**Table 1:** Table of evidence.

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| **Micronutrient: Authors; Year of publication; Study design** | **Sample** | **Purpose; Study/Protocol** | **Results** | **Level of evidence** |
| CoQ10; Alehagen, U., Johansson, P., Bjornstedt, M., Rosen, A., & Dahlstrom, U. (2013). Prospective, randomized, double-blind, placebo-controlled trial [17] | N = 443. Group 1: n = 221 patients, mean age 78.0, 115 males, 106 females; 97 withdrew Group 2: n = 222 patients, mean age 78.2, 110 males, 112 females; 118 withdrew  | Evaluate if supplement of CoQ10 and selenium would affect the severity of HF, mortality (all-cause and cardiovascular). Group 1: Combo pill of CoQ10 200 mg/day and organic selenium yeast 200 mcg/day Group 2: Placebo Median follow up time of 1891 days (348-1900) | Significant difference in NT-proBNP seen at 24 months (p = 0.048) and at 48 months (p = 0.014). Cardiovascular mortality: 28 (12.6%) in placebo group and 13 (5.9%) in treatment group. All-cause mortality: 36 deaths occurred in placebo group (16.2%) and 28 (12.7%) in treatment group. Long-term supplementation of CoQ10 and selenium decreases cardiovascular mortality | Class ILevel of Evidence B |
| CoQ10; Adarsh, K., Kaur, H., & Mohan, V. (2008). Quasi-experimental [15] | N = 86. Group 1: n = 46, mean age 48.5, 32 males, > NYHA class II, > Grade 1 MRGroup 2: n = 40, age/sex matched | Evaluate if CoQ10 benefits diastolic dysfunction in patients with hypertrophic cardiomyopathy. Group 1 (experimental group) given CoQ10 100 mg BID in addition to conventional treatment. Group 2- only conventional treatment. Patients were followed for a mean of 14.5 months (range 9.4 to 27.5 months) | Improvement in NYHA class > 1, improvement quality of life on 6 minute walk test, improvement in diastolic dysfunction by > 1 parameter, significant reduction in LVOT gradient > 15 mmHG in obstructive cases. No patients in treatment group had VT, 4 cases of VT in control group | Class ILevel of Evidence B |
| CoQ10; Fumagalli, S., Fattirolli, F., Guarducci, L., Cellai, T., Baldasseroni, S., Tarantini, F., Marchionni, N. (2011). Randomized, double blind, placebo-controlled trail [7] | N = 67. Group 1: n = 35 with stable HF, age 72 + 6, 82.9% male Group 2: n = 32 with stable HF, age 71 + 6, 87.5% male  | Evaluate the effects of oral CoQ10 on exercise tolerance and quality of life in patients in HF. Group 1: Q-ter 320 mg and creatine 340 mg daily for 2 months Group 2: Placebo  | TWC significantly improved after 8 weeks in groups receiving Q-ter and creatine (p = 0.04). No significant change in group receiving placebo Peak VO2 increased in active treatment group (p = 0.003) with no change in placebo group.  | Class ILevel of Evidence B |
| CoQ10; Belardinelli, R., Mucaj, A., Lacalaprice, F., Solenghi, M., Seddaiu, G., Principi, F., Tiano, L., & Littarru, G.P. (2006) Double-blind, placebo-controlled cross-over study [18] | N = 23 with stable moderate HF, 20 males (86.9%), age 59 + 9. NYHA II and III, stable in 3 months (no changed in meds × 3 months, no hospitalizations), ability to exercise  | Determine if patients with HF benefit from CoQ10 supplementation alone or in combination with exercise training (ET). Patients randomized into 3 groups to participate in 4 consecutive treatments lasting 4 weeks each: CoQ10 100 mg TID, CoQ10 + ET, placebo (TID), and placebo + ET | Supplementation increase CoQ10 levels four-fold (p < 0.0001), ET improved CoQ10 levels even if not significantly (p = 0.0652), ET reduced total cholesterol (p = 0.0122), ET improved cardiopulmonary indexes (peak VO2 p < 0.0001), improved LV contractibility, functional capacity, and endothelial function. Combo of exercise training and CoQ10 had higher plasma CoQ10 levels | Class ILevel of Evidence B |
