

Chapter - 7

**NUTRITIONAL STATUS ON DIALYSIS**

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### SECTION 7.1: SERUM ALBUMIN LEVELS ON DIALYSIS

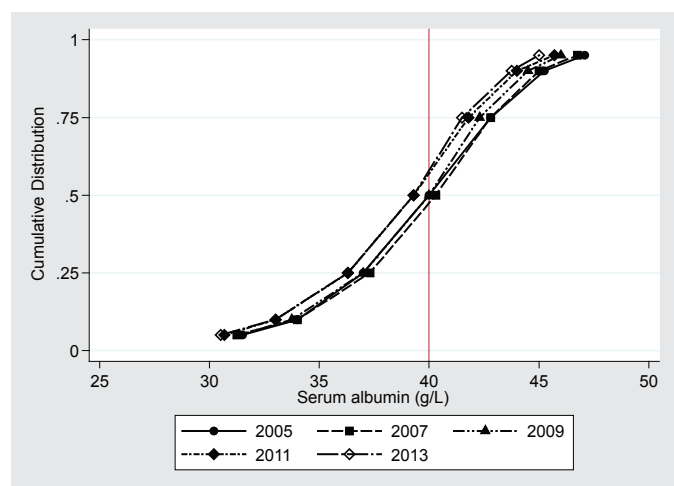
The mean serum albumin level in HD patients in the year 2013 was 38.6 ± 4.9 g/L. The percentage of patients with low serum albumin of <30g/L has remained the same but the percentage of patients with desirable serum albumin of ≥ 40 g/L had reduced gradually over 10 years since 2004 (Table 7.1.1). Overall, the proportion of patients with serum albumin ≥ 40g/L showed a decreasing trend from 53 to 41% from the year 2004 to 2013.

Cumulative distribution trends of serum albumin for HD patients from 2004 to 2013 supported this observation (Figure 7.1.1).

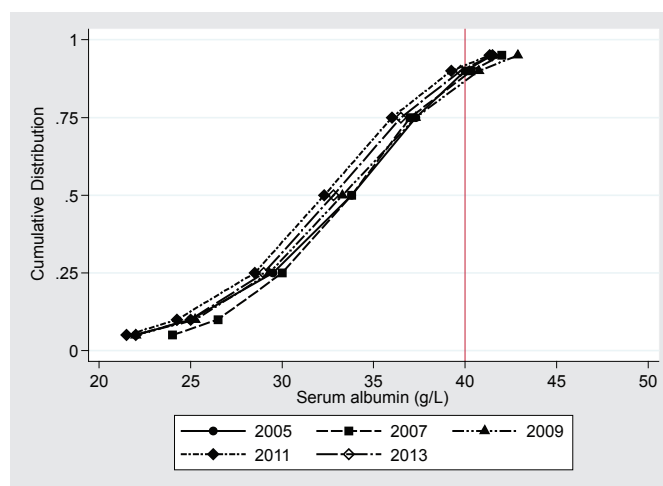
**Table 7.1.1:** Distribution of serum albumin, HD patients, 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (g/L)			
							<30	30-<35	35-<40	≥40
2004	7580	39.9	5.3	40	37	42.8	3	10	34	53
2005	8705	40	5.2	40.3	37.5	42.8	3	9	33	56
2006	10927	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	14551	39.4	5.1	40	37	42.3	3	10	36	50
2009	16948	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	21360	38.8	4.9	39.3	36.5	41.5	4	12	41	43
2012	24531	38.8	5	39.3	36.3	41.5	4	13	41	43
2013	27614	38.6	4.9	39	36	41.5	4	13	42	41

**Figure 7.1.1:** Cumulative distribution of serum albumin, HD patients 2004-2013



**Figure 7.1.2:** Cumulative distribution of serum albumin, PD patients 2004-2013



Serum albumin showed a steady and gradual improvement in PD patients since 2010. Percentage of patients with unsatisfactory serum albumin (<30g/L) dropped to 29% while the percentage of patients with good serum albumin levels of ≥ 40g/L increased to 12% in 2013. Cumulative distribution trends of serum albumin for PD patients from 2004 to 2013 supported this observation (Figure 7.1.2).

