International Journal of Neurologic Physical Therapy
2019; 5(2): 31-36
http://www.sciencepublishinggroup.com/j/ijnpt
doi: 10.11648/j.ijnpt.20190502.11
ISSN: 2575-176X (Print); ISSN: 2575-1778 (Online)

Assessment of Serum Electrolytes in Sudanese Hypertensive Patients in Khartoum State-Sudan

Nedal Babiker Alawad[1], Salman Taha Ahmed Elmukashfi[2, *], Abdelwahab Abdien Saeed[1], Rashid Eltayeb Abdalla[3]

[1]Department of Clinical Chemistry, Faculty of Medical Laboratory Sciences, Shendi University, Shendi, Sudan

[2]Department of Clinical Chemistry, Medical Laboratory Science Program, Al-Yarmouk College, Khartoum, Sudan

[3]Department of Biochemistry, Faculty of Medicine, Shendi University, Shendi, Sudan

Email address:

salmantahamls@gmail.com (S. T. A. Elmukashfi)

[*]Corresponding author

To cite this article:

Nedal Babiker Alawad, Salman Taha Ahmed Elmukashfi, Abdelwahab Abdien Saeed, Rashid Eltayeb Abdalla. Assessment of Serum Electrolytes in Sudanese Hypertensive Patients in Khartoum State-Sudan. *International Journal of Neurologic Physical Therapy.* Vol. 5, No. 2, 2019, pp. 31-36. doi: 10.11648/j.ijnpt.20190502.11

Received: May 14, 2019; **Accepted**: July 18, 2019; **Published**: July 31, 2019

Abstract: Background: Hypertension increases the risk of heart failure and kidney failure [1]. Worldwide, hypertension is estimated to cause (7.5) million deaths, about (12.8%) of the total of all deaths. In Africa, however, more than (40%) (And up to 50%) of adults in many countries are estimated to have hypertension [2]. The aim of this study was to assess the association between hypertension and serum electrolytes (sodium, potassium, magnesium and calcium) in hypertensive Sudanese males and females in Khartoum State. Material and Methods: Study Approach is A quantitative approach was used to measure Na^+, K^+, Mg^{2+} and Ca^{2+} in hypertensive Sudanese patients in period from March to Augustus 2018. The study was designed as prospective, hospitals/laboratory based study, this study was performed in different hospitals at Khartoum State. This study was include 30 blood samples collected from patients with hypertension, the restriction of the sample size to (30) subjects is due to lack of financial support. Data was collected using questionnaire. Two and half ml from venous blood sample was collected in heparin container, by using sterile disposable plastic syringes and aseptic condition, vein puncture technique was applied. The sample was centrifuged at (3500 rpm) for (5 minute), and reading. A quantitative method can be used to measuring Ca^{2+} and Mg^{2+} concentration by used semi automation method by used spectrophotometer instrument, and the level of Na^+ and K^+ is determined by methodology is based on the selective electrode measurement (SLE) principle to precisely determine measurement values. Results: This study presented that there were non-significant correlations between levels of (sodium, potassium, magnesium and calcium) of hypertensive patients compared to normal range. The illustrated that there were non-significant correlations between age, duration, social status, gander, job, education status of hypertensive tested group. The study revealed that there was a finding referring to significant correlation between level of (magnesium) and economic status of test group, but non-significant in (sodium, potassium, magnesium). Conclusion: Based on the results of the study was demonstrated the non-significant correlation between serum electrolyte and hypertension tested group compared with normal range. Also the study was not finding any correlation or effect of age, gender, duration of disease and education status of hypertensive patients on serum electrolytes levels, but depended on the finding of results study was presented prevailed significant correlation with economic status of tested group and level of magnesium serum. From this study concluded there was non physiological alteration in electrolytes balance in patients of hypertension.

