Stroke Risk Classification by Use of the CHADS2 Score in Community Population in Absence of Atrial Fibrillation

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MKAS and EAF designed the study, wrote the protocol, authors MKAS and ZES wrote the first draft of the manuscript. Authors TME and FI managed the literature searches. Authors MKAS done the analyses of the study. Author MAAE done the English editing. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Objectives: To use CHADS2 and Community Stroke Risk Classification (CSRC) scores to describe and classify the distribution of the risk factors of stroke in a population without known atrial fibrillation (AF).
Study Design: Was community, cross-sectional study.
Place and Duration of Study: North Africa, among individuals living in capital of Libya (Tripoli);

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study is done by the community & family medical department, faculty of medicine, University of Tripoli, from 1/1/2010 to 31/12/2014

Methodology: A total of 7497 individuals did not have AF (52.8%male & 48.2% female) who were interviewed by doctors using CHADS2 and CSRC scores.

Results: According to both CHADS2 scores and CSRC, about 64.2 %of the study population had at least one risk factor of stroke while 35.8% had no risk factors. Among people having CHADS2 risk score, the majority (41.3%) had an intermediate risk score ($P<0.01$), which corresponds to an intermediate or moderate stroke risk, and 22.9% have a high risk score which corresponds to a higher stroke risk. According to the CSRC score, the majority of people (44.6%) had intermediate score grades ($P<0.001$), and 19.6% had a high risk score with three risk factors or more. An intermediate score (1-2 Risk Factors) dominated in all study age groups in comparison to high scores (3-6 Risk Factors) ($P<0.001$); Hypertension and Diabetes are the major risk factors of stroke in all scores, especially those of intermediate ($P<0.001$). Finally, in comparison to females, males show a significant increase in all score grades especially in intermediate CHADS2 & CSRC score risk ($P<0.004$) and this could be related to a genetic-behavior difference.

Conclusion: Both the CHADS2 score and CSRC are simple tools that can be used for stroke risk description and assessment among communities of people who do not have atrial fibrillation. In addition, most communities of people have at least one risk factor for stroke, and this corresponds to intermediate scores; the highest risk factors contributing to the intermediate scores are hypertension, diabetes mellitus and being of an age of over forty years. Other risk factors of stroke like congestive heart failure, transient ischemic attack and history of prior stroke usually present among people who have high scores; this means it comes with or as result of other risk factors to form multiple risk factors associated with stroke forming higher scores of CHADS2 and CSRC

ABBREVIATIONS

CHF: Congestive Heart Failure; CDC: Centers for Disease Control; CSRC: Community Stroke Risk Classification; DM: Diabetes Mellitus; HT: Hypertension; TIA: Transient Ischemic Attack; RF: Risk Factor; RP: Risk Point; WHO: World Health Organization; LRS: Low Risk Score; IRS: Intermediate Risk Score; HRS: High Risk Score.

1. INTRODUCTION

The CHADS2 score is an essential tool for estimating cardio embolic risk (mainly stroke) in patients with nonvalvular atrial fibrillation (AF) [1]. It is a validated clinical prediction tool commonly used to estimate the risk of stroke in atrial fibrillation [2].

The score is derived from the sum of point values of individual stroke risk factors (congestive heart failure (CHF), hypertension, age≥ 70, diabetes (1 point each), and prior stroke or transient ischemic attack (TIA) (2 points) [2].

A high CHADS2 score corresponds to a greater risk of stroke, while low CHADS2 scores corresponds toa lower risk of stroke [2]. Furthermore, the CHADS2 score is used in clinical practice to guide decisions regarding antiplatelet and anticoagulation therapy. The simplicity of its calculation has facilitated its widespread adoption and endorsement by national and international society guidelines [3]. Although the CHADS2 score and other similar risk stratification schemes have proven useful in populations with known AF, the vast majorities (85%) of ischemic strokes occur in individuals without known AF; therefore the use of the score in general public is necessary [4].

