# *Original Research Article*

## Differences between the incident and prevalent hemodialysis patients in Egypt


### ABSTRACT

The HD population is divided into the incident and prevalent HD patients according to the duration of HD. Predictors of death of both groups are not yet identified in Egyptian HD patients. We aimed to compare both groups and their mortality predictors.

This study was started in June 2016, comprising 2,123 HD patients. Patients were classified into Incident and Prevalent groups. All patients were observed for eighteen months and their data were recorded.

The incident group showed significantly lower hemoglobin, serum albumin, urea reduction ratio, serum phosphorus, and serum ferritin but higher erythropoiesis-stimulating agents dose. There was significantly a higher frequency of hypertension and a lower frequency of positive hepatitis C virus antibodies and hyperparathyroidism in the incident group. The mortality frequency was found to be significantly higher in the incident group. Older age and corrected serum calcium were significant predictors of mortality in the total studied group and the prevalent one.

The incident HD group tends to show laboratory findings suggestive of malnutrition, and a higher frequency of mortality with different mortality predictors.



***Keywords: Incident, Prevalent, Hemodialysis Patients, Egypt.***




## 1. INTRODUCTION

The number of end-stage renal disease (ESRD) patients is known to be increasing continuously. Meanwhile, their mortality has been shown to be significantly higher than that of the normal population despite the advances in hemodialysis (HD) **[1], [2], [3]**. This high mortality rate in HD patients could be explained by the presence of co-morbidities, such as cardiovascular diseases (CVD) diabetes (DM), advanced age and under-nutrition **[4]**. In addition, inflammatory markers are playing a role as predictive factors for mortality in HD patients **[5]**.

According to the duration of HD, previous publications differentiated two groups of patients: early and late or, in other words, incident and prevalent groups, respectively. However, there is still a controversy on the definition of incident HD patients; some defined these patients as those who had received HD for ≤30 days **[6], [7]**. Others defined incident HD patients as patients who had been receiving HD for <3 months **[8], [9]**, while De Francisco et al considered HD patients who had been on dialysis <6 months as incident ones **[10]**. Higher rate of death was described by many authors to be within 90 days of starting dialysis **[11], [12], [13]**, while Bradbury et al found elevated risk of mortality during the first 120 days **[6]**. On the other hand, Lukowsky et al reported a higher mortality in the first six months, with most of deaths in the first two months **[4]**.

There are limited available data comparing the incident and prevalent HD patients. Moreover, the mortality predictors' after short and long HD vintage among Egyptian HD patients have not been well-studied. The current study aims to compare between the incident and prevalent HD patients, regarding their clinical and laboratory characteristics, and to explore their mortality and its predictors among multiple HD services from different localities in Egypt.

## 2. PATIENTS AND METHODS

Many HD units, that we have experienced their cooperation and accurate data provision before, in different governorates in Egypt were approached and communicated to perform the study; however, only 25 HDUs in six governorates responded satisfactorily. This sample was utilized before in two previous research articles about Ramadan fasting in Egyptian HD patients published in the Saudi Journal of Kidney Disease and Transplantation in 2019 **[14]** and Gender-Related Differences and Mortality Predictors among Egyptian Hemodialysis Patients under publication in the Asian Journal of Medicine and Health **[15]**. This prospective multicenter study was started in June 2016, comprising 2123 HD patients in Egypt. Demographic and laboratory data, as well as the presence of comorbid conditions, were extracted from patients' records. Patients were classified according to HD duration into 2 groups: Incident group including patients with HD duration equals to or less than 6 months, and a prevalent group including patients who had been maintained on HD for more than 6 months. During the first month of the study, every patient was subjected to thorough observation including demographic data, associated comorbidities, and all available routine investigations. Blood pressure was measured using an aneroid sphygmomanometer in the dialysis room and was carried out before midweek dialysis sessions. Patients' dry body weights were recorded at the start of

the study as the weight in which the patient has neither edema nor volume-dependent hypertension. All patients were followed for eighteen months to record mortality events.

