

CHAPTER 7

NUTRITIONAL STATUS ON DIALYSIS

Winnie Chee Siew Swee
Abdul Halim B Abd Gafor
Ahmad Fauzi B Abd Rahman
Koh Keng Hee
Tilakavati Karupaiah

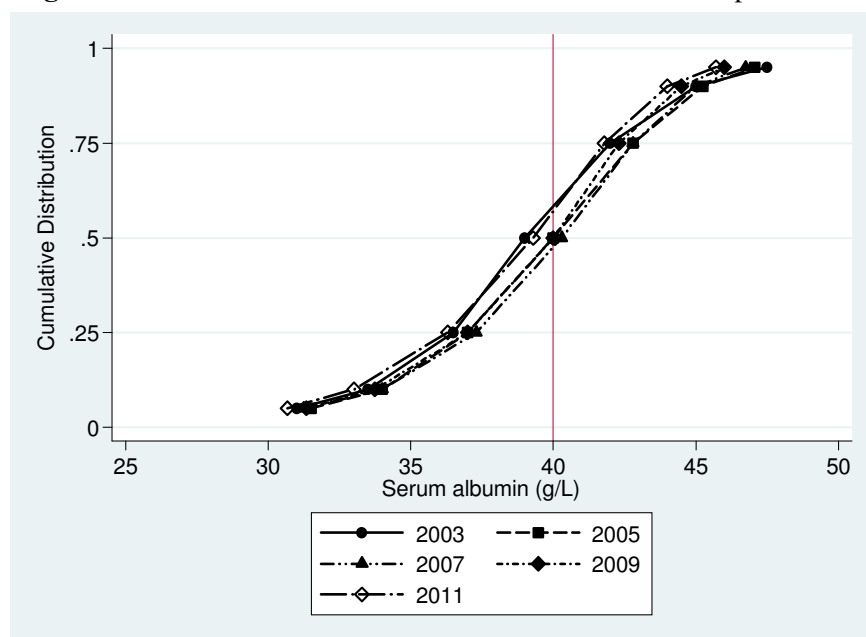
SECTION 7.1: SERUM ALBUMIN LEVELS ON DIALYSIS

For HD patients, mean serum albumin levels in 2011 of 38.7 g/L, and the median serum albumin levels of 39 g/L was still below the desired level of ≥ 40 g/L. The mean had dropped gradually in year 2005 - 2010 by about 0.2 g/L/year. The percentage of patients with very low serum albumin of <30 g/L had remained the same as year 2010 while patients with desirable serum albumin of ≥ 40 g/L had dropped by 1% compared to 2010. The albumin level of HD patients had improved slightly in from 2003 to 2005, but it declined slightly from 2007 to 2011. (Figure 7.1.1)

Table 7.1.1: Distribution of serum albumin, HD patients, 2002-2011

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <30 g/L	% patients 30- <35 g/L	% patients 35- <40 g/L	% patients ≥ 40 g/L
2002	5568	39.2	5.6	39	36.5	42	3	12	42	43
2003	6524	39.9	5.4	40	37.3	42.5	3	9	35	52
2004	7581	39.9	5.3	40	37	42.8	3	10	34	53
2005	8706	40	5.2	40.3	37.5	42.8	3	9	33	56
2006	10928	39.8	5.4	40.3	37.3	42.8	3	10	33	54
2007	12315	39.7	5.3	40	37	42.5	3	10	35	52
2008	14548	39.4	5.1	40	37	42.3	3	10	36	50
2009	16940	39.4	5.1	40	37	42.3	3	11	35	51
2010	18757	38.9	4.9	39.3	36.3	41.8	4	13	40	44
2011	21793	38.7	4.9	39	36.3	41.5	4	13	41	43