**Table 7.1.2:** Distribution of serum albumin, PD patients, 2004-2013

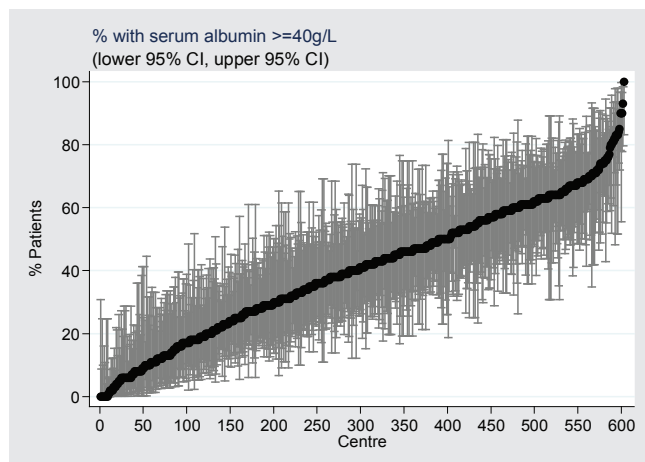
Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients (g/L)			
							<30	30-<35	35-<40	≥40
2004	1284	33	6	33.8	29.5	37.3	27	32	30	11
2005	1346	33.2	6.4	33.3	29.5	37	27	33	30	10
2006	1498	33.5	6.1	33.8	30	37	25	33	30	12
2007	1753	33.6	6.2	34	30	37.8	25	31	30	14
2008	2021	33.1	6.4	33.3	29.3	37.3	28	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	2465	31.9	6	32	28.3	36	35	34	23	8
2012	2801	32.6	6.5	32.8	29	36.5	31	33	27	10
2013	3173	33	6.6	33.3	29	37.3	29	31	28	12

As expected, there was a wide variation in serum albumin among the 603 HD centres in 2013 (Table 7.1.3). Half of the HD centres achieved 41% of their HD patients with albumin level ≥40g/L. The median percentage of HD patients with albumin level ≥40 g/L had rapidly deteriorated from 44% in 2012 to 41% in 2013 (Figure 7.1.3).

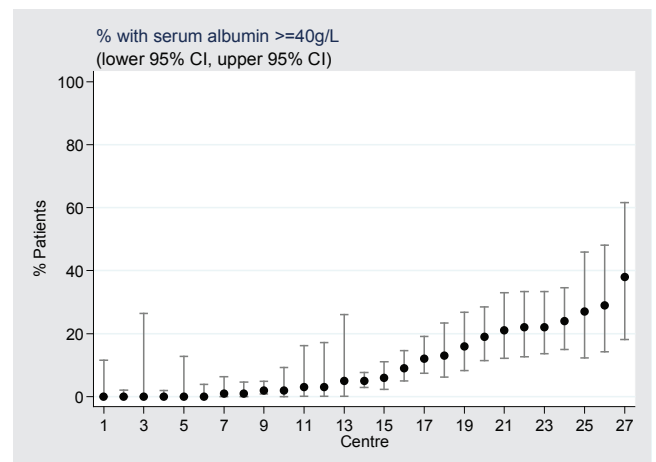
**Table 7.1.3:** Variation in proportion of patients with serum albumin ≥40g/L among HD centres 2004-2013

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	203	0	11	36	59	73	88	100
2005	230	0	11	42	56	68	85	97
2006	276	0	13	37.5	53	72	87	96
2007	312	0	12	36	52	67.5	85	100
2008	362	0	8	35	50	67	82	100
2009	413	0	9	36	53	66	83	100
2010	444	0	7	27	44	59	79	100
2011	505	0	6	29	44	57	76	94
2012	549	0	6	26	44	58	76	96
2013	603	0	6	24	41	57	72	100

**Figure 7.1.3:** Variation in proportion of patients with serum albumin ≥40g/L, HD centres 2013



**Figure 7.1.4:** Variation in proportion of patients with serum albumin ≥40g/L, PD centres 2013



There were 28 PD centres for the year 2013. Only half of the PD centres achieved 8% of their PD patients with serum albumin level  $\geq 40\text{g/L}$  (Figure 7.1.4).