According to the current recommendations of the Egyptian Ministry of Health (MOH), all patients were essentially dialyzed with a dialysate flow rate of ~500ml/min, blood flow rate ranging from 250-350 ml/min and a total dialysis dose of 10-12 hours per week. All patients were dialyzed by a bicarbonate-based dialysis solution with a dialyzer surface area of 1.3-1.6 $m^2$ made of Polysulfone or Helexone membrane material **[16]**. Egyptian MOH guidelines were followed for water treatment in all the included HD units **[17]** Urea reduction ratio (URR) was utilized to assess dialysis adequacy monthly, being targeted to be above 60 % **[16]**.

**Statistical analysis**

Data were collected, revised, verified then edited on a personal computer. The statistical analysis was performed using SPSS (Statistical Package of Social Sciences) version 20 for Windows (SPSS, Inc., Chicago, IL, USA). The distributions of tested variables were examined by Shapiro-Wilk (SK) or Kolmogorov-Smirnov tests when appropriate. Qualitative data were described using number and percent (n, %). Association between categorical variables was tested using the Chi-square test ($\chi^2$) Continuous variables were presented as mean ± std (standard deviation) for parametric data or median (min-max,) for non-parametric data. Unpaired data were compared using a student t-test for parametric data and Mann–Whitney test for nonparametric data. A $p<0.05$ was taken as an indicator for significant difference. Predictors of mortality in both incident and prevalent hemodialysis patients were assessed using binary logistic regression analysis.

## 3. RESULTS

This study was conducted on 2123 HD patients, including 265 incidents, and 1858 prevalent HD patients. **Table [1]** elucidates data in both the incident and the prevalent groups. Both groups were comparable in many of the demographic, clinical, and laboratory data, although there were significantly lower hemoglobin (Hb), serum albumin, URR, serum phosphorus, and serum ferritin in the incident HD group. On the other hand, there was significantly higher average erythropoiesis stimulating erythropoiesis-stimulating agents (ESA) dose in the incident HD patients. According to comorbidities, there was significantly higher frequency of hypertension in the incident compared to the prevalent group, while there was no significant difference in diabetes mellitus (DM) or ischemic heart disease (IHD) between the groups.

As regard serology of the studied HD patients, table [1] shows an unequal distribution between the incident and the prevalent groups, with a higher number of patients with positive hepatitis C antibody (HCV Ab) in the prevalent than the incident group (37.4%, and 29.1%, respectively), while the incident group had a higher number of patients with positive hepatitis B Surface Antigen (HBs Ag; 3.8% and 2.2%, respectively).

Serum parathyroid hormone (PTH) was categorized according to its serum levels (<150, 150-299, 300-700, and >700 pg/mL) in both groups of patients. These PTH categories were distributed independently in both patient groups, the patients of the prevalent group contained more frequency of hyperparathyroidism >700 pg/mL with a statistically significant difference.

After eighteen months-follow up, the mortality frequency was found to be significantly higher in the incident than the prevalent group (14%, vs. 9.6%, respectively, p=0.02;) in Table **[1]**.

**Table [2]** shows a comparison between the patients who died and those who survived during the study period in the incident as well the prevalent HD groups. Those who died, in both the incident and prevalent groups, tended to be statistically significantly older than the survived ones. On the other hand, the patients who died had statistically significantly lower Hb levels compared to those who survived in the prevalent but not in the incident groups. Moreover, the incident group had significantly higher pre-dialysis urea in those who died compared to the survived patients; although there was no significant difference, in this respect, in the prevalent group. In contrary, there were significantly higher corrected serum calcium levels in the patients who died than those who survived in the prevalent ($p<0.001$) but not in the incident group. While serum phosphate level was significantly lower in the deceased than the survived patients in the incident but not in the prevalent group. A significantly higher number of patients with both DM and IHD was encountered in the patients who died compared to those who survived in the prevalent group. As regard viral serology, there was a higher number of patients with positive HCV Ab in the deceased than in the survived patients of the prevalent, while it was comparable in the incident group. On the other hand, variables like gender, body mass index (BMI), blood pressure (BP); systolic and diastolic, serum albumin, creatinine, ferritin, PTH, potassium, and transferrin saturation, URR, average ESA dose and number of hypertensive patients had no significant difference between the patients who died and those who survived in both groups.