The North African population is at an increased risk for stroke [5], the incidence of stroke varies from 63 to 162 per 100,000 populations, males are affected more than females [5] and according to the WHO 2014 report, 78% of deaths among Libyan citizens are due to non-communicable diseases, which include stroke [6].

Although the CHADS2 score was not used in North Africa, however, the Libyan Centre for Disease Control and the World Health Organization in 2009 used their own stroke risk factor classification in a community survey among 3096 Libyans [classifying stroke in to two categories; category one, representing low

grades where people have one or two risk factors (1-2RF) and high grades where people have three to five risk factors (3-5RF)]. They found that 99.6% of the population had at least some risk of stroke [7]. Moreover, among the study population, the high grades (3-5RF) prevailed with 57.6% over the low grades (1-2RF) with 42.4%. Furthermore, the majority of males 62.7% had 3-5 RF while only 37.3% of them had 1-2 RF. In contrast, 52.2% of females had 3-5RF and 48.8% of them had 1-2RF. In addition, they found high grades (3-5RF) dominated two age intervals (25- 44 years old, and 45-64 years old) [7].

2. STUDY OBJECTIVES

To examine the use of the CHADS2 and Community Stroke Risk Classification-CSRC scores (this classification was developed and used by authors for the first time) to describe the distribution of the risk factors of stroke according to both scales in the population without known atrial fibrillation in a Mediterranean population of Africa (Libya).

3. METHODOLOGY

3.1 Study Type

Community based descriptive cross-sectional study.

3.2 Populations; Adult Age

From 16 to ≥80 years old.

3.3 Population Sample

7497 individuals screened by Shambesh et al. [8].

3.4 Ethical Approval

Study had an ethical approval, and participants had informed consent.

3.5 Area

North Africa (Libya-Tripoli the capital).

3.6 Time

Five years from 1/1/2010 to 31/12/2014.

3.7 Method of Survey

Individuals with no known atrial fibrillation were interviewed using a CHADS2 score questionnaire as well as the local Libyan classification of stroke risk factors (called Community Stroke Risk Classification-CSRC).

The CHADS2 questionnaire used to assess stroke risk in patients with atrial fibrillation [1], and also was adapted in this study to be used among populations without AF as it had been used in other studies elsewhere [9]. The CHADS2 score is derived from the sum of point values of individual stroke risk factors {congestive heart failure (CHF), hypertension (HT), age ≥ 70, diabetes (DM) (1 point each), and prior stroke or transient ischemic attack (2 points) [2] (Table 1). The CHADS2 scoring table, which shown below, displays the points that correspond to the condition representing the results in CHADS2 score which is used to estimate stroke risk as follows:

Score Zero points = No risk = Low Risk Score
Score 1,2 points = Intermediate Risk Score
Score ≥3 points= High Risk Score

Table 1. Shows the CHADS2 score in the questionnaire used by the study

Condition		Points
C:	Congestive heart failure	1
H:	Hypertension	1
A:	Age ≥70	1
D:	DM	1
S:	Prior stroke or TIA	2

3.8 Community Stroke Risk Classification-CSRC

This classification depends on the calculation of the number of risk factors (RF), each risk factor used in the study (age ≥ 70, DM, Hypertension, CHF, TIA and prior stroke) was given one number for each condition among each individual who participated and the score resulting from the summation of those risk factors as shown in Table 2.

3.9 Field Survey

Doctors who work in the community and family medical department were trained by professionals to collect data using CHADS2 and CSRC questionnaires and interviewing individuals by taking a detailed history (present, past, medical, hospital admission), checking on any available investigations, discharge letters, medical reports and doing medical examinations when needed.

3.10 Statistical Analysis

This step was done by statisticians who scored the CHADS2 and CSRC grades by SPSS package version 19- USA. Data was calculated and described by using mean, mode, standard deviation, cross tabulations and graphical presentations. T student test for independent samples of numerical data was used with Chi-square analysis for categorized data.