**Table 7.1.4:** Variation in proportion of patients with serum albumin  $\geq 40\text{g/L}$  among PD centres 2004-2013

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	18	2	2	8	15.5	21	35	35
2005	19	1	1	6	14	23	29	29
2006	22	1	1	6	12.5	22	42	70
2007	22	0	1	12	14	21	36	61
2008	24	0	1	4.5	15	24	41	51
2009	25	0	0	6	14	23	35	37
2010	26	0	0	2	9	15	30	33
2011	27	0	0	0	5	21	30	38
2012	28	0	0	3	9.5	20	33	37
2013	28	0	0	3	8	23.5	32	40

### SECTION 7.2: BODY MASS INDEX (BMI) ON DIALYSIS

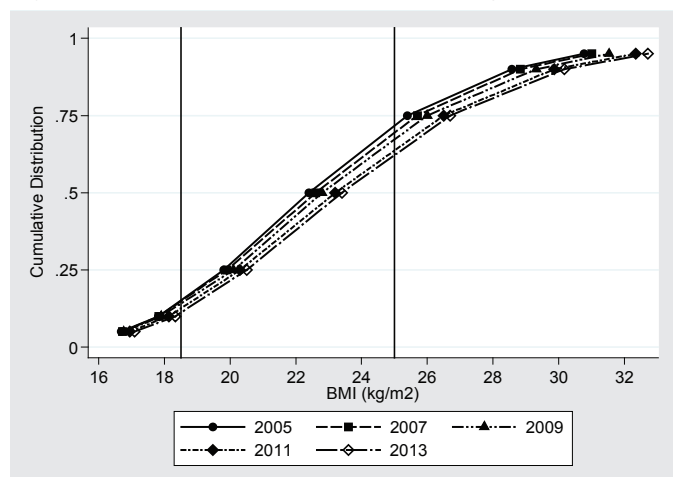
The mean BMI for HD patients in 2013 was  $24.5 \pm 9.1 \text{ kg/m}^2$ . An increasing trend of BMI was observed for HD patients, with the percentage of HD patients with BMI  $\geq 25$  increasing from 28% in 2004 to 38% in 2013. The percentage of patients with BMI  $< 18.5$  reduced from 14% in 2004 to 11% in 2013 (Table 7.2.1)

Figures 7.2.1 reflect the increasing BMI trend in HD patients as the curve for 2013 continues moving to the right.

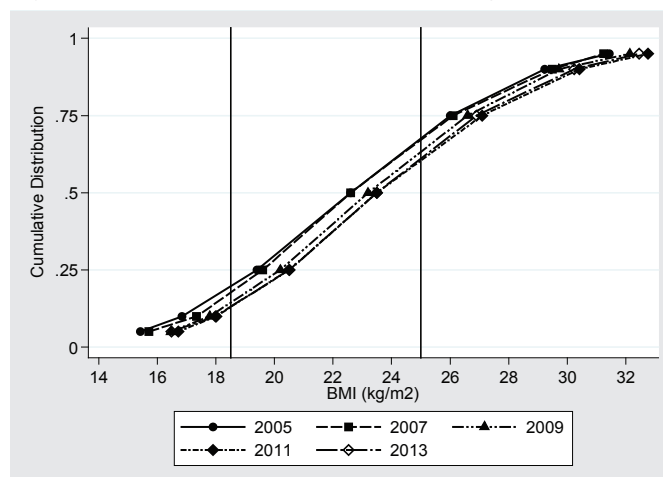
**Table 7.2.1:** Distribution of BMI, HD patients, 2004-2013

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients		
							<18.5	18.5-25	$\geq 25$
2004	6775	23.3	9	22.4	19.8	25.4	14	58	28
2005	7836	23.4	9	22.5	19.8	25.6	14	57	29
2006	9792	23.3	7.9	22.6	19.9	25.7	14	56	29
2007	10516	23.4	7.9	22.7	19.9	25.8	14	56	30
2008	12232	23.5	7.5	22.8	20.1	26	13	55	31
2009	13747	23.8	8.2	23	20.1	26.2	13	54	33
2010	14714	23.9	7.8	23.2	20.3	26.5	12	53	35
2011	16457	24.1	8.7	23.3	20.4	26.5	12	53	35
2012	18330	24.3	8.4	23.4	20.5	26.7	11	52	37
2013	19491	24.5	9.1	23.5	20.6	26.9	11	51	38

**Figure 7.2.1:** Cumulative distribution of BMI, HD patients 2004-2013



**Figure 7.2.2:** Cumulative distribution of BMI, PD patients 2004-2013



The mean BMI for PD patients in 2013 was  $24.2 \pm 7.1$  kg/m<sup>2</sup>. Similar to HD patients, the percentage of PD patients with BMI  $\geq 25$  increased from 31% in 2004 to 38% in 2013. The percentage of patients with BMI  $< 18.5$  kg/m<sup>2</sup> reduced from 19% in 2004 to 14% in 2013 (Table 7.2.2). The shifting of the cumulative distribution curve for 2013 was to the right (Figure 7.2.2).