In the total studied group; there were statistically significant older age, lower hemoglobin, lower phosphorus, higher corrected calcium, higher ESA dose in IU, higher frequencies of associated comorbidities–in the form of DM and IHD–and shorter HD duration in the patients who died than in those who survived during the 18-month

study observation duration (Data were not shown). **Tables [3a and 3b]** show multiple regression analysis of mortality predictors in the total studied group and in the incident and the prevalent groups, respectively. Regression analysis was performed utilizing all studied variables that showed statistically significant relation with mortality. Older age and corrected serum calcium were significant predictors of mortality in the total studied group and the prevalent group. However, this analysis did not reveal statistically significant predictors of mortality among the incident group.

## Tables

**Table (1): Comparison between the incident and the prevalent HD patients as regard different variables (demographic, clinical, and laboratory parameters).**

| | **Incident n=265** | **Prevalent n=1858** | P |
|---|---|---|---|
| **Age (years)** | 52.74(13.66) | 51.72(13.03) | 0.165 |
| **Sex: Female**<br>**Male** | 115(43.4%)<br>150(56.6%) | 788(42.4%)<br>1070(57.6%) | 0.76 |
| **Dry body weight Kg)** [n1=250 & n2=1805] | 72.3581± 7.035 | 72.3251± 6.800 | 0.92 |
| **Systolic BP (mmHg)**<br>**Diastolic BP** [n1=237 & n2= 1753] | 136.03±19.54<br>83.65±9.89 | 134.02± 21.63<br>82.54±11.55 | 0.17<br>0.16 |
| **Hb (gm/dl) [n1=240 & n2=1743]** | 9.06± 1.83 | 9.73± 1.86 | 0.000 |
| **Serum creatinine (mg/dl)** [n1=208 & n2=1526] | 7.73± 2.67 | 7.95± 4.47 | 0.49 |
| **Serum Albumin (gm/dl)** [n1= 140 & n2=1121] | 3.72± 0.819 | 3.818± 0.696 | 0.039 |
| **URR** [n1= 177 &n2=1506] | 0.576±0.126 | 0.603± 0.11 | 0.002 |
| **Serum Potassium (mg/dl) [n1=44 & n2=340]** | 5.35± 1.26 | 5.03± 1.16 | 0.09 |
| **Corrected Serum Calcium (mg/dl)** [n1= 93 &n2=755] | 9.09 ±1.34 | 9.00±1.48 | 0.62 |
| **Serum Phosphorus(mg/dl)** [n1= 146 & n2=986] | 4.94 ±1.25 | 5.25±1.43 | 0.01 |
| **Serum Ferritin (ng/ml)** [n1= 76 & n2=554] | 409.1(196.3-700) | 527(253.3-842.3) | 0.02 |
| **T.Sat**.(%) [n1= 35 &n2=254] | 26 (7-123) | 32 (6-100.7) | 0.123 |
| **Average monthly ESA dose in thousands of Units** [n= 59 & n2=514] | 25.79±0.013 | 19.83±0.013 | 0.001 |
| **DM** | 55(20.8%) | 344(18.5%) | 0.38 |
| **Hypertension** | 142(53.6%) | 847(45.6%) | 0.01 |
| **IHD** | 53(20.0%) | 443(23.8%) | 0.17 |
| **Previous kidney transplantation** [n1= 256 & n2=1858] | 5(1.9%) | 20(1.1%) | 0.25 |
| **Serology of viruses**<br>Negative serology | 175(66%) | 1098(59.1%) | |
| HCV Ab positive | 77(29.1%) | 695(37.4%) | |
| HBs Ag positive | 10(3.8%) | 40(2.2%) | 0.017 |
| Combined HBs Ag positive & HCV Ab positive | 2(0.8%) | 24(1.3%) | |
| HIV Ab positive | 1(0.4%) | 1(0.1%) | |