4. RESULTS

Among the total population (7497) of apparently healthy individuals living in similar social communities with similar demographic characteristics were screened by Shambesh et al. [8] looking for stroke risk factors; males constituted 52.8% and females 48.2% with mean ages of 52 and 51 respectively. The age range was between 16 and 112 years old with a mean age of 52 years. Risk factor prevalence among the total population were as follows:

Diabetes 39%, Hypertension 38%, Congestive Heart Failure 15.2%, Transient Ischemic Attack 15% and Prior Stroke (ischemic or hemorrhagic) prevalence was 9.7% [8].

4.1 CHADS2 Score among Study Population

Among individuals screened, 64.2% had at least one risk point of stroke and 35.8% (2682) had no risk which corresponds to a low stroke risk (Low risk score, LRS0). The number of CHADS2 score grades gradually decreased from lower to higher scores [IRS1 (24.65%) having one risk point, IRS2 (16.65%) having two risk points. High scores, HRS3 (9.5%) having three risk points, HRS4 (8.1%) having four risk points, HRS5 (4.19%) having five risk points and HRS6 (1.15%) having six risk points] as shown in Fig. 1. However, intermediate scores (41.3%) were predominant (*P*<0.01) when compared to high scores (22.9%).

Table 2. Shows the CSRC score used by the study

| Level	Score	No. of risks	Abbreviation
Low risk score	score of zero	No risk factor	LRS 0
Intermediate risk score	score of one	One risk factor	IRS 1
Intermediate risk score	score of two	Two risk factors	IRS 2
High risk with a score ≥3. Subdivided to:			
High risk score	score three	Three risk factors	HRS 3
High risk score	score four	Four risk factors	HRS 4
High risk score	score five	Five risk factors	HRS 5
High risk score	score six	Six risk factors	HRS 6
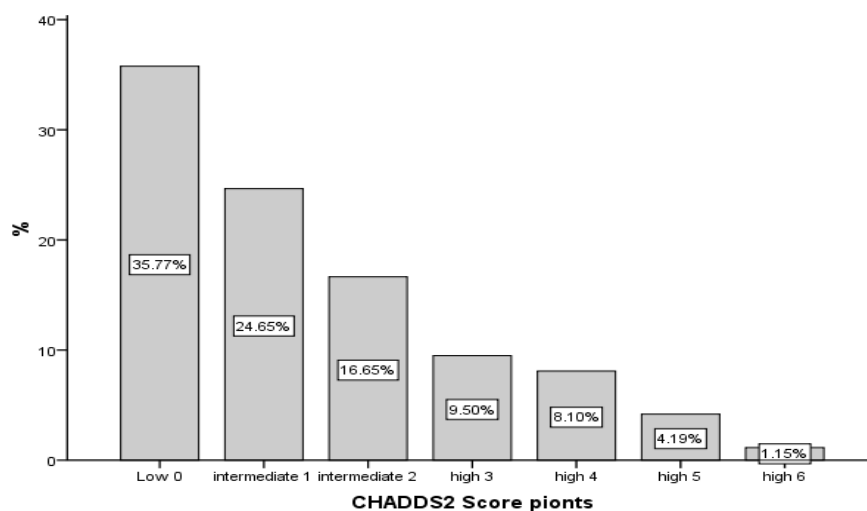
Fig. 1. Shows the percentage of the study population in regards to CHADS2 scores

4.2 Community Stroke Risk Classification (CSRC) among Study Population

Among the population screened, 64.2% had at least one risk factor (RF), and 35.8% had no risk on their CRSC score (LRS 0) .44.6% had an intermediate score risk (IRS 1&2), constituting individuals who had one or two risk factors, and 19.6% had high risk scores (HRS 3,4,5,6) with three risk factors or more.

The number of CRSC score grades gradually decreased from lower to higher grades, and intermediate scores were predominant (*P*<0.01) compared to high scores. The percentage of individuals with IRS1 (having one risk factor), IRS2 (having two risk factors), HRS3 (having three risk factors), HRS4 (having four risk factors), HRS5 (having five risk factors),and HRS6 having six risk factors were 26.6%, 17.9%, 10.6%, 6.1%, 2.3% and 0.6% respectively (Fig. 2).