**Table 7.2.2:** Distribution of BMI, PD patients 2004-2013

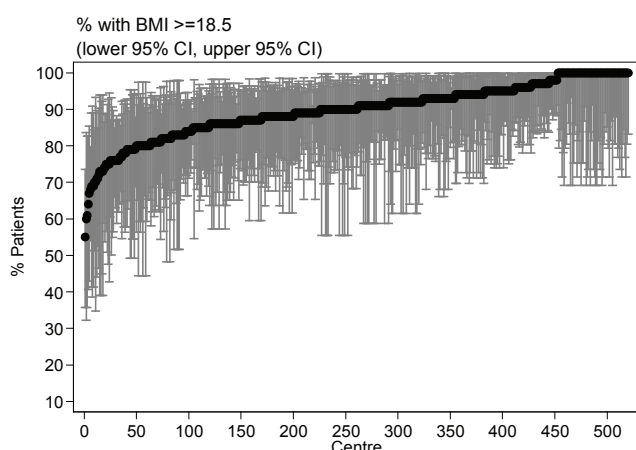
Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients		
							<18.5	18.5-25	$\geq 25$
2004	1175	23.1	7.3	22.6	19.4	26	19	50	31
2005	1223	23	7.2	22.5	19.3	25.8	20	50	30
2006	1420	23.3	8.3	22.6	19.6	26.1	16	50	33
2007	1617	23.4	5.9	22.9	19.9	26.3	15	51	34
2008	1874	23.7	5.9	23.2	20.2	26.6	14	50	36
2009	1946	24	7.1	23.4	20.4	26.8	13	50	38
2010	2051	24.4	8.8	23.5	20.5	27.1	13	49	39
2011	2177	24.1	7.8	23.6	20.3	27	13	49	38
2012	2212	24.1	6.8	23.5	20.5	26.9	13	49	38
2013	1822	24.2	7.1	23.5	20.5	26.9	14	48	38

The variation in HD centres with proportion of patients with BMI  $\geq 18.5$ kg/m<sup>2</sup> for 2013 is given in Table 7.2.3. Half of the HD centers achieved 90% of their patients with BMI  $\geq 18.5$  kg/m<sup>2</sup>.

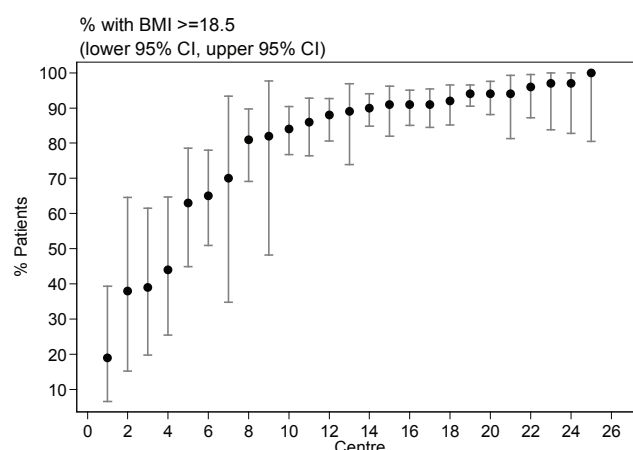
**Table 7.2.3:** Variation in proportion of patients with BMI  $\geq 18.5$ kg/m<sup>2</sup> among HD centres 2004-2013

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	193	60	70	82	87	92	100	100
2005	204	58	70	80	87	93	100	100
2006	257	50	69	80	86	92	100	100
2007	278	50	70	81	87	92	100	100
2008	321	40	72	82	87	93	100	100
2009	356	55	74	81	88	93	100	100
2010	384	55	74	83	89	94	100	100
2011	429	59	75	84	90	94	100	100
2012	478	64	77	85	91	94	100	100
2013	520	55	76	86	90	95	100	100

**Figure 7.2.3:** Variation in proportion of patients with BMI  $\geq 18.5$ kg/m<sup>2</sup> among HD centres 2013



**Figure 7.2.4:** Variation in proportion of patients with BMI  $\geq 18.5$ kg/m<sup>2</sup> among PD centres 2013



The variation in PD centres with proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  for 2013 is given in Table 7.2.4. Half of the PD centers achieved 89% of their patients with BMI  $\geq 18.5\text{ kg/m}^2$ . There was a positive trend compared to the year 2012.