| | | | |
|---|---|---|---|
| **PTH (pg/ml)** [n1= 93& n2= 619]<br>**<150** | 295(152.5-424)<br>22(23.7%) | 318(146-686)<br>165(26.5%) | 0.014 |
| **150-299** | 26(28%) | 129(20.7%) | |
| **300-700** | 35(37.6%) | 179(28.8%) | |
| **>700** | 10(10.8%) | 149(24%) | |
| **Frequency of mortality** | 37(14.0%) | 179(9.6 %) | 0.02 |

Data presented as mean ±std, median (minimum, maximum), or as number (percentage), n1 & n2: number of data in any variable in the incident and the prevalent HD patients, respectively. BP: blood pressures, Hb: hemoglobin, URR: Urea Reduction Ratio, PTH: parathyroid hormone, T.Sat: transferrin saturation, ESA: erythropoiesis stimulating agents, DM: diabetes mellitus, IHD: ischemic heart disease , HCV Ab: hepatitis C virus antibody , HBs Ag: hepatitis B virus surface antigen, and HIV: Human immunodeficiency virus.

**Table (2): Comparison between patients who died and who survived during the study period in the incident and the prevalent HD groups as regard; demographic, clinical, and laboratory variables.**

| | **Incident** | | | **Prevalent** | | |
|---|---|---|---|---|---|---|
| | Survived N:228 | Died N:37 | p | Survived N:1679 | Died N:179 | P |
| **Age (years)** | 51.79±13.12 | 58.62±11.82 | *0.005* | *51.15±13.11* | *57.11±11.57* | *0.001* |
| **Gender: Female**<br>**Male** | 101(44.3%)<br>127(55.7%) | 14(37.8%)<br>23(62.2%) | $\chi^2$=0.59 p=0.44 | *719(42.82%)*<br>*960(57.18%)* | *69(38.5%)*<br>*110(61.5%)* | $\chi^2$=1.37*P=0.24* |
| **BP** (mmHg)<br>(n1A=204 &n1D=33)<br>(n2A=1583&n2D=167)<br>**Systolic BP** | 135.3±18.85 | 139.70±23.38 | *0.87* | *133.75±21.51* | *135.33±22.76* | *0.37* |
| **Diastolic BP** | 83.64±9.88 | 83.33±10.21 | 0.23 | *82.41±11.41* | *82.81±12.51* | *0.67* |
| **Dry body weight (Kg)**<br>(n1A= 217 & n1D=33)<br>(n2A=1636&n2D=169) | 72.9263 ±16.73684 | 68.6212± 18.72541 | *0.12* | *72.2307 ±16.8387* | *73.2337± 16.44191* | *0.39* |
| **BMI (kg/m$^{2)}$**<br>(n1A=75 &n1D=18)<br>(n2A= 575&n2D= 71) | 25.54±7.16 | 24.39±5.56 | *0.53* | *25.56±6.51* | *25.92±6.93* | *0.67* |
| **Dialysis duration (months)**<br>(n1A= 228 & n1D=27)<br>(n2A=1666&n2D=179) | 3.06±1.66 | 2.9±1.54 | *0.715* | *66±45* | *68.48±56.95* | *0.28* |
| **Hb(gm/dl)**<br>(n1A=206& n1D=31)<br>(n2A= 1569&n2D= 162) | 9.15±1.81 | 8.63±1.84 | *0.14* | *9.77±1.83* | *9.39±1.98* | *0.012* |
| **Serum albumin (gm/dl)**<br>(n1A=120 & n1D=17)<br>(n2A= 1025&n2D=94) | 3.67±0.64 | 3.58±0.82 | *0.59* | *3.81±0.66* | *3.78±0.79* | 0.68 |