Keywords: Hypertension, Sodium, Potassium, Calcium, Magnesium, Sudanese

1. Introduction

Hypertension (HTN) refer to high blood pressure (HBP), defined by American Heart Association (AHA), Blood pressure (BP) is determined by cardiac output and peripheral vascular resistance [3]. Systolic BP, which is the peak pressure in the arteries, represents the ejection of blood into

the aorta during ventricular systole. It is largely determined by stroke volume, the elastic properties of aorta and the velocity of ejection [4]. Diastolic BP refers to the lowest pressure in the arterial system during diastole. The diastolic blood lowest pressure in the arterial system during diastole pressure rises when peripheral vascular resistance increases [5]. Change with age. Although the precise mechanism is not understood, the contributing factors of aging to increased BP may include arterial stiffness, atherosclerosis, decreased functional decreased functional efficiency of the heart, age-related changes in hormone profiles, and salt-sensitivity among older people etc. In some non-industrialized countries, BP is less likely to increase as people age [6]. This difference may be explained by differences in diet and stress, among other things [7].

Systolic BP increases with age for men and women, while diastolic BP rises up to the age of (50-59) years Thus, the difference between systolic and diastolic BP (defined as pulse pressure), increases steeply with age in the elderly population. Increasing evidence suggests that high pulse pressure in the elderly marker of increased artery stiffness and widespread atherosclerosis. Elevated pulse pressure is also recognized as an enhanced risk for cardiovascular events. BP reading of (>=140 mm Hg) systolic and/or (>=90 mm Hg) diastolic or any treatment for (HTN). For people who are categorized as normal, a BP reading of (<120mm Hg) systolic and (<80mm Hg) diastolic, whereas a BP reading of (120-139 mm Hg) systolic and/or (80-89Hg) diastolic is categorized as “pre hypertension” [8, 9]. HTN for those who are not on antihypertensive treatment consists of two stages: stage 1: BP reading of (140-159mm Hg) systolic and/or (90-99 mm Hg) diastolic: and stage 2 BP reading of (>=160mm Hg) systolic and/or (>=100 mmHg) diastolic [10, 11]. Prevalence of systolic HTN is directly proportional to advancing age. It is estimated that more than half of Americans over age (65) years had isolated systolic or combined systolic-diastolic HTN while fewer than (10%) of individuals in this age group had diastolic HTN in 2005. HTN is a well-known independent risk factor for cardiovascular disease (CVD), stroke, and renal failure (RF) [12]. Globally, the overall prevalence of HTN in adults aged (18) and over was (22%) in 2014. HTN is one of the leading risk factors for global mortality [13]. An electrolyte is any substance that contains free ions that behaves as an electrically conductive medium (conducts electricity).

Sodium (Na^+) has a pulling effect on water it affects extracellular fluids equally (plasma and intestinal). However, because there is considerably more Na^+ outside cells than inside, the water is pulled out of cells into extracellular fluid. Na^+ determines osmotic pressure of extracellular fluid. Diet sodium is easily absorbed from the diet Na^+-K^+ ATP-ase enzyme regulate Na^+ and K^+ pump, pumps Na^+ out and K^+ into cells. Without this active transport pump, the cells would fill with Na^+ and subsequent osmotic pressure would rupture the cells. The increase in “effective” body Na^+ usually causes a rise in BP that characterized by an increase in peripheral vascular resistance [14].

High Na^+ diet (>2800 mg/day) risk in heart failure was associated with of acute decompensated heart failure, all-cause hospitalization, and all-cause mortality over a median three years' follow-up period. people with high Na^+ intake and low potassium (K^+) diet alters the electrolyte balance inpatients of HTN developed higher grades of coronary collaterals which lead to coronary disease [15]. Magnesium (Mg^{+2}) has additive antihypertensive effects. Furthermore, Mg^{+2} is more involved in the functional vascular changes, and also on local metabolic stability with no influence on the vascular structure. Calcium (Ca^{+2}) ion affects BP acting as regulator of hormones have all been found to have vasoactive properties and therefore may influence BP.