Figure 7.1.1: Cumulative distribution of serum albumin, HD patients 2002-2011

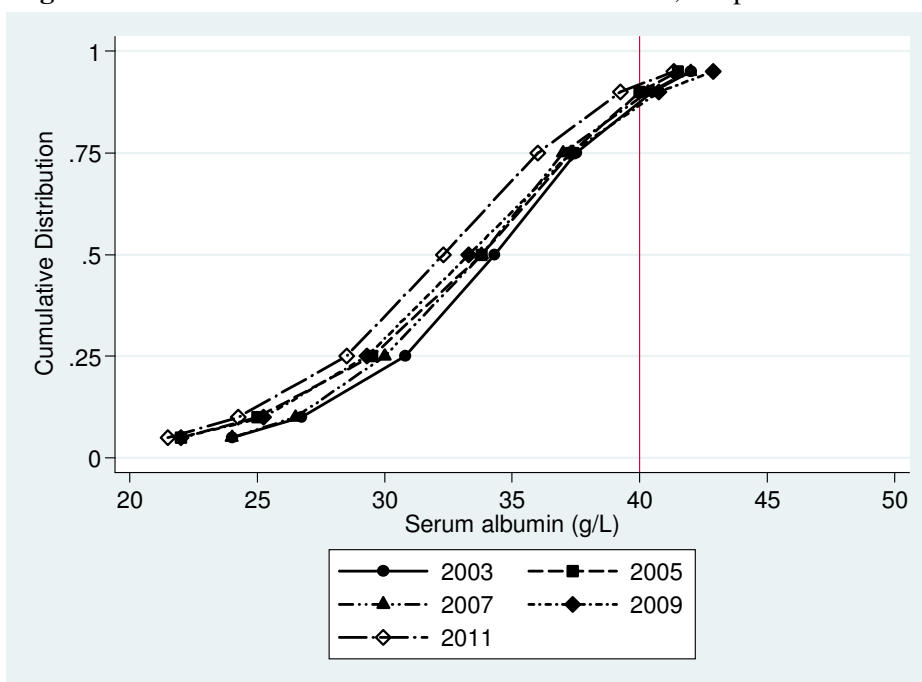


In PD patients, the mean serum albumin levels showed downward trend, from 33.9 g/L in 2002 to 31.9 g/L in 2011 (Table 7.1.2). The percentage of patients with unsatisfactory serum albumin (<30 g/L) increased by 2% from 2010 to 2011, and more than one-third of CAPD patients has poor albumin level. On the other hand, the percentage of patients with good serum albumin levels (≥ 40 g/L) maintained at 8%, same as in 2010. The cumulative distribution graph (Figure 7.1.2) showed the serum albumin trend had deteriorated gradually since 2003.

Table 7.1.2: Distribution of serum albumin, PD patients, 2002-2011

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥ 40 g/L
2002	862	33.9	5.9	34.3	30.8	37.5	21	35	33	12
2003	1180	33.3	5.8	33.8	29.7	37.3	26	33	30	11
2004	1284	33	6	33.8	29.5	37.3	27	32	30	11
2005	1346	33.2	6.4	33.3	29.5	37	27	33	30	10
2006	1498	33.5	6.1	33.8	30	37	25	33	30	12
2007	1753	33.6	6.2	34	30	37.8	25	31	30	14
2008	2021	33.1	6.4	33.3	29.3	37.3	28	32	27	13
2009	2138	32.7	6.4	33	29	36.8	30	34	25	11
2010	2305	32.1	6.2	32.3	28.5	36	33	35	24	8
2011	2523	31.9	6	32	28.3	36	35	34	23	8

Figure 7.1.2: Cumulative distribution of serum albumin, PD patients 2002-2011



From year 2003 to 2009, more than half of the HD centres achieved proportion of HD patients >50% with albumin level ≥ 40 g/L. After 2009, the median proportion of patients achieving ≥ 40 g/L albumin have decreased further from 44% in 2010 to 43% in 2011. Figure 7.1.3. showed a wide variation amongst 496 HD centers reporting the proportion of patients able to achieve the target serum albumin ≥ 40 g/L for the year 2011.

Table 7.1.3: Proportion of patients with serum albumin ≥ 40 g/L among HD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	143	0	10	25	43	62	85	100
2003	172	0	18	39	54	70	92	100
2004	203	4	12	36	58	73	87	100
2005	233	4	11	42	57	68	86	100
2006	278	0	11	37	54	71	87	96
2007	315	0	12	36	54	68	85	100
2008	364	0	7	35	50	66.5	83	100
2009	400	0	8	36	53	67	82.5	100
2010	440	0	6	25	44	60	80	96
2011	496	0	5	26	43	57	76	100

Figure 7.1.3: Variation in proportion of patients with serum albumin ≥ 40 g/L, HD centres 2011

