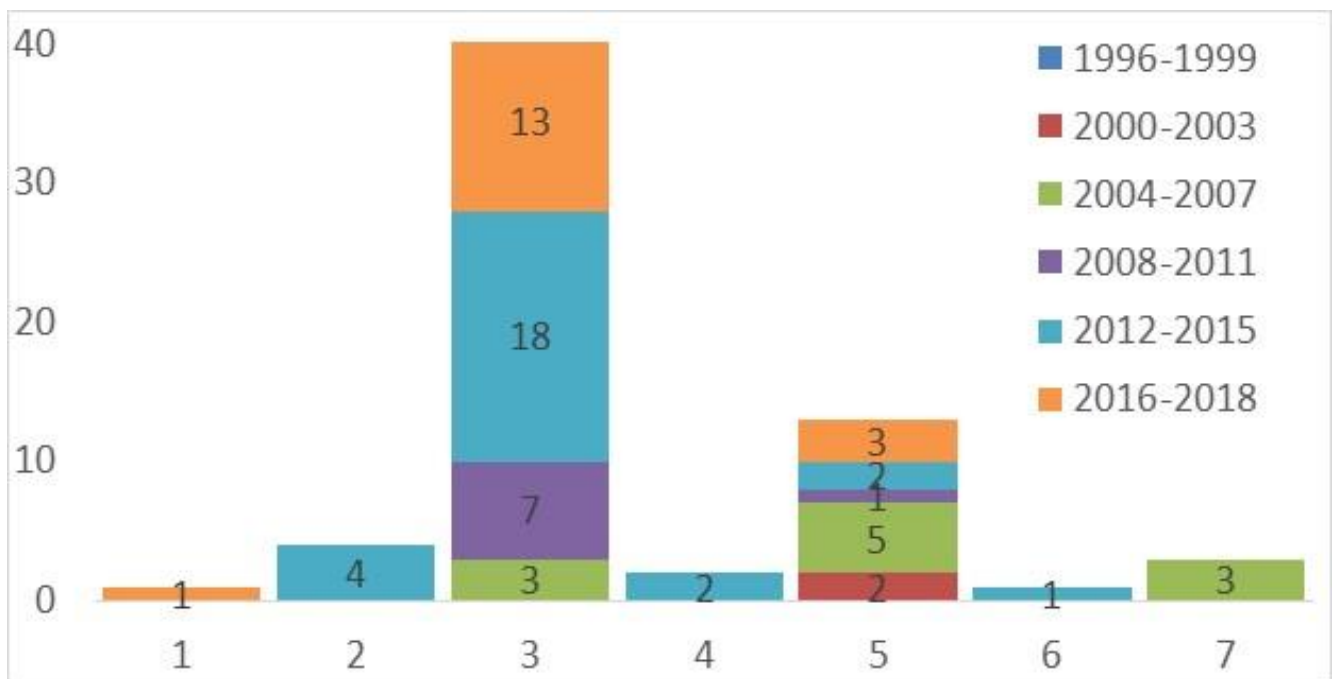


Figure 4: Research by areas of the iris (1-7).

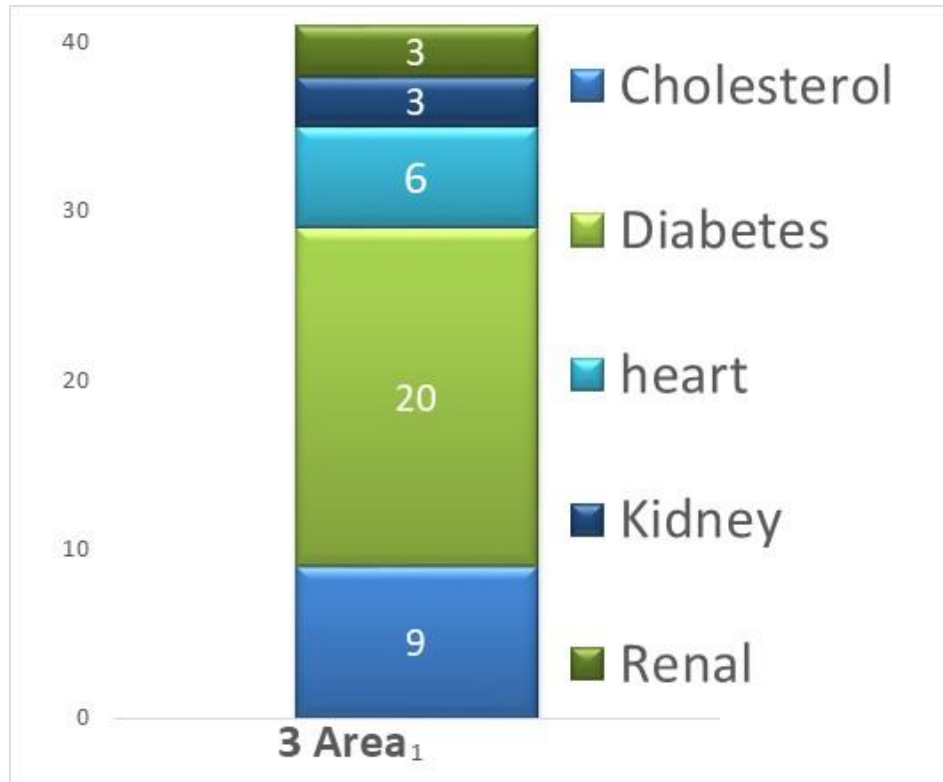


Figure 5: Total 41 reviewed papers focus on 3 areas, most focused diabetes with acceptable results.

et al., 2005; Fusetti, 2010) could determine these asymptomatic pathologies in the iris, which could become the first symptom?

This non-invasive and inexpensive procedure (Iridology), applied as routine in primary care, perhaps in the not too distant future could serve as an early diagnostic and thus to treat the aforementioned diseases. The Iridologists are aware that this practice should not be used in isolation, it must work in conjunction with traditional diagnostic techniques, and must be monitored and corroborate the information obtained from the iris. Data give us a small sample with a suitable knowledge and PDI can be of great support for the detection of various diseases and thus, in a brief time and / or make traditional diagnostic tests (from iridology) and / or to treat the pathology.

CONCLUSIONS

The correlations result shows a high connection between the iris constitutions established through iridological criteria and the existent pathology. Iridology technique also indicates weakness long before the symptoms appear.

The risks due to lack of accurate and rapid disease detection with a high cost of diagnosis is considered as one of the problems of medical society. Many signs of Iridology were closely researched to examine the relationship

between Iridology and disease (as Diabetes Mellitus and Cholesterol). Within a short time, we can have a great outcome and more objective diagnostic skill as this review presents. One of the issues to consider in image processing is size of the pupil that varies according to the degree of dilatation due to light or other organic defects. Another point to consider is processing techniques, although it is true, most are in the spatial domain, it can be considered the frequency domain and validate the algorithm and technique.

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