2. Material and Methods

Study Approach is A quantitative approach was used to measure Na^+, K^+, Mg^{2+} and Ca^{2+} in hypertensive Sudanese patients in period from March to Augustus 2018. The study was designed as prospective, hospitals/laboratory based study, this study was performed in different hospitals at Khartoum State. The test group covered (30) patients with hypertension. Non probability sampling was carried out and the study was restricted on hypertensive patients. This study was include 30 blood samples, the restriction of the sample size to (30) subjects is due to lack of financial support. Data was collected using structural interviewing questionnaire. Two and half ml from venous blood sample was collected in heparin container, by using sterile disposable plastic syringes and aseptic condition, vein puncture technique was applied. The sample was centrifuged at (3500 rpm) for (5 minute), and reading. Data was analysis using SPSS. A quantitative method can be used to measuring Ca2+and Mg2+concentration by used semi automation method by used spectrophotometer instrument, and the level of Na+ and K+ is determined by methodology is based on the selective electrode measurement (SLE) principle to precisely determine measurement values.

2.1. Ethical Consideration

Permission to carry out the study was taken from health administration and Ethical Research Committee and hypertension patients were informed for the purpose of the study before collection of samples and verbal consent was taken.

2.2. Data Collection

Data were collected using structural interviewing questionnaire. Which is designed to collect and maintain all valuable information concerned each case examined.

2.3. Sampling Collection

Two and half ml from venous blood sample was collected in heparin container, by using sterile disposable plastic syringes and aseptic condition, vein puncture technique was applied. The sample was centrifuged at (3500 rpm) for (5

minute), and reading.

2.4. Quality Control

Sample representing the normal and pathological level of serum Na^+, K^+, Mg^{2+} and Ca^{2+}, was used for assessment of the quality control.

Result (±2SD) of the target values of the control sera were accepted.

2.5. Statistical Analysis

Data was analyzed by computer software, by using SPSS program manual master sheet. The mean and standard deviation of Na^+, K^+, Mg^{2+} and Ca^{2+}, level was obtained, and the T- test was used for the comparison of Na^+, K^+, Mg^{2+} and Ca^{2+} between the test and normal range, and the mean difference is significant at ($p \leq 0.05$). Correlation (r) between mean of Na^+, K^+, Mg^{2+} and Ca^{2+} with duration of hypertension and age, gander, education status economic status, social status, jobs of hypertensive patients are considered to be statistically significant at ($P \leq 0.05$).

3. Results

The result of Na^+ showed normal concentration with mean (138mmol/l) compared with normal range (135-145mmol/I). Result of K^+ showed mean (4.4 mg/dl) which is normal concentration compared with normal range (3.5-5.0 mmol/l). Result of Mg^{2+} showed mean (2.2 mg/dl) which is normal concentration compared with normal range (1.7-2.7mg/dl), also result of Ca^{2+} showed normal concentration with mean (8.8 mg/dl) compared with normal range (8.5-10.5) mg/dl.

Table 1. *Mean and Std. Deviation of Na^+, K^+, Mg^{2+}, and Ca^{2+}.*

	Na^+	K^+	Mg^{2+}	Ca^{2+}
Mean	138	4.4	2.1	8.8
Std. Deviation	3.37	0.70	0.29	0.36

Table 2. *Mean and Std Deviation of Na^+ and K^+ with age, gender, duration and social status.*

		Na^+			K^+		
		Mean	**Std. Deviation**	**P. value**	**Mean**	**Std. Deviation**	**P. value**
Age	30-60	138	3.17	0.5	4.4	0.57	0.9
	61-80	137	4.03		4.4	1.04	
Gender	Male	137	3.45	0.5	4.6	0.90	0.2
	Female	138	3.37		4.3	0.53	
Duration	1-10	138	3.47	0.4	4.5	0.75	0.4
	11-20	139	3.16		4.3	0.61	
Married	Married	138	3.27	0.5	4.5	0.74	0.5
	Single	137	3.85		4.3	0.60	

Non-significant correlations (P>0.05).