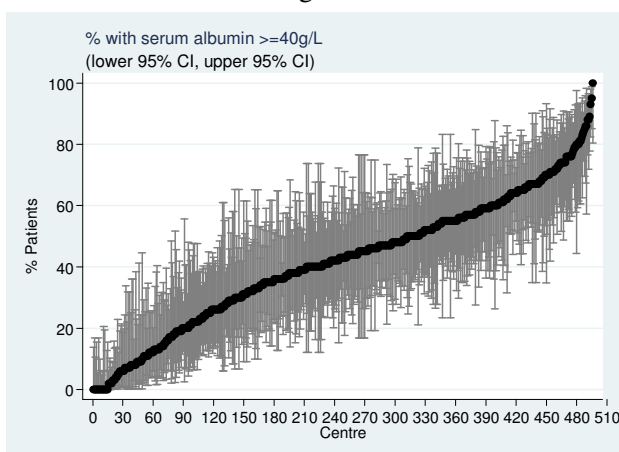


Figure 7.1.4: Variation in proportion of patients with serum albumin ≥ 40 g/L, PD centres 2011

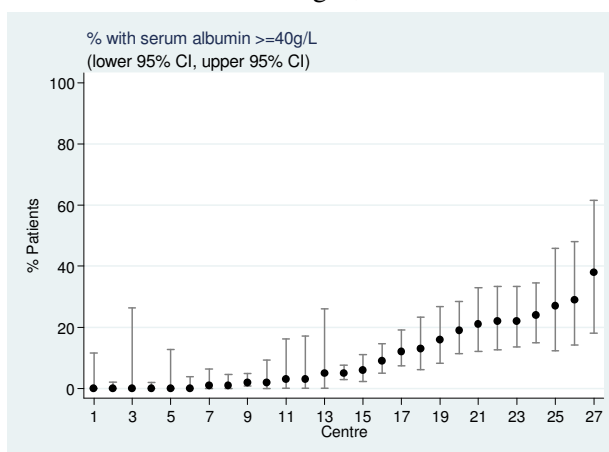


Table 7.1.4 showed that for 27 PD centers in 2011, all centers reported achieving less than 40 g/L in at least half of their patients (max 38%). However, about a quarter of PD centres (UQ) were able to achieve slightly better nutrition with at least 20% of the patients with albumin ≥ 40 g/L. The similar trend were shown in Figure 7.1.4

Table 7.1.4: Proportion of patients with serum albumin ≥ 40 g/L among PD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	15	5	5	6	10	24	36	36
2003	18	1	1	8	14	19	58	58
2004	18	2	2	8	14	21	35	35
2005	19	1	1	7	14	23	29	29
2006	22	1	1	6	12.5	22	42	72
2007	22	0	1	11	14	21	36	62
2008	23	0	1	4	15	25	41	53
2009	24	0	0	6	14	21	35	37
2010	25	0	0	2	9	14	30	31
2011	27	0	0	1	5	21	29	38

SECTION 7.2: BODY MASS INDEX (BMI) ON DIALYSIS

Table 7.2.1 showed the mean BMI for HD patients from year 2002 to 2011. For the year 2011 the mean BMI was 24.1 kg/m². An increasing trend of higher BMI was observed for HD patients, with the percentage of HD patients with BMI ≥25 increased from 24% in 2002 to 35% in 2011. The percentage of patients with BMI <18.5 was stable at 12% similar to 2010. Figure 7.2.1 showed the graph for 2011 shifted to the right, indicating the increased trend in BMI.

Table 7.2.1: Distribution of BMI, HD patients, 2002-2011

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients ≥25
2002	5104	23.2	10.6	22	19.5	24.9	16	59	24
2003	5990	23.1	9.7	22.1	19.5	25.1	16	58	26
2004	6776	23.3	9	22.4	19.8	25.4	14	58	28
2005	7837	23.4	9	22.5	19.8	25.6	14	57	29
2006	9793	23.3	7.9	22.6	19.9	25.7	14	56	29
2007	10514	23.4	7.9	22.7	19.9	25.8	14	56	30
2008	12222	23.5	7.5	22.8	20.1	26	13	55	31
2009	13721	23.8	8.2	23	20.1	26.2	13	54	33
2010	14694	24	7.8	23.2	20.3	26.5	12	53	35
2011	16496	24.1	8.7	23.3	20.4	26.5	12	53	35