| **Serum creatinine(mg/dl)**<br>(n1A=181&n1D=27)<br>(n2A=1398&&n2D128) | 7.82±2.68 | 7.13±2.58 | *0.21* | *7.99±4.62* | *7.56±2.25* | *0.304* |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pre Dialysis Urea (mg/dl)** (n1A=168&n1D=33) (n2A= 1446&n2D125) | 124.25±28.92 | 139.69±20.4 | *0.0039* | *128.09±36.29* | *123.57±34.43* | *0.18* |
| **URR** (n1A=148& n1D=26) (n2A= 1367&n2D= 128) | 0.58±0.13 | 0.565±0.12 | 0.55 | 0.60±0.11 | 0.59±0.11 | 0.48 |
| **Serum Potassium(mg/dl)** (n1A=38 & n1D=6) (n2A= 319& n2D=21) | 5.37±1.35 | 5.26±1.33 | *0.86* | 5.02±1.16 | 5.18±0.15 | 0.56 |
| **Corrected serum Ca(mg/dl)** (n1A=80&n1D=13) (n2A= 686 &n2D=69) | 9.04±1.34 | 9.38±1.34 | 0.40 | 8.95±1.47 | 9.55±1.55 | 0.001 |
| **Serum Phosphorus (mg/dl)** (n1A=77 & n1D=12) (n2A= 901 & n2D=85) | 5.26±1.41 | 4.34±1.26 | 0.03 | 5.27±1.42 | 5.05±1.54 | 0.17 |
| **PTH** (pg/ml) (n1A=80 & n1D=13) (n2A= 573 & n2D=46) | 308.5(8.6-2208) | 213(28-772) | *0.23* | *326.3(4.7-3576)* | *217.75(14-1771)* | *0.11* |
| **Serum Ferritin (ng/ml)** (n1A=63 &n1D= 13) (n2A= 509 & n2D=45) | 351(23.7-1326) | 509(60-1360) | *0.16* | *520(17.7-5295)* | *640(36-2100)* | *0.16* |
| T.sat (%) (n1A=30 & n1D=5) (n2A= 236 & n2D=18) | 26(7-123) | 31(12-56.7) | *0.66* | 32(6-100.7) | *28.6(8-53)* | *0.099* |
| **Average monthly ESA dose in thousands of units** (n1A=50& n1D= 9) (n2A= 471 & n2D=43) | 24.98±12.07 50<br>24.(16-32) | 30.22±19.91<br>32(8-48) | 0.357 | 19.5±12.56<br>16(12-24) | 22.38±13.51<br>24(16-32) | 0.139 |
| **DM** | 45(20.1%) | 10(27.0%) | *0.34* | *297(17.8%)* | *45(25.1%)* | *0.01* |
| **Hypertension** | 121(54.0) | 19(51.4%) | *0.76* | *753(45.2%)* | *86(48.0%)* | *0.47* |

**Table (2): Continued**

| | **Incident** | | | **Prevalent** | | |
|---|---|---|---|---|---|---|
| | Survived N:228 | Died N:37 | p | Survived N:1679 | Died N:179 | P |
| **IHD** | 42(18.8%) | 11(29.7%) | *0.12* | *378(22.7%)* | *65(36.3%)* | *0.001* |
| **Serology of viruses** Negative serology | 149(65.35) | 26(70.27%) | 0.56 | 1000(59.55 %) | 98(54.7%) | 0.23 |
| HCV Ab positive | 68(29.82%) | 9(24.32%) | 0.49 | 62(36.98%) | 74(41.3%) | <0.001 * |
| HBs Ag positive | 8(3.5%) | 2(5.4%) | 0.57 | 38(2.26%) | 2(1.12%) | 0.32 |
| HCV Ab & HBs Ag positive | 2(0.87%) | 0(0.0%) | 1.0 | 19(1.13%) | 5(2.8%) | 0.06 |
| HIV positive | 1(0.43%) | 0(0.0%) | 1.0 | 1(0.05%) | 0(0.0%) | 1.0 |

Data presented as mean +/-SD, median (minimum, maximum), and others as number& (percentage) n1A & n1D: number of data in any variable in patients who survived & died in the incident HD patients, respectively. n2 A & n2D: number of data in any variable in patients who survived & died in the prevalent HD patients, respectively.