Table 3. *Mean and Std. Deviation of Mg^{2+}, and Ca^{2+} with age, gender, duration and social status.*

		Mg^{2+}			Ca^{2+}		
		Mean	**Std. Deviation**	**P. value**	**Mean**	**Std. Deviation**	**P. value**
Age	30-60	2.1	0.30	0.1	8.8	0.35	0.3
	61-80	2.3	0.22		8.7	0.37	
Gender	Male	2.2	0.30	0.5	8.7	0.44	0.7
	Female	2.1	0.28		8.8	0.30	
Duration	1-10	2.1	0.30	0.9	8.7	0.37	0.2
	11-20	2.1	0.29		8.9	0.31	
Married	Married	2.1	0.28	0.3	8.7	0.38	0.4
	Single	2.2	0.32		8.9	0.30	

The above table denoted that there were no significant correlations (P>0.05).

Table 4. *Mean and Std. Deviation of Na^+ and K^+ with job.*

Job	Na^+			K^+		
	Mean	**Std. Deviation**	**P. value**	**Mean**	**Std. Deviation**	**P. value**
No job	140	2.22	0.3	3.9	0.26	0.4
Employer	137	3.59		4.5	0.72	
Paterfamilias	140	2.59		4.5	0.15	
Pensionary	137	5.66		4.8	0.92	
Other	137	3.31		4.5	1.05	

The above table illustrated that there were non-significant correlation (P>0.05).

Table 5. *Mean and Std. Deviation of Mg^{2+} andCa^{2+} with job.*

Job	Mg^{2+}			Ca^{2+}		
	Mean	Std. Deviation	P. value	Mean	Std. Deviation	P. value
No job	2.2	0.39		9.1	0.21	
Employer	2.2	0.30		8.7	0.36	
Paterfamilias	2.1	0.28	0.8	9.0	0.26	0.06
Pensionary	2.1	0.28		8.6	0.21	
Other	2.0	0.28		8.6	0.34	

The above mentioned table presented that there were non-significant correlation (P-value>0.05).

Table 6. *Mean and Std. Deviation of Na^+ and K^+, with education and economic statue.*

		Na^+			K^+		
		Mean	Std. Deviation	P. value	Mean	Std. Deviation	P. value
Education	primary	138	3.27	0.4	4.5	1.07	0.5
	secondary	140	2.39		4.2	0.41	
	university	137	3.89		4.4	0.73	
	post graduate	138	3.73		4.6	0.66	
Economic	low	139	1.83	0.4	4.3	0.47	0.5
	Medium	138	3.57		4.4	0.76	
	High	136	3.63		4.7	0.76	

The above table indicated that, there were non-significance correlation (P>0.05).

Table 7. *Mean and Std. Deviation of $Mg^{2+}$and Ca^{2+} with education and economic status.*

		Mg^{2+}			Ca^{2+}		
		Mean	Std. Deviation	P. value	Mean	Std. Deviation	P. value
Education	primary	2.0	0.29	0.7	8.9	0.49	0.5
	secondary	2.0	0.25		8.8	0.22	
	university	2.2	0.33		8.8	0.44	
	post graduate	2.2	0.26		8.6	0.26	
Economic	low	1.9	0.16	0.01	8.8	0.24	0.7
	Medium	2.2	0.29		8.8	0.34	
	High	2.3	0.26		8.7	0.53	

Above table show significance difference with economic status and Mg^{2+} level (p<0.05).

With economic status show significance difference for Mg^{2+} (p<0.05) and non-significance difference for of K^+ and Ca^{2+} (p> 0.05).