**Table 7.2.4:** Variation in proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  among PD centres 2004-2013

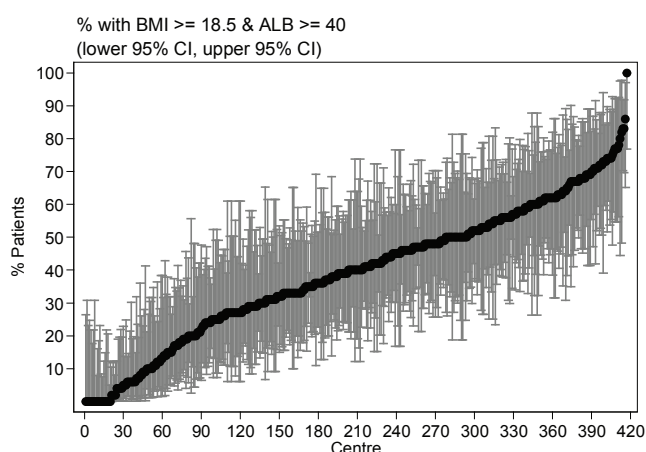
Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	18	28	28	73	83	89	94	94
2005	18	17	17	68	83.5	87	90	90
2006	22	14	20	78	84	91	92	92
2007	22	16	18	76	86.5	91	97	100
2008	22	17	27	78	88.5	91	95	100
2009	22	33	35	80	89	93	95	97
2010	24	35	35	80.5	89	94	98	100
2011	26	26	31	80	88	93	96	98
2012	24	30	33	75.5	86.5	92.5	97	100
2013	25	19	38	70	89	94	97	100

Table 7.2.5 indicated a wide variation in the nutritional status of patients in 498 HD centres. Half of the centres achieved the combined nutritional status targets (serum albumin  $\geq 40\text{ g/dL}$  and BMI  $\geq 18.5\text{kg/m}^2$ ) in 39% of their patients. A trend of lower nutritional status in most centres was observed.

**Table 7.2.5:** Variation in proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  and serum albumin  $\geq 40\text{ g/dL}$  among HD centres 2004-2013

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	185	0	9	34	50	64	79	100
2005	197	0	13	37	50	62	80	90
2006	242	0	11	33	45.5	63	79	91
2007	269	0	9	32	47	60	72	100
2008	308	0	8	31	46	59	76	92
2009	350	0	7	33	47	60	75	100
2010	371	0	6	25	41	57	73	100
2011	415	0	5	26	40	55	71	92
2012	467	0	5	24	40	55	71	90
2013	498	0	4	23	39	53	72	94

**Figure 7.2.5:** Variation in proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  and serum albumin  $\geq 40\text{ g/dL}$  among HD centres 2013



**Figure 7.2.6:** Variation in proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  and serum albumin  $\geq 40\text{ g/dL}$  among PD centres 2013

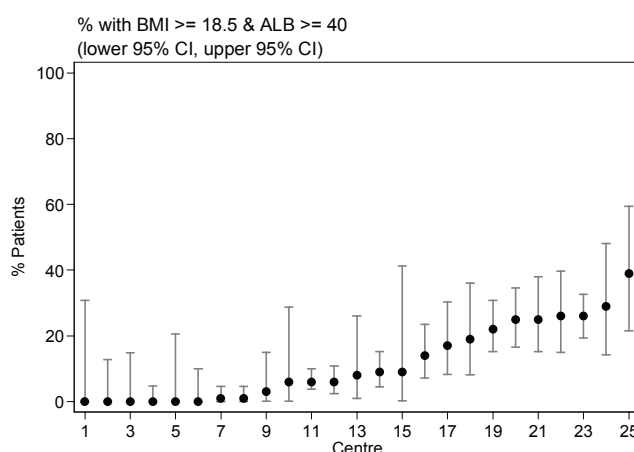


Table 7.2.6 indicated a wide variation in the nutritional status of patients in 25 PD centres as assessed by BMI  $\geq 18.5\text{kg/m}^2$  and serum albumin  $\geq 40$  g/dL. Half of these centres achieved the combined nutritional status targets in only 8% of their patients. As in 2013, none of the 25 PD centres had 50% of their patients achieved the combined nutritional status targets in 2013 (Figure 7.2.6).