4.3 Sex and Classification Scores

4.3.1 Sex and CHADS2 score

65.7% of male and 62.6% of female participants had at least one risk point (RP) of stroke. Among the study population who had risk points (4814), males constituted 53% and females 47%. Nearly 63.4% of males had an intermediate score risk with 1-2 RP, and 36.5% had a high score with 3-6 RP; about 65.2% of females had an intermediate score risk with 1-2 RP, and 34.8% had high score with 3-6 RP.

4.3.2 Sex and CSRC score

65.7% of male and 62.6% of female participants had at least one risk factor of stroke. Among study the population who had risk factors (4814), males constituted 53% and females 47%. Nearly 68.9% of males had an intermediate score risk with 1-2 RF, and 31.1%had a high score with 3-6 RF; about 70% of females had an intermediate score risk with 1-2 RF, and 30% had a high score with 3-6 RF.

In comparison to females, males show a significant increase in all score grades especially in intermediate CHADS2 & CSRC score risks (*P*<0.004) (Fig. 3). This increased risk among males could be related to multiple contributing factors (genetic or behavioral differences) like high rates of DM, hypertension, sedentary life, obesity, bad eating habits, lack of exercise, an epidemic of smoking, and severe stress due to life difficulty and responsibility.

4.4 Age Grouping and Classification Scores

The study found higher risk factors of stroke with increase of age. All age groups were affected with risk scores especially of whom were forty years or older (highest prevalence in 50-59), and the most prominent scores were the intermediate scores (IRS1 & IRS2) (*P*<0.001).
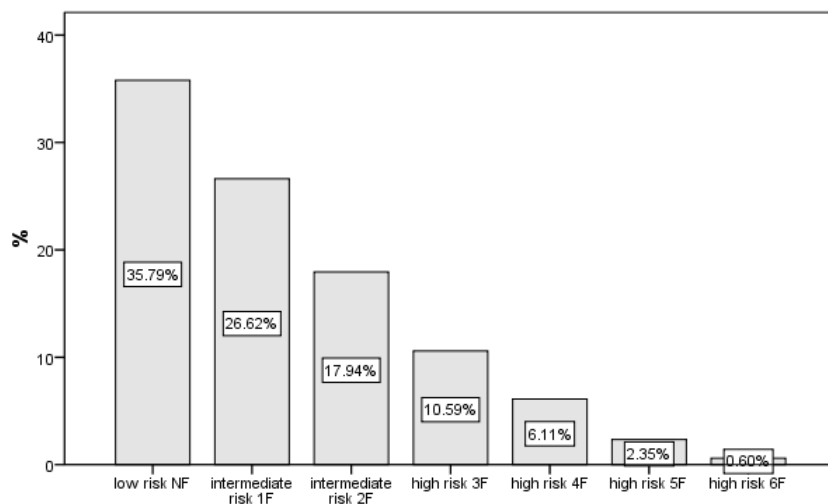

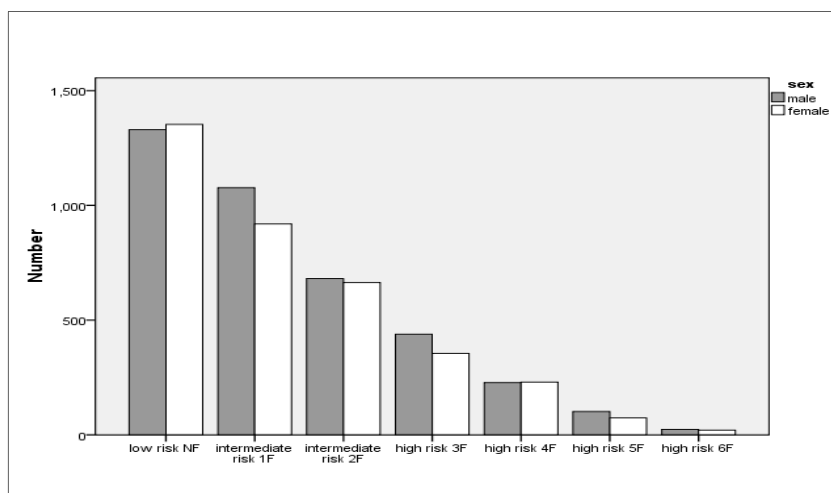**Fig. 2. Shows the percentage of the study population in regards to CSRC scores**