BP: blood pressures, Hb: hemoglobin, URR: Urea Reduction Ratio, PTH: parathyroid hormone, T.Sat: transferrin saturation, ESA: erythropoiesis stimulating agents, DM: diabetes mellitus ,IHD: ischemic heart disease , HCV Ab: hepatitis C virus antibody , HBs Ag: hepatitis B virus surface antigen, and HIV: Human immunodeficiency virus

**Table (3a): Multiple regression analysis of predictors of mortality in total studied groups**

| | B | Sig. | Odds Ratio | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| **Age (years )** | 0.061 | 0.001 | 1.063 | 1.024 | 1.103 |
| **DM** | 0.370 | 0.429 | 1.448 | 0.578 | 3.627 |
| **IHD** | -0.552 | 0.186 | 0.576 | 0.254 | 1.305 |
| **Hb (gm/dl)** | -0.131 | 0.535 | 0.877 | 0.580 | 1.327 |
| **Serum phosphorus (mg/dl)** | -0.200 | 0.214 | 0.819 | 0.598 | 1.122 |
| **Average ESA in thousands of units** | 0.000 | 0.954 | 1.000 | 1.000 | 1.000 |
| **Corrected Calcium (mg/dl)** | 0.250 | 0.046 | 1.284 | 1.004 | 1.641 |
| **Dialysis Duration code** | 0.986 | 0.05 | 2.680 | 0.982 | 7.313 |
| **Constant** | -5.377 | 0.100 | 0.005 | | |

Dialysis duration code: dialysis duration 6 months or less and dialysis duration of more than 6 months, CI: Confidence interval, Hb: hemoglobin, DM: diabetes mellitus, IHD: ischemic heart disease, ESA: erythropoiesis stimulating agents.

**Table (3b): Multiple regression analysis of predictors of mortality in the incident and prevalent HD patients.**

| | | B | Sig. | Odds Ratio | 95% C.I. | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Incident** | Age(years ) | 0.038 | 0.118 | 1.038 | 0.991 | 1.088 |
| | Pre session Bl. Urea (mg/dl) | -0.003 | 0.724 | 0.997 | 0.982 | 1.012 |
| | Serum phosphorus (mg/dl) | -0.161 | 0.480 | 0.852 | 0.545 | 1.330 |
| | Constant | -2.939 | 0.145 | 0.053 | | |
| **Prevalent** | Age(years) | 0.051 | 0.000 | 1.053 | 1.027 | 1.079 |
| | DM | -0.327 | 0.256 | 0.721 | 0.411 | 1.268 |
| | IHD | -0.315 | 0.247 | 0.730 | 0.428 | 1.244 |
| | Hb (gm/dl) | -0.063 | 0.350 | 0.939 | 0.822 | 1.072 |
| | Corrected Calcium(mg/dl) | 0.257 | 0.008 | 1.293 | 1.068 | 1.565 |
| | Constant | -6.502 | 0.000 | 0.002 | | |

CI: Confidence interval, Hb: hemoglobin, DM: diabetes mellitus, IHD: ischemic heart disease.

## 4. DISCUSSION

The two studied groups of patients were comparable regarding their age and gender. Similarly, they were not significantly different regarding their dry body weight or their blood pressure readings. This homogeneity might denote that these variables were not significant differential determinants of mortality in both groups. One would expect that the prevalent HD patients would be older than the new-comer patients, knowing that many of the former group had been on HD for many years, provided that most of them had started hemodialysis in a more or less similar age. However, having indifferent ages at the time of data collection implies that the new-comer

patients might have started hemodialysis at an older age than their corresponding prevalent patients; which could denote an increasing age at starting HD.