| CoQ10; Molyneux, S., Florkowski, C., George, P., Pilbrow, A., Frampton, C., Lever, M., & Richards, A. (2008). Cohort [16] | N = 236, aged 32-89 (mean 77) | Evaluate if plasma CoQ10 is a predictor of overall mortality among patients with HF. One time venous labs for cholesterol, NT-proBNP and CoQ10 concentration Patients followed for median of 2.69 years (0.12-5.75) | Significant correlation between CoQ10 and TC (p < 0.001) and LCL-C (p = 0.001), and NT-proBNP (p = < 0.001). 76 deaths occurred. There is an independent association between low CoQ10 levels and increased mortality in patients with CHF | N/A |
| Vitamin D; Gotsman, I., Shauer, A., Zwas, D.R., Hellman, Y., Keren, A., Lotan, C., & Admon, D. (2012). Retrospective, Cohort study [21] | Members of a health maintenance organization (HMO) 45 years and older with vitamin D levels available. N = 49,834 Group 1: CHF group (n = 3009), age 75.9 + 10.7, 49% male Group 2: control group (n = 46,825), age 64.7 + 11.3, 35% male | Determine and compare vitamin D levels in patients with and without CHF and the impact of vitamin D deficiency and supplementation on patient survival. 25-Hydroxyvitamin D levels evaluated on members from a HMO. Comparison done between members with CHF and no CHF. Median follow up of 518 days (514-521). Overall mortality was 15.4% in patients with CHF and 1.7% in control group  | HF patients had a lower median 25(OH) D level- 36.9 nmol/L (23.2-55.9) than control group-40.7 nmol/L (26.7-56.9) p < 0.00001. Higher prevalence of vitamin D deficiency in HF patients (28%) vs. control group (22%) p < 0.0001. Overall mortality higher in HF group (15.4% vs. 1.7%). Vitamin D deficiency is associated with reduced survival p < 0.0001. Seasonal variation: increased 25(OH)D levels seen in summer months (June-August) vs. lower levels seen in winter months (December-February) with an increase of 14% in levels during summer months p < 0.0001 | Class ILevel of Evidence B |
| Vitamin D; Amin, A., Minaee, S., Chitsazan, M., Naderi, N., Taghavi, S., & Ardeshiri, M., (2013). Prospective cohort study [20] | N = 100. Consecutive patients with diagnosis of HF between Sept 2010 and February 2012 on optimal medical treatment for at least 3 months. 73 males (73%), 27 females, mean age of 45.25 + 15.53, NYHA class I (3%), II (43%), and III (54%) | Determine if vitamin D supplementation can improve cardiac functional capacity. Patients (76%) with deficient levels of 25 (OH) D were given oral vitamin D3 for 4 months- 50,000 IU every week for 8 weeks, then 50,000 IU every month for 2 months | Mean concentration of 24(OH) D increased by 41.86nmol/L. Mean NYHA class improved significantly (p < 0.001). Reduction of NT-proBNP seen (p < 0.001). Overall improvement in physical performance and laboratory values was seen | Class ILevel of Evidence B |
| Vitamin D; Schoten, N., Ruifrok, W., Kleijn, L., Dokter, M., Silje, H., Heerspink, H., Bakker, S., Kema, I., & de Boer, R., (2013). An open-label, blinded end point, randomized prospective trial (VitD-CHF trial). [23] | N = 101 stable with CHF with decrease LV function between March 2010 and November 2011 Group 1: Control group- n = 51, age 63.5 + 11.1, 90% male Group 2: Treatment group- n = 50, age 64.0 + 9.0, 96% male | Determine in patients with HF if vitamin D3 supplementation lowers plasma renin activity (PRA) Randomized: Control group (51 patients) Treatment group (50 patients)-6 weeks of 2,000 IU oral vitamin D3. 2 patients withdrew from study-1 from each group | Increase in vitamin D in treatment group compared to control group. Seen at 3 weeks treatment (p < 0.001) and continued thought treatment. At end of trial, 52% of treatment group had normal vitamin D levels vs. only 4% in control group. At six weeks, PRA significantly decreased in treatment group (p < 0.002) along with PRC (p < 0.020). Patients with CHF can be safely and effectively treated with vitamin D3. Treatment with Vitamin D3 is associated with decrease in PRA and PRC | Class ILevel of Evidence B |