Fig. 3. Shows the sex distribution of the study in regards to CSRC scores

4.5 Diabetes Mellitus (DM) and CSRC Score

Diabetes Mellitus presents in all score risks with a predominance of intermediate score IRS1 (33%) and IRS2 (30%) (*P*<0.001) shown in Fig. 4.

Males were slightly higher than females in all scores and age groups. Diabetic patients was distributed all over the age groups but the highest prevalence of them was found in age groups over forty with predominance in intermediate scores (IRS 1&2).

This result confirms that DM is a major risk factor of stroke, usually coming alone or with hypertension as a risk factor in IRS1 or IRS2 which was less in account with other risk factors in multiple high score patterns.

4.6 Hypertension (HT) and CSRC Score

Hypertension presents in all score risks with a predominance in intermediate scores IRS2 (33.3%) and IRS1 (22.6%) (*P*<0.001) shown in Fig. 5.

Hypertensive females were generally higher than males in most scores especially in ages of over 40 years in IRS1 and IRS2 (*P*<0.001).

This result showed that HT was associated with stroke in more than one third of the study population, which comes alone or with DM forming an intermediate risk score of stroke (IRS1&2), and also to a lesser extent accompanies other risk factors to form multiple risks in higher scores.

4.7 Congestive Heart Failure (CHF) and CSRC Score

CHF is distributed over all scorers with a high prevalence in IRS2 (21.5%) (*P*<0.001); Males dominated in all scores (*P*<0.001) except in HRS4 where females were higher, especially in age groups over sixty (Fig. 6).

This result showed that **CHF** usually comes with or as result of other risk factors to form multiple risk factors in higher scores.

4.8 Transient Ischemic Attack (TIA) and CSRC Score

TIA presents in all risk scores with high prevalence in HRS3 (29.7%) (Fig. 7); also, TIA affects those who are sixty years of age or older of whom were predominantly male; this means TIA comes with or as result of other risk factors to form multiple risk factors associated with stroke especially in higher scores.