In the current study, we found significantly lower levels of Hb, but higher average ESA dose in the incident HD group. There were also significantly lower albumin and phosphorus in the incident than in the prevalent group, and serum creatinine was like wisely lower in the incident group, although it did not reach statistical significance. Two of the latter three variables could be considered as surrogates of nutritional status in the studied group, reflecting a relatively worse nutritional condition in the incident group. This observation might point to a possibility of substandard medical follow up of many of our predialytic patients, with inadequate management of anemia and poor nutritional supervision. Moreover, we have got an impression, during our experience in HD practice, that many patients in our locality were reluctant to be prepared by creating permanent vascular accesses at the appropriate time, and to start dialysis therapy in the due time. This could explain the lower Hb levels in the incident HD group, with consequent more need for erythropoietin therapy to correct the anemia and try to reach target Hb level. In harmony with these data, many previous studies reported significantly lower blood hemoglobin, and serum albumin, creatinine, and phosphorus levels in the incident than in the prevalent HD patients **[4], [18], [19]**.

The current work shows higher ferritin level in the prevalent group; a finding that is in harmony with that of a recent study **[19]**. The higher serum ferritin in the prevalent HD patients might be explained by time-dependent building up of several factors; namely inflammation **[20]**, and the use of IV iron therapy in HD patients that might supersede their therapeutic needs **[21]**, with possible reluctance to perform regular assessment of iron study.

The urea reduction ratio (URR) has long been considered by many nephrologists as a valid indicator of hemodialysis adequacy, although it is inferior to other more sophisticated markers. URR was routinely carried out to most of our patients and was found to be significantly higher in the prevalent group. A possible explanation of this is our adoption of published guidelines of starting hemodialysis by a low dose and gradually increasing the efficiency over the initial few weeks in order to preclude development of the dreadful dialysis disequilibrium **[22]**. This could possibly be translated into an overall lower average URR in the incident patients.

Hypertension in CKD and HD patients may develop de novo or may be due to several factors including volume overload, and erythropoietin-use **[23], [24]**. In our incident group, statistically significantly higher frequency of hypertension could be attributed to volume overload in the recently dialyzed patients whilst they

still have not yet achieved their dry body weights, and/or to higher ESA doses which were required for management of their lower Hb level. There was a higher frequency of patients with positive HCV-Abs in the prevalent than in the incident group; this is in agreement with previous publications reporting a higher number of HCV positive cases with longer HD vintage **[25], [26]**. Patients with hyperparathyroidism (PTH >700pg/ml) were more frequent in the prevalent group in our study than the incident one; an observation that might be attributable to the possible need of the PTH for longer time to reach such high level. This is in accordance with previous work that found higher PTH in their long-term dialysis patients **[4]**. Moreover, other studies found that PTH level correlated positively with the duration of hemodialysis **[27]**.

In the current study, the incident HD patients were inflicted with a mortality frequency of 14%, while the prevalent HD patients had a mortality frequency of only 9.6% during the eighteen-month observation period; a difference that was statistically significant. This finding parallels many previous studies that found that HD patients had the highest mortality during the first four months **[6]**, and especially during the first two months **[28], [4], [29], [30].**

The patients destined to mortality from both the incident and the prevalent groups were older than the survived patients in this study, taking into consideration that the age was recorded at the time of the start of the study. This finding is in accordance with other previous works **[31], [5]**. On the other hand, in the study of Robinson et al , **[30]** there was a gradual decline in mortality from the second to the sixth month following initiation of dialysis that was substantially greater among patients aged ≥65 years (53%) than in younger patients (~35%). A significantly lower phosphorus and higher pre-dialysis urea levels were found in the mortality patients of the incident group of our study; which is in harmony with previous work which reported that low phosphate level was associated with higher mortality; a relation that was proposed to be attributable to poor nutritional state **[32]** However, in the current study, higher pre-dialysis urea was encountered in the incident HD patients destined to mortality; a finding that argues against the concept of poor nutrition, and could otherwise be understood in the light of the common practice of initiating HD by lower efficiency and gradually increasing its adequacy in order to avoid the intolerance of the new-comer patients to the full efficient dialysis dose in initial sessions **[22]**. In the contrary, other reports found that an elevated serum phosphate level was associated with vascular calcification, and cardiovascular mortality in HD patients **[33]**. Similarly, Soleymanian et al, concluded that high serum PTH, calcium, and phosphorus levels had determined the mortality risk in hemodialysis patients **[34]**. In a different aspect of the relation to mortality, Zhao et al reported that mortality rate of the incident HD patients was more