Figure 7.2.1: Cumulative distribution of BMI, HD patients 2002-2011

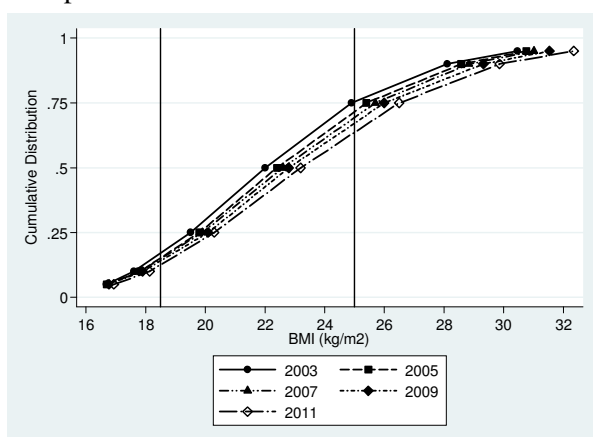


Figure 7.2.2: Cumulative distribution of BMI, PD patients 2002-2011

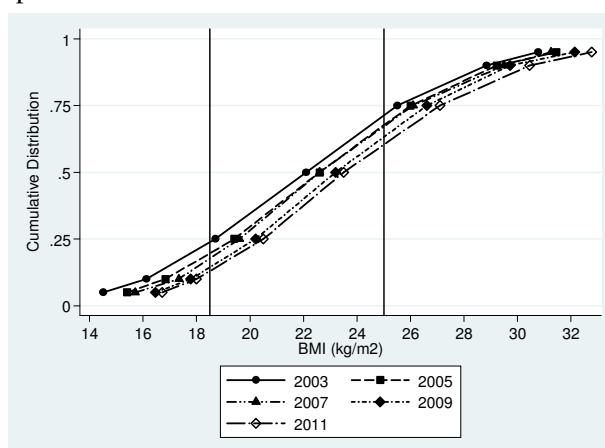


Table 7.2.2. showed that mean BMI for PD patients from 2002 to 2011 is increasing from 22.2 to 24.2. The percentage of PD patients with BMI ≥25 increased from 30% in 2002 to 38% in 2011. The shifting of the cumulative distribution curve for 2011 to the right reflects the small increases in BMI compared to the previous years. (Figure 7.2.2)

Table 7.2.2: Distribution of BMI, PD patients 2002-2011

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients ≥25
2002	751	22.2	5.1	22.1	18.7	25.5	24	47	30
2003	1071	22.8	6.9	22.5	19.2	25.8	20	50	30
2004	1175	23.1	7.3	22.6	19.4	26	19	50	31
2005	1223	23	7.2	22.5	19.3	25.8	20	50	30
2006	1420	23.3	8.3	22.6	19.6	26.1	16	50	33
2007	1616	23.4	5.9	22.9	19.9	26.3	15	51	34
2008	1872	23.8	7.7	23.2	20.2	26.6	14	50	36
2009	1944	24.1	8.5	23.4	20.4	26.8	13	50	38
2010	2050	24.5	10.2	23.5	20.5	27.1	13	49	39
2011	2223	24.2	8.8	23.5	20.3	27	13	49	38

The HD centres with proportion of patients with BMI ≥ 18.5 for year 2002-2011 was shown in Table 7.2.3. The median for HD centers achieving the BMI target was 89% for the year 2011 and this positive trend continued from the previous years. Figure 7.2.3 showed variation amongst 429 HD centers in the proportion of patients achieved the target BMI ≥ 18.5 for the year 2011.

Table 7.2.3: Proportion of patients with BMI ≥ 18.5 among HD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	133	55	67	79	85	89	100	100
2003	159	62	70	79	84	91	100	100
2004	189	60	70	82	87	92	100	100
2005	208	60	70	80	88	93	100	100
2006	259	53	70	80	86	92	100	100
2007	279	62	70	81	87	92	100	100
2008	328	59	71	82	88	93	100	100
2009	359	63	74	82	88	93	100	100
2010	388	31	74	84	89	93.5	100	100
2011	429	57	75	84	89	94	100	100

Figure 7.2.3: Variation in proportion of patients with BMI ≥ 18.5 among HD centres 2011

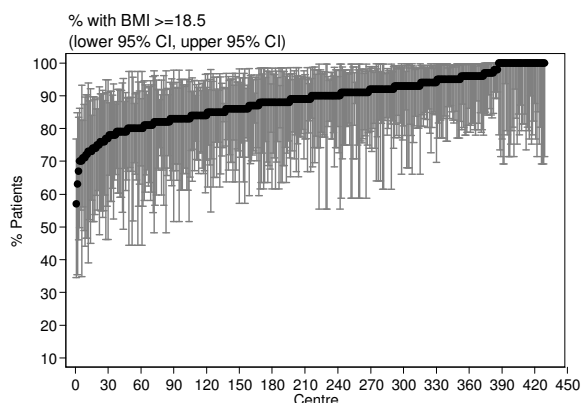
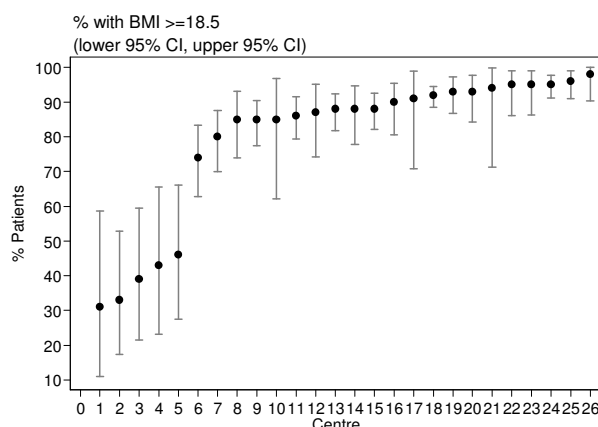