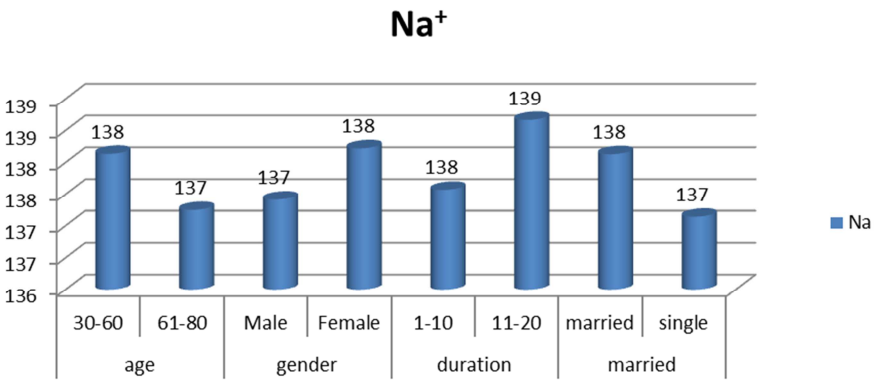


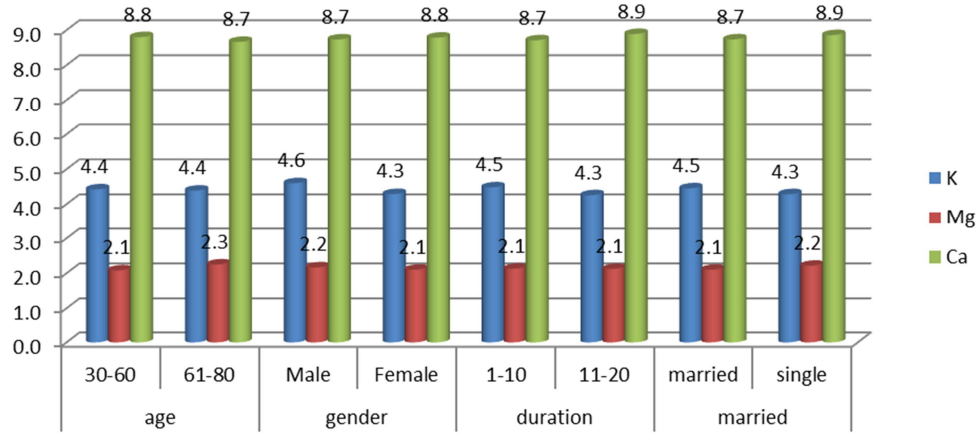
Figure 1. *Mean and Std. Deviation of Na+ with age, gender, duration and social status.*

The above mentioned figure presented that there was non-significant difference (p>0.05).

4. Discussion

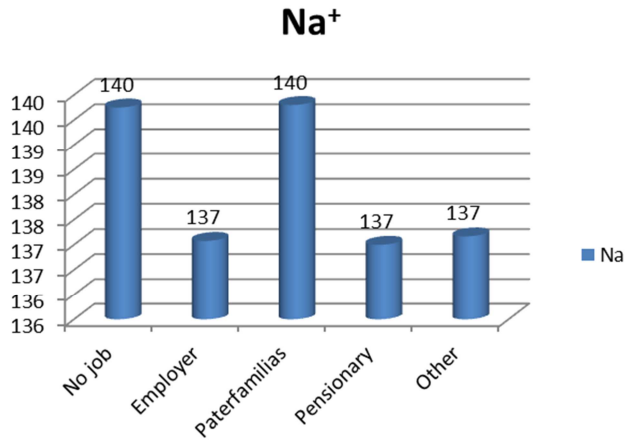
The study covered (30) individuals in Khartoum State with hypertension (19 females, 11male), with age range from (30-80) years, and duration form (1-20) years. The results of Na^+ showed normal concentration with mean (138 mmol/l) compared with normal range (135-145 mmol/). Results of K^+ show mean (4.4 mg/dl) which was normal concentration compared with normal range (3.5-5.0 mmol/l). Results of

Mg^{2+} indicated mean (2.2 mg/dl) which was normal concentration compared with normal range (1.7-2.7mg/dl), also results of Ca^{2+} demonstrated normal concentration with mean (8.8 mg/dl) compared with normal range This result was in agreement with other similar study carried in china by (Jiang He and GretheS. Tell *et al* (1991) whom were reported non-significant change in serum level of Sodium, magnesium and calcium of tested group with normal range, But was in disagreement with potassium level of tested group whom was found to have a negative significant change.



non-significance difference (p>0.05).