4.9 Prior Stroke (PS) (Embolic or Hemorrhagic) and CSRC Score

PS was found in all risk scores, especially in high score grades HRS3 (26.5%), shown in Fig. 8. Females dominated in intermediate scores and males dominated in higher scores. Similarly, DM, HT, CHF, TIA, PS affect those who are forty years of age or older; this means PS comes with or as result of the other risk factors to form multiple patterns in higher scores.
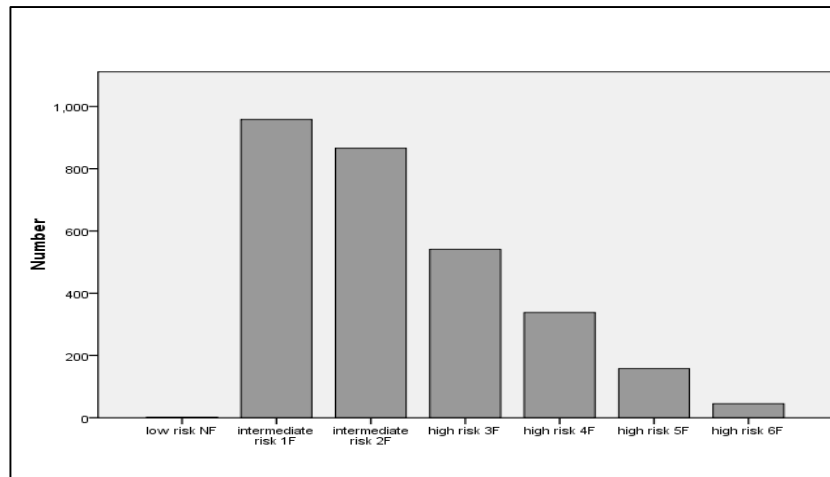
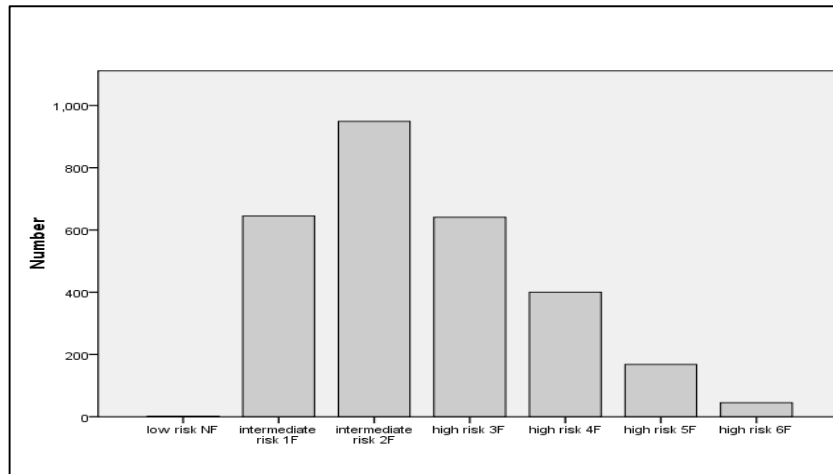**Fig. 4. Shows the amounts of individuals with Diabetes Mellitus classified by CSRC scores**

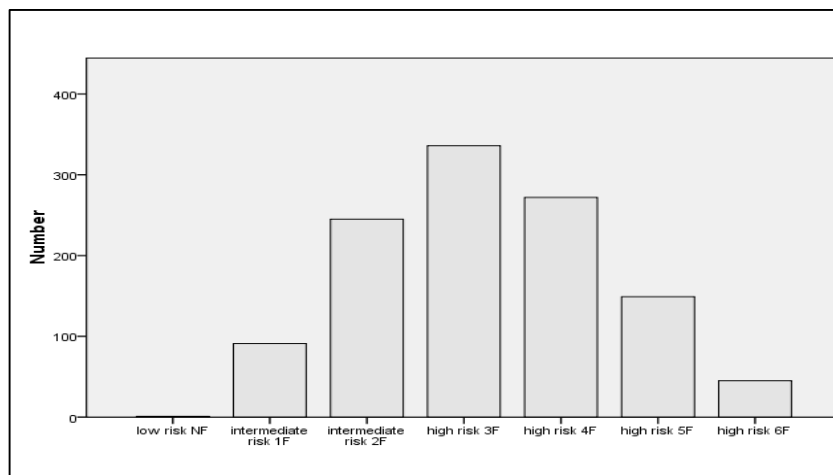**Fig. 5. Shows the amounts of individuals with hypertension classified by CSRC scores**