Figure 7.2.4: Variation in proportion of patients with BMI ≥ 18.5 among PD centres 2011



In year 2011 among the 26 PD centers, the centre maximum proportion of patients achieving the target BMI ≥ 18.5 was 98% whilst the worst centre reported 31% of their patients achieving this target. Figure 7.2.4 showed that 5 centers reported $<50\%$ of their patients achieving the target BMI ≥ 18.5 whilst 21 centers reported higher proportions ($>75\%$) meeting the target.

Table 7.2.4: Proportion of patients with BMI ≥ 18.5 among PD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	14	20	20	73	81.5	85	87	87
2003	18	18	18	74	80.5	88	96	96
2004	18	28	28	73	81.5	89	94	94
2005	18	17	17	70	83.5	87	91	91
2006	22	13	20	78	84	91	92	92
2007	22	15	18	76	87	91	97	100
2008	22	17	27	78	87.5	91	96	100
2009	22	35	38	80	90.5	93	95	97
2010	23	40	42	77	89	93	98	98
2011	26	31	33	80	88	93	96	98

Table and Figure 7.2.5 showed a wide variation in the nutritional status of patients at 417 HD centers. There was a wide inter-centile variation of 70% between the 5th and 95th centile of patients with BMI >18.5 and serum albumin of more >40 g/dL. There were some HD centres who reported more than 90% of their patients achieving with BMI >18.5 and serum albumin of more >40 g/dL. There was a decreasing trend in centres with severely malnourished patients.

Table 7.2.5: Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among HD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	125	0	7	26	36	54	73	100
2003	149	0	18	35	48	61	77	100
2004	182	0	11	35	52	64	80	100
2005	196	3	13	38	51	62	80	90
2006	244	0	11	33	47	62.5	80	92
2007	271	0	9	33	48	61	74	92
2008	311	0	8	31	47	60	76	92
2009	351	0	7	32	47	62	76	92
2010	380	0	1.5	23	41	57	72	91
2011	417	0	2	26	40	54	72	100

Figure 7.2.5: Variation in proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among HD centres 2011

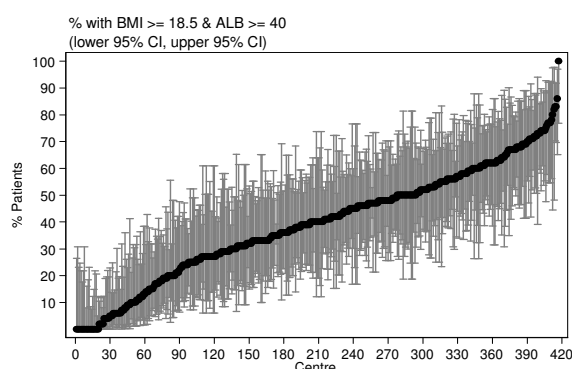


Figure 7.2.6: Variation in proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among PD centres 2011

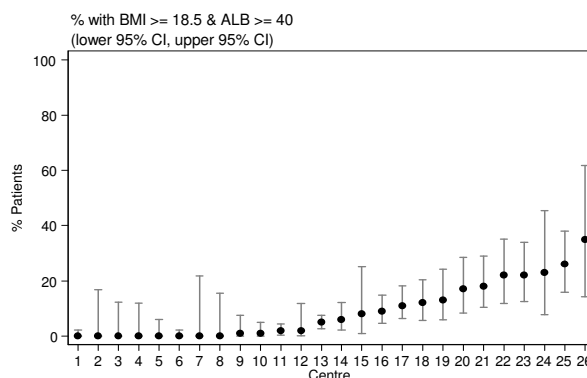


Table 7.2.6 and Figure 7.2.6 showed a wide variation in the nutritional status of patients at 26 PD centers. All 26 centers reported less than 40% of their patients meeting the criteria of BMI ≥18.5 and serum albumin ≥40 g/dL. Nevertheless, there is an increasing trend in improvement of nutritional status is observed with these centres.