| Vitamin D; Ameri, P., Ronco, D., Casu, M., Denegri, A., Bovio, M., Menoni, S., Ferone, D., & Murialdo. (2010). Cross sectional and retrospective review of database [19] | N = 90. All Caucasian 45 males- age 76.93 + 8.78, 45 females- age 79.89 + 6.30. Patients evaluated during March to May and September to November 2008 due to these months having a similar number of sunny months | Determine the relationship between NYHA classifications, NT-proBNP, LV function and vitamin D status in patients with stable HF. 90 patients assessed, 52 patients (26 males, 26 females) underwent echocardiography. Due to high prevalence of Vitamin D deficiency, a control group was found retrospectively from the database of ambulatory visits. 31 (19 females, 12 males) > 60 years old, evaluated between March and May 2009 who had Vitamin D levels assessed | 2 pts (2.2%) had sufficient vitamin D levels which was significantly lower than the control group. Control group 25(OH)D level mean 25.0 (17.38-45.13) vs. 17.25 nmol/L (10.00-28.63) in HF group. Control group 1,25(OH)2D 64.70 pmol/L (48.60-96.80) vs. 54.80 pmol/L (37.25-77.25) in HF group | N/A |
| Vitamin D; Pilz, S., Marz, W., Wellnitz, B., Seelhorst, U., Fahrleitner-Pammer, A., Dimai, H., Boehm, B., & Dobnig, H. (2008). Prospective, cross sectional, cohort study [22] | N = 3299 having coronary angiography between 1997 and 2000. Patients with severe deficiency- mean age of 66.0, 27.1% female; moderate deficiency- mean age 64, 27.3% female; insufficiency- mean age 61.8, 26.8% female; optimal range- mean age 61.0, 22.7% female  | Determine if vitamin D deficiency is associated with CHF and sudden cardiac death. Vitamin D levels assessed in 3299 patients. 18 patients were lost in follow up. At 7.7 years follow up, 760 patients were available, 188 (25%) died from sudden cardiac death and 116 (15%) from CHF | Low vitamin D levels associated with impaired LV function and a higher NYHA classification and significant risk factor for mortality due to CHF and sudden cardiac death. Low vitamin D correlated with NT-proBNP levels (p < 0.001), LV function association with low vitamin D (p < 0.001) More females had lower vitamin D levels compared to men | N/A |
| B Vitamins; Lee, N., Huang, M., Chung, C., Lin, K., Su, K., & Huang, Y. (2004). Single-blind, randomized study [28] | N = 50 with at least 70% stenosis of a major coronary artery identified by cardiac catheterization between January 2002 and December 2002. 46 men, 4 women, mean age 71.6 + 9.7 years | Determine if vitamin B6 supplementation has an effect on lowering homocysteine levels in patients with heart disease. Patients randomized to 1 of 5 groups: placebo (n = 10), vitamin B6 5 mg (n = 10), vitamin B6 10mg (n = 10), or folic acid 5mg combined with 0.25 mg vitamin B12 (n = 10) for 12 weeks. Patients didn’t take any other supplements during this time and were reminded with a phone call every other week to monitor compliance. 24 hour diet recalls were done before intervention and at week 12. Venous labs done for homocysteine and vitamin B6, glucose, creatinine, cholesterol, triacylglycerol, alanine aminotransferase, serum alkaline phosphatase, vitamin B12, and folate. 8 patients lost during study | Homocysteine level decreased significantly-32% p < 0.001, after 12 weeks of folic acid and B12 supplementation. B6 and placebo not effective at lowering homocysteine | Class ILevel of Evidence B |
| B Vitamins; Andersson, S.E., Edvinsson, M., & Edvinsson, L. (2005). Prospective, cohort, open-label study [29] | N = 14 patients, 14% female, mean age 81 + 1 with BMI 26 + 1. NYHA class mean 2.8 + 0.2 with estimated walking distance 400 m with a range of 10 to 1000 m | Determine if vitamin supplementation can normalize homocysteine levels in elderly patients with HF. Labs done for interleukin-6, soluble interleukin2-receptor, C-reactive protein, cobalamines, folate, von Willebrand factor, hemoglobin A1C, creatinine, and uric acid. Patients given 6 weeks of vitamin B6 3 mg, folate 0.8 mg, and cyanocobalamin 0.5 mg | Mean homocysteine level was 17.9 + 0.6 µM at inclusion. Decreased to 13.8 + 1.1 with supplementation. Level decreased in all patients except 1 with end stage renal disease. No change in subjective health quality or walking distance | Class ILevel of Evidence B |