among females, diabetics, and hypertensive, findings that disagree with our respective data of the incident group **[31]**.

On the other hand, the prevalent HD group destined to mortality in the current study had lower Hb level, higher corrected serum calcium level and higher frequencies of IHD and DM. This is in partial accordance with previous work, on patients treated by regular HD for more than six months, which showed relying on bivariate analyses that the mortality risk of HD was determined by age and low serum albumin level **[5]**.

In order to discern the most predictive variables for mortality in both the incident and prevalent HD groups we utilized a model of multiple logistic regression analysis including all logically associated variables ensued from bivariate analysis. In the incident HD group of our study, no single risk factor was revealed as an independent predictor for mortality. This might suggest that many risk factors could have been allied with mortality at the same time. It may also be possible that other factors, which unfortunately were not included in the study; e.g. the type of vascular access at initiation of HD and the efficiency of pre-dialysis medical service, could have acted as independent predictors of mortality, in case they were included in the analysis. In contrary to our results, a previous study found that hypoalbuminemia, diabetes mellitus, decreased frequency of dialysis, and low hemoglobin level were statistically significant predictors of mortality in ninety-day duration of HD **[35]**. To highlight the detrimental role of HD acute catheters, vascular access and its related complications were shown to be prominent risk factors for mortality in the early few months of HD **[4]**. In this respect, an Egyptian study showed that 6.6% of HD patients utilized catheter access; over 99.9% of HD patients used catheter access for HD at least once during their lifetime **[36]**.

In the current study, on the other hand, when associated variables were entered in the multiple logistic analysis of both the total and prevalent patient groups, only older age and higher corrected serum calcium level were found to be significant predictors of mortality. High serum calcium level might be thought of being related to hyperparathyroidism or to the use of oral calcium and active vitamin D to suppress the parathyroid gland, with consequent predisposition to more vascular calcification with high mortality risk. In a previous study on HD patients, irrespective of the duration of dialysis, it was found that high serum calcium, low serum phosphorus, and high and low PTH levels were associated with increased mortality **[37]**. Another study reported that hypercalcemia had greater mortality risk than hypocalcemia. **[38]**. Additionally, another study reported that both low and high serum calcium levels were related to increased mortality **[39]**. However, other researchers concluded that the relative risk of death was associated with being outside the targets for Kt/V, hemoglobin and

the parathyroid hormone **[40]**; variables that were not found to be significant predictors of mortality in the current study.

## 5. CONCLUSION

In conclusion, the mortality risk is higher during the early 6 months following HD initiation and mortality in both early and late HD patients is associated with older age, lower phosphorus, and lower hemoglobin levels, respectively, while higher corrected serum calcium and age were significant predictors of mortality in the prevalent HD group This may highlight a possible survival advantage of adequate anemia management and good nutrition during the pre-dialysis and early dialysis periods and adequate CKD-MBD management in long-term dialysis.

### Informed consent

Informed consent was obtained verbally from each study participant.

Ethical Committee Approval: Depending on Egyptian minister of health and population decree #95/year 2005 for Health Research and decree #539/year 2016 – ICH – Good Clinical Practice, Declaration of Helsinki and World Health Organization Guidelines, the Ethics Committee meet in the Central Directorate of Research and Health Development and review: Differences between the incident and prevalent hemodialysis patients in Egypt. The approval number is Com. No/Dec. No: 11-2017/ 27
Moreover, Verbal consent was taken from all the participants.

### COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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