Table 7.2.6: Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among PD centres 2002-2011

Year	Number of centers	Min	5 th centile	LQ	Median	UQ	95 th centile	Max
2002	14	0	0	4	10.5	18	36	36
2003	18	0	0	4	10	16	46	46
2004	18	1	1	5	10.5	16	36	36
2005	18	0	0	4	8.5	17	26	26
2006	22	0	0	4	9.5	15	20	57
2007	22	0	1	5	11.5	19	37	57
2008	22	0	1	4	10	19	26	45
2009	22	0	0	5	11	20	29	34
2010	23	0	0	2	8	13	23	24
2011	26	0	0	0	5.5	17	26	35

SECTION 7.3: NUTRITIONAL PARAMETERS

Table 7.3.1: Nutritional parameters between HD (n=22,740) and PD (n=2,612) patients, 2011

	HD		PD	
	Mean	SD	Mean	SD
Age	55.4	13.7	49.3	18.3
Albumin (g/dL)	38.7	4.9	31.9	6.0
BMI	24.1	8.7	24.2	8.8
Cholesterol (mmol/L)	4.5	1.1	5.1	1.3
SrCreatinine (mg/dL)	820.1	242.1	858.7	323.2
Hemoglobin	10.4	1.6	10.4	1.6

HD cohort seemed to be older (~6 yrs) and had better serum albumin (by 6g/dL) compared to PD cohort. On the other hand, serum total cholesterol (~0.6mmol/L) was higher in PD cohort. Both cohorts were comparable in serum creatinine, hemoglobin levels and BMI. (Table 7.3.1)

In the HD cohorts, the diabetic patients seemed to be younger (by 8 years) and with lower BMI (by 1) compared to the non-diabetic patients. Serum creatinine was higher in the diabetic group (by 128mg/dL). [(Table 7.3.2(a))

In the PD cohort, diabetic patients were noted to be younger (by ~15yrs) and had lower BMI (~1.6) compared to non diabetic PD patients. Diabetic patients also had higher serum albumin (~2g/dL) and higher serum creatinine (by ~150mg/dL) levels. [(Table 7.3.2 (b))

Table 7.3.2(a): Nutritional parameters between diabetic (n=10,523) and non-diabetic (n=11,773) HD patients, 2011

	Diabetes		Non-Diabetes	
	Mean	SD	Mean	SD
Age	51.6	15.0	59.7	10.6
Albumin (g/dL)	39.4	4.9	38.2	4.8
BMI	23.2	8.7	25.2	8.5
Cholesterol (mmol/L)	4.5	1.0	4.4	1.1
SrCreatinine (mg/dL)	878.0	245.9	750.6	216.9
Hemoglobin	10.5	1.6	10.3	1.6

Table 7.3.2(b): Nutritional parameters between diabetic (n=840) and non-diabetic (n=1,711) PD patients, 2011

	Diabetes		Non-Diabetes	
	Mean	SD	Mean	SD
Age	44.3	19.0	59.4	11.0
Albumin (g/dL)	32.6	5.9	30.5	6.0
BMI	23.4	7.8	26.0	10.5
Cholesterol (mmol/L)	5.2	1.3	5.0	1.3
SrCreatinine (mg/dL)	908.2	332.1	742.1	269.1
Hemoglobin	10.3	1.6	10.6	1.5

Table 7.3.3(a): Distribution of serum albumin and BMI by duration of dialysis among HD patients, 2002-2011

Years	<1		1-<5		5-<10		≥10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Albumin (g/dL)	36.3	5.6	39.1	4.0	40.3	3.3	40.5	3.0
BMI	24.3	10.5	24.5	8.1	23.8	6.9	22.6	10.6

Better serum albumin were noted in both HD and PD patients who survived the longest duration of dialysis treatment. This observation was probably due to better nutritional status in those who survived the longest. [(Table 7.3.3 (a) & (b)).

Table 7.3.3(b): Distribution of serum albumin and BMI by duration of dialysis among PD patients, 2002-2011

Years	<1		1-<5		5-<10		≥10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Albumin (g/dL)	31.6	6.3	32.8	5.3	34.9	3.8	34.5	3.9
BMI	23.9	5.2	24.6	11.2	23.2	4.6	21.2	3.5