| B Vitamins; Schoenenberger, A., Schoenenbeger-Berzins, R., Auf der Maur, C., Suter, P., Vergopoulous, A., & Erne, P. (2012). A randomized, double-blind, placebo-controlled, cross-over pilot study [30] | N = 9 randomized to 2 groups, mean age 56.7 + 9.2, 2 (22%) females  | Evaluate the effect of high dose thiamine supplementation on CHF patients. Group 1: 5 patients- Received thiamine 300 mg/day × 28 days, 6 weeks of washout, then placebo × 28 days Group 2: 4 patients- Received placebo × 28 days, 6 weeks of washout, then thiamine 300 mg/day × 28 days | EF increased during thiamine treatment 29.5% to 32.8%. Improvement in functional status with thiamine supplementation | Class ILevel of Evidence B |
| B Vitamins; Rodríguez, J.J., Santolaria, F., Martinez-Riera, A., González-Reimers, de la Vega Prieto, Valls, M.R., & Gaspar, M.R. (2006). Cohort study [27] | N = 337- 184 males, 153 females aged 77.2 + 0.4, admitted to a general medicine unit in a hospital between Jan 2002 and April 2004 with 42.7% having CHF, 35.9% with atrial fibrillation | Determine the clinical significance of serum homocysteine levels in patients admitted to hospital and determine possible long-term effects of low and high homocysteine levels. Nutritional assessments done, serum homocysteine levels, and vitamin measurements- folate, B12 | With homocysteine of 15 µmol/L as upper limit of normal- 47.2% of patients above this. 2.8% of control patients had level about 25 µmol/L vs. 11% of admitted patients with 5.6% of control patients having homocysteine levels lower than 10 µmol/L vs. 15.4% of patients (p = 0.29). Low serum folate levels (< 3 ng/mL) in 12.1% and serum B12 less than 200pg/mL in 8.9% of patients. HF was related to an increase in homocysteine- 17.8 + 0.7 µmol/L vs. 15.5 + 0.6 µmol/L in patients without HF. Prevalence of HF increased with homocysteine levels- 30% when homocysteine below 15th percentile, 40% between 15th-50th percentile, and 48% above 50th percentile | N/A |
| B Vitamins; Guéant-Rodriguez, R. Julliére, Y, Nippert, M., Adelmouttaleb, I, Herbeth, B., Aliot, E., Danchin, N., Guéant, J. (2007). Prospective cohort study [26] | N = 709. Consecutive patients seen for diagnostic coronary angiography- 515 patients with CAD and 194 patients without CAD, median age 63 (53-71), 77.1% men, 25% (n = 177) with LVEF < 40%, 24.5% (n = 174) with NYHA class II or III | Determine the association between homocysteine levels and left ventricular dysfunction (LVEF, end-diastolic left ventricular pressure, and NT-proBNP levels. Patients given a questionnaire about history of chest pain, MI, dyspnea, hypertension, diabetes, dyslipidemia, family history, medications, alcohol abuse, and tobacco abuse. Venus blood was drawn for folate, total homocysteine, vitamin B12, and creatinine | Total homocysteine level higher in CAD patients vs. non-CAD patients p < 0.001, higher homocysteine level seen in patients with NYHA class III than class II (p = 0.0009). Association between homocysteine and LVEF with and without CAD was seen | N/A |
| B Vitamins; Gibelin, P., Serre, S., Candito, M., Houcher, B., Berthier, F., & Baudouy, M. (2006). Prospective cohort study [25] | N = 278. Group 1: n = 159 patients with HF, 56% (n = 89) with non-ischemic, 44% (n = 70) with ischemic HF, 83% males, mean age of 62.1 + 13.1, mean EF 27%. Group 2: n = 119 control group- patients with no known cardiovascular disease, no chest pain, and no symptoms of CHF,79% males, mean age 59.8 + 15.7  | Determine the impact of increased homocysteine in patient with HR. Follow up of 49.6 + 36.7 months Fasting blood samples done for total homocysteine level, folate, and vitamin B12.  | Mean homocysteine level in HF group- 15.8 + 6.9 µmol/L vs. 10.9 + 3.2 µmol/L, higher in patients with non-ischemic HF - 16.11 + 6.84 µmol/L vs. 15.41 + 6.45 µmol/L in patients with ischemic CHF. Folic acid levels and vitamin B12 levels not significantly different than control group | N/A |