Figure 2. *Mean and Std. Deviation of K^{+}, Mg^{2+} and $Ca^{2+}$with age, gender, duration and social status.*



non- significance difference (p>0.05).

Figure 3. *Mean and Std. Deviation of Na^{+} with job.*

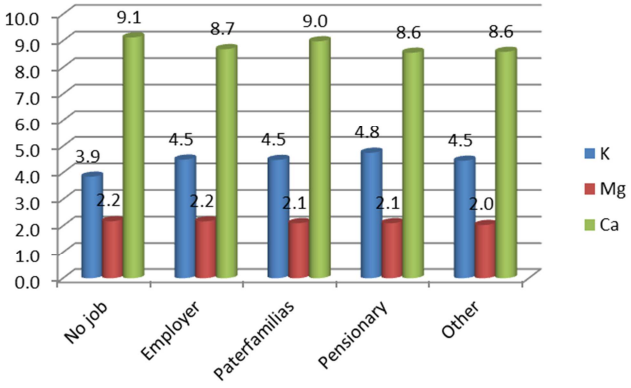
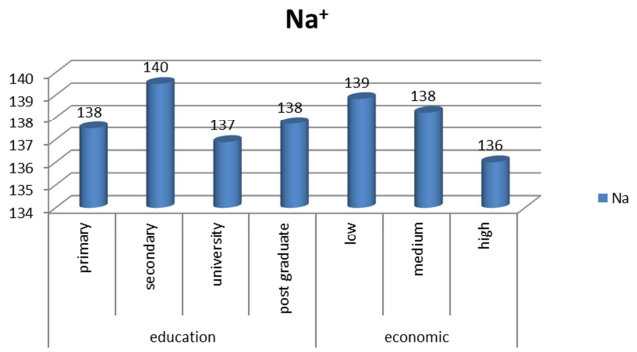


Figure 4. *Mean and Std. Deviation of, K^{+}, $Mg^{2+}$and $Ca^{2+}$with job.*

The above figure denoted that there was non- significance difference (p>0.05).



non-significance difference (p>0.05).

Figure 5. *Mean and Std. Deviation of Na^{+} with education and economic status.*

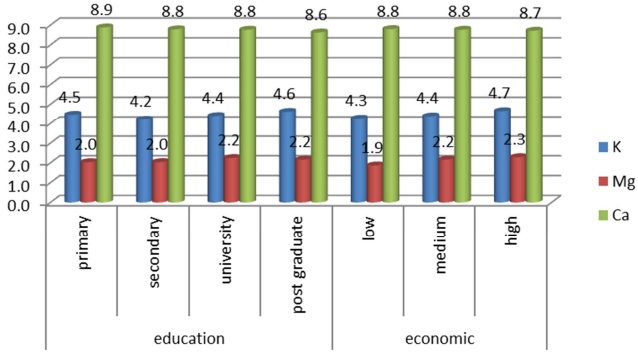


Figure 6. *Mean and Std. Deviation of K^{+}, Mg^{2+} and Ca^{2+} with education and economic status.*

Above Figure Show non-significance difference between education and serum level of K^{+}, Mg^{2+} and Ca^{2+} (p>0.05).