Fig. 6. Shows the amounts of individuals with congestive heart failure classified by CSRC scores
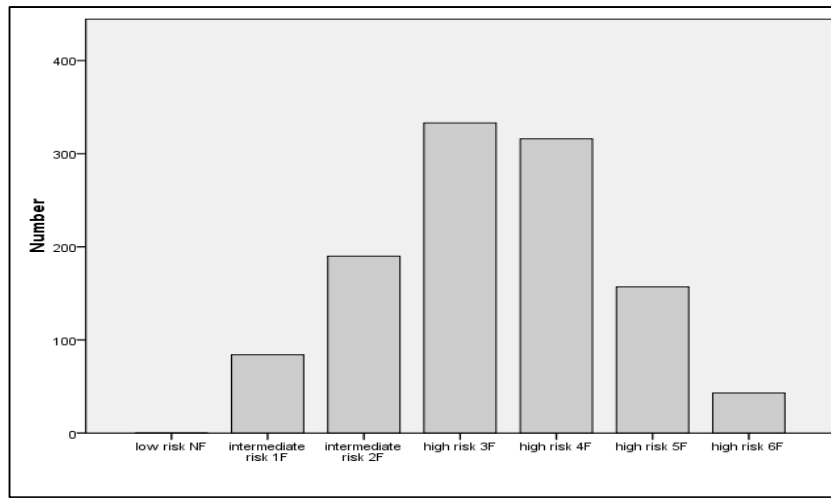
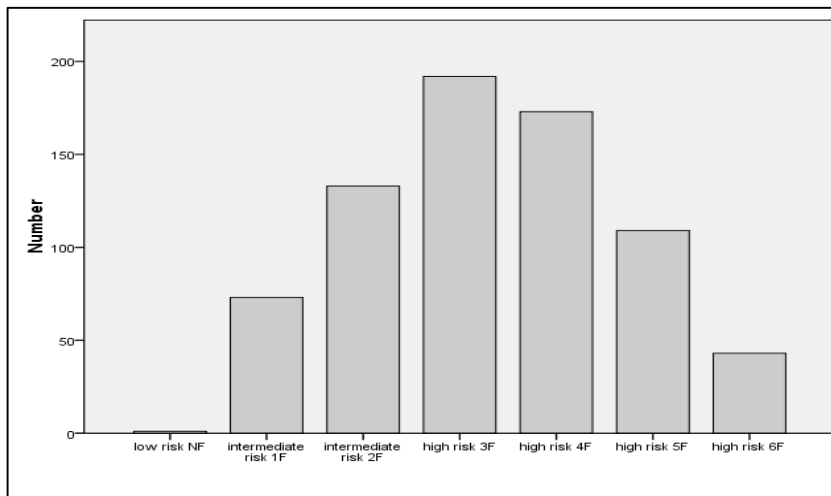**Fig. 7. Shows the amount of individuals with transient ischemic attack (TIA) classified by CSRC scores**

Fig. 8. Shows the amount of individuals with prior stroke (embolic or hemorrhagic) classified by CSRC scores

5. DISCUSSION

This is the first time such a big study of assessing the beneficial use of the CHADS2 score and Community Stroke Risk Classification (CSRC) for stroke risk factor description and classification to be done in North Africa among a population of a community who do not have AF; it found stroke risk factors to be a very common and important public health problem among the African (Libyan) population and those scores were very helpful in describing the stroke risk factor distribution, classification and a very important tool to be added to the primary prevention programe of stroke.

In the past; different studies done in Arab countries [5], Africa and Middle East [10] revealed a high prevalence of stroke among the North African and Arab population which were confirmed by the results of this study in Libya.

In spite of beneficial use of the CHADS2 score and other risk stratification approaches among patients with nonvalvular atrial fibrillation [11], most ischemic strokes (85%) occur in individuals without known atrial fibrillation [4]. Moreover, epidemiologic studies found that hypertension and DM are the most important determinants of stroke risk, and each component of the CHADS2 score is independently associated with

cerebrovascular events in the general population [12]. Furthermore, Morillas P et al. [9], found that the CHADS2 score is an essential and useful tool in estimating stroke risks among hypertensive patients with no known history of AF; to our knowledge, there have been no studies done in Africa investigating the utility of this score to estimate the risk of a cerebrovascular event among people without known atrial fibrillation. This study used this score which is usually used as clinical predictor of stroke in patients with nonvavular AF [13]. Also, because it's simple and easy to remember and to apply in clinical practice; it has been validated by several studies [14].

The study found stroke to be associated with multiple risk factors like increasing of age (especially who are forty years of age or older), hypertension, diabetes, CHF, prior stroke and TIA are major stroke risk factors in North Africa; this result is similar to other studies in Arab countries [5], North Africa [10], and Libya [6-8].They found stroke to be associated with an increase of age, hypertension, DM, obesity and smoking [7,8].