| B Vitamins; Maurer, M., Burri, S., de Marchi, S., Hullin, R., Martinelli, M., Mohasci, P., & Hess, O.M. (2010). Cohort study [24] | N = 161 between 2003-2005, with HF- 94 with systolic HF, 64 with diastolic HF, mean EF 38 + 16%, mean VO2 max 19 + 7 ml/min.  | Determine if homocysteine has an impact on cardiovascular events in patients with HF. Patients evaluated with clinical exams, laboratory values, and clinical events | More cardiac events (death, heart transplantation, hospitalization due to cardiovascular event) in patients with high homocysteine (20 µmol/L) than those with lower homocysteine (< 20 µmol/L). Homocysteine is an important cardiovascular risk for cardiac events | N/A |
| B Vitamins; Hanninen, S.A., Darling, P.B., Sole, M.J.,Barr, A., & Keith, M.E. (2006). Prospective, cross-sectional, observational study [10] | N = 100. Consecutive patients admitted to a hospital with a diagnosis of HF between April 2001 and June 2002, age 67.1 + 10.1, 58% male. Control group-50 patients age 61.1 + 11.1, 48% male | Determine the prevalence of thiamine deficiency of patients admitted with HF. Within 48 hours of admission, labs for thiamine analysis drawn and 24 hour urine collection started. Patients assessed by registered dietitian to look at nutrition status and dietary intake of thiamine was estimated  | 50% of patients with HF were malnourished. 33% of patients with HF were thiamine deficient, significantly higher than controls (p = 0.007) | N/A |
| Magnesium; Almoznino-Sarafian, D., Sarafian, G., Berman, S., Shteinshnaider, M., Tzur, I., Cohen, N., & Gorelik, O. (2009). A randomized, controlled trial [31] | N = 32. Group 1: n = 16 aged 71.3 ± 8, 50% male. Group 2: n = 16 aged 71.8 ± 7, 56% male | Evaluate the effect of magnesium supplementation on heart rate variability in patients with CHF. Group 1 received Mag citrate 300 mg/day for 5 weeks. Group 2 control group with no placebo or additional medication | Serum Mg and intracellular Mg levels increased in treatment group and control group but significant in the treatment group (p < 0.001). HRV-CD also increased in the treatment group. Mg supplementation may be beneficial in patients with CHF | Class ILevel of Evidence B |
| Magnesium; Stepura, O.B. & Martnow, A.I. (2009). A prospective, randomized, double-blind, placebo-controlled monocentric study [14] | N = 79. Group 1: n = 40, aged 62.6 ± 6.9. Group 2: n = 39, aged 62.9 ± 7.3. Sex not listed | Evaluate the effect of magnesium orotate in patients with severe CHF. Group 1 received magnesium orotate 600 mg for 1 month then 3000 mg for 11 months. Group 2 received placebo | Survival rate was higher in treatment group (p < 0.05) and clinical symptoms improved in the treatment group (p < 0.001) | Class ILevel of Evidence B |
| Multiple micronutrients; Witte, K.K., Nikitin, N.P., Parker, A.C., von Haehling, S., V, H., Anker, S.D., Clark, A.L., & Cleland, J.G. (2005). Double-blind randomized (two-by-two method), prospective, blind, placebo trial [12] | 32 patients with stable HF (EF < 35%) due to ischemic heart disease randomized to 2 groups. 2 patients dropped out due to inability to tolerate MRI scanner because of claustrophobia Group 1: Treatment group- age 74.2 (2.8) Group 2: Placebo group- age 75.5 (3.5) Sex not listed | Determine significance of long-term multiple micronutrient supplementation in patients with HF on quality of life, LV function, and levels of pro-inflammatory cytokines. Group 1: Capsules of combo of high-dose micronutrients (calcium, magnesium, zinc, copper, selenium, vitamin A, thiamine, riboflavin, Vit B6, folate, vitamin B12, vitamin C, vitamin E, Vitamin D, and coenzyme Q10 for 9 month Group 2: Placebo for 9 months 2 patients (1 from each group) died during follow up | LV function increased by 5.3 + 1.4% in treatment group with no change in placebo group. Treatment group had significant improvement in quality of life score (p = 0.02). 6 minute walk test remained unchanged in both groups. No change in NYHA class in either group | Class ILevel of Evidence B |