Also the findings of this study denoted a non-significant difference between the serum levels of sodium, potassium, magnesium and calcium of tested group to age, gender,

duration, social status and job ($p>0.05$) also there was a non- significant correlation between education status and serum level of electrolytes ($P>0.05$), and non- significant correlation between economic status and serum level of Na^{+}, K^{+}, Ca^{2+} ($P>0.05$), but presented a significant correlation between serum level of Mg^{2+} and economic status ($P<0.05$).

5. Conclusion

Based on the results of the study was demonstrated the non-significant correlation between serum electrolyte and hypertension tested group compared with normal range. Also the study was not finding any correlation or effect of age, gender, duration of disease and education status of hypertensive patients on serum electrolytes levels, but depended on the finding of results study was presented prevailed significant correlation with economic status of tested group and level of magnesium serum.

From this study concluded there was non physiological alteration in electrolytes balance in patients of hypertension.

References

[1] WHO a (2008) Global Health Observatory (GHO) data New data highlight increases in hypertension, diabetes incidence. 11-8-2015-10 pm.

[2] WHO b (2015) Global Health Observatory (GHO) data, Raised blood pressure, Situation and trends. 11: 54 pm.

[3] Fares, A (2013). "Winter Hypertension: Potential mechanisms". International journal of health sciences. 7 (2): 210–9. doi: 10.12816/0006044. PMC 3883610. PMID 24421749.

[4] The fact about high Blood Pressure National Center for Chronic CDC: Deaths: Final Data for 2009www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60_03. 12: Am.

[5] Gennari FJ (2002). Disorders of potassium homeostasis. Hypokalemia and hyperkalemia. Crit Care Clin. 2002; 18: 273–88.

[6] Sheen, E; Triadafilopoulos, G (2011). "Adverse effects of long-term proton pump inhibitor therapy". Digestive diseases and sciences. 56 (4): 931–50. doi: 10.1007/s10620-010-1560-3.

[7] Thomas, D; Barry, et al (2009). Definition and Classification of. The journal of clinical hypertension. 611-614.

[8] Ayus JC, Moritz ML (2010). "Bone disease as a new complication of hyponatremia: moving beyond brain injury". Clin J Am Soc Nephrol 5 (2): 167–8. doi: 10.2215/CJN. 09281209. PMID 20089487.

[9] Giles TD, Berk BC, et al (2015). On behalf of the Hypertension Writing Group. Expanding the definition and classification of hypertension. Hypertension. 2005; 7: 505–512.

[10] Minisola, S; Pepe, J; et al (2015). "The diagnosis and management of hypercalcaemia". BMJ (Clinical research ed.). 350: h2723. doi: 10.1136/bmj.h2723. PMID 26037642.

[11] Doherty, J (exclusive editor); Kenney, J. Mohr man; S (c. attributing editors) Shanta, V; Yovin, L (copy editors): (2007) Communicating Food for. Health www.foodandhealth.com; 2007: 42-487 "High Blood Pressure Fact Sheet". CDC. 19 February 2015. Archived from the original on 6 March 2016. Retrieved 6 March 2016.

[12] Lackland, DT; Weber, MA (2015). "Global burden of cardiovascular disease and stroke: hypertension at the core". The Canadian journal of cardiology. 31 (5): 569-71. doi: 10.1016/j.cjca. 2015.01.009. PMID 25795106.

[13] Poulter, NR; Prabhakaran, D; et al (2015). "Hypertension". Lancet. 386 (9995): 801–12. doi: 10.1016/s0140-6736 (14) 61468-9. PMID 25832858.

[14] LeMone, Priscilla; Burke, Karen; et al (2015). Medical-Surgical Nursing. Pearson Higher Education AU. p. 237. ISBN 9781486014408. Archived from the original on 2016-10-02.

[15] Viering, Daan H. H. M.; Baaij, et al (2016). "Genetic causes of hypomagnesemia, a clinical overview". Pediatric Nephrology: 1–13. doi: 10.1007/s00467-016-3416-3. ISSN 0931-041X.