The results of Arboix et al. [15] in developed counties, who found no statistical difference in the occurrence of different lacunar infarcts between the very elderly patients and patients below 85 but the very old group with lacunar infarcts showed a significantly higher proportion of the female sex (56.4% versus 37.3%) and history of atrial fibrillation (28.2% versus 8.7%), chronic renal disease and pathological conditions and a significantly lower proportion of hypertension (61.5% versus 77.3%), diabetes (7.7% versus 28.4%), ischemic heart disease, hypercholesterolemia, and a neurologic deficit at discharge from the hospital for patients below 85 [15]. Our results showed the opposite; there was significant difference in stroke prevalence between the very elderly patients and patients below 85 whereas despite an increase in age, it is more prevalent among those over 40 years old. Furthermore, stoke was higher among males than females and hypertension and diabetes were the dominating risk factors among elderly patients.

A report from Libyan research institutes in 2001 showed stroke was associated with multiple risk factors [16]. Similarly, reports from the Libyan CDC-WHO in 2009 revealed an association of stroke with multiple risk factors [7]; this result is similar to what this study found.

The Libyan CDC-WHO study in 2009 classified stroke risk factors into two grades, a low grade (1-2RF) and a high grade (3-5RF) [7]; our study classified stroke risk according to the CHADS2 and CSRC scores into a low score (Zero RF), an intermediate score (1-2RF) and a high score (3-6RF).

According to the CDC-WHO study in 2009, there was a contrast to our result, the high grade (3-5RF) dominated (57%) the low grade (1-2RF) among the study population [7] whereas in our study the intermediate grade dominated (1-2RF). This difference between the two studies is due to a difference of stroke risk factors used among the two study populations; the Libyan CDC-WHO study used DM, HT, age, smoking, obesity and lack of exercise as risk factors because DM, HT, obesity are prevalent among Libyan citizens and are major causes of their mortality [7]. Therefore, most of the study population in 2009 would have had at least three risk factors (High grade) especially when we consider lack of exercise among Libyans.

Our findings of adominating CHADS2 intermediate score (1-2RF) being more than that of a the high score (3-6RF) is different from that found by the study done among AF patients; that study revealed domination of high scores (5-6RF) more than the moderate CHADS2 scores of (1-2RF) [17], this difference is because AF patients already had other co-morbidities and risk factors like old age (especially ≥40) DM, HT, CHF which are prevalent among them more than a community of people who do not have AF and other disease complications. Therefore, unlike community residents, AF patients will likely have high CHADS2 scores rather than moderate scores.

6. CONCLUSION

Both the CHADS2 score and Community Stroke Risk Classification (CSRC) are simple tools that can be used to describe the distribution of the risk factors of stroke in a population living in a community who do not have atrial fibrillation. In addition, most people of a community have at least one risk factor, and this corresponds to intermediate scores (IRS1 & 2); and most risk factors contribute to the intermediate scores which are Hypertension, DM, and being over forty years old (each factor may present alone or in combination of two factors together). However, CHF, TIA and history of prior stroke usually present among people who have high scores

(HRS 3-6); this means that they come with or as result of other risk factors to form multiple risk factors associated with stroke, especially in higher scores.

7. STRENGTHS AND LIMITATIONS OF THE STUDY

This is the first Libyan community based study that assesses the beneficial use of the CHADS2 questionnaire and Community Stroke Risk Classification among people with no known atrial fibrillation to describe stroke risk factors. Moreover, it used a large sample size, thus, stroke classification resulting from rates and percentages produced from this study reflect the real situation in the Libyan community. Finally, because, this study is a cross-sectional study, it explores associations, not causation.

8. RECOMMENDATION

To conduct future studies that depend on medical and laboratory investigations, follow up and treatment monitoring of stroke risk factors and stroke characteristics using CHADS2 and CSRC scores.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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