**Table 7.2.6:** Variation in proportion of patients with BMI  $\geq 18.5\text{kg/m}^2$  and serum albumin  $\geq 40$  g/dL among PD centres 2004-2013

Year	Number of centres	Min	5 <sup>th</sup> Centile	LQ	Median	UQ	95 <sup>th</sup> Centile	Max
2004	18	1	1	5	10	16	36	36
2005	18	0	0	4	8.5	17	26	26
2006	22	0	0	4	9.5	15	20	52
2007	22	0	1	5	12.5	19	37	54
2008	22	0	1	3	10	19	26	43
2009	22	0	0	5	11.5	17	31	34
2010	24	0	0	2	6.5	14	23	24
2011	26	0	0	0	6	14	25	35
2012	24	0	0	2	7	14	26	38
2013	25	0	0	1	8	22	29	39

### SECTION 7.3: NUTRITIONAL PARAMETERS

HD patients were older and had better serum albumin compared to PD patients. On the other hand, serum total cholesterol was higher in PD patients. Both groups were equal in terms of their serum creatinine, hemoglobin levels and BMI.

**Table 7.3.1:** Nutritional parameters between HD and PD patients, 2013

	HD		PD	
	n=28898		n=3261	
	Mean	SD	Mean	SD
Age	55.8	13.7	50.3	17.9
Albumin (g/dL)	38.6	4.9	33.0	6.6
BMI	24.5	9.1	24.2	7.1
Total Cholesterol (mmol/L)	4.5	1.1	5.0	1.4
Sr Creatinine ( $\mu\text{mol/L}$ )	812.1	238.6	841.3	318.2
Hemoglobin	10.4	1.6	10.4	1.6

In the HD population, the diabetic patients were younger with lower BMI compared to the non-diabetic patients. Serum creatinine was slightly higher in the diabetic group. Total cholesterol and serum haemoglobin were comparable in both groups.

**Table 7.3.2(a):** Nutritional parameters between diabetic and non-diabetic HD patients, 2013

	Diabetes		Non-Diabetes	
	n=13547		n=15351	
	Mean	SD	Mean	SD
Age	52.3	15.0	59.8	10.7
Albumin (g/dL)	39.1	4.9	38.0	4.8
BMI	23.5	8.1	25.6	9.9
Total Cholesterol (mmol/L)	4.5	1.0	4.4	1.1
Sr Creatinine ( $\mu\text{mol/L}$ )	867.1	244.6	749.5	215.2
Hemoglobin	10.5	1.6	10.4	1.5

Diabetic PD patients were younger and had lower BMI compared to non diabetic PD patients. Diabetic PD patients also had better serum albumin and higher serum creatinine levels compared to non diabetic PD patients.

**Table 7.3.2(b):** Nutritional parameters between diabetic and non-diabetic PD patients, 2013

	Diabetes		Non-Diabetes	
	n=947		n=2314	
	Mean	SD	Mean	SD
Age	46.5	18.8	59.3	11.2
Albumin (g/dL)	33.6	6.6	31.5	6.3
BMI	23.4	6.6	25.8	7.9
Total Cholesterol (mmol/L)	5.1	1.4	4.9	1.3
Sr Creatinine (( $\mu$ mol/L)	883.2	326.3	738.4	271.3
Hemoglobin	10.4	1.6	10.6	1.5

We noted that in HD patients, the longer they were on treatment, the higher their serum albumin and lower their BMI (Table 7.3.3a). Similar findings were noted in PD patients. The longer they were on PD treatment, the higher their serum albumin and lower their BMI (Table 7.3.3b).

**Table 7.3.3(a):** Distribution of serum albumin and BMI by duration of dialysis among HD patients, 2004-2013

Years	<1		1-<5		5-<10		≥10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Albumin (g/dL)	36.0	5.5	38.8	3.9	40.0	3.3	40.4	3.0
BMI	24.6	10.8	24.9	9.1	24.2	7.2	22.9	9.2

**Table 7.3.3(b):** Distribution of serum albumin and BMI by duration of dialysis among PD patients, 2004-2013

Years	<1		1-<5		5-<10		≥10	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Albumin (g/dL)	32.5	7.2	33.3	5.3	34.4	4.3	35.1	3.5
BMI	24.0	5.5	24.5	8.6	23.4	4.4	21.8	3.8