

## PaLMS (PATHOLOGY NORTH) TRACE ELEMENTS REFERENCE INTERVALS

### Introduction

The reference intervals currently supplied on trace element reports are for adults. Time, cost and adequate patient numbers prevent us from establishing our own population ranges. We have collated data from various international and local studies and, based on these, hope to soon be able to provide age and sex dependent reference ranges. In the interim, results of this study are presented to assist in the interpretation of trace element results.

### Serum / Plasma Copper Reference Intervals

Country	Year	Method	Age	n	Sex	2.5th - 97.5th Centiles
Australia	2005	ICP-MS	0-6 MONTHS	17	M,F	6.2-23.9
			6 MONTHS - 5 YEARS	56	M,F	13.3-43.8
				23	M,F	14.7-32.3
				16	M,F	14.7-24.2
Canada	1998	AAS	0-5 DAYS	27	M,F	1.4-7.2
			1-5 YEARS	77	M,F	12.6-32.6
			6-9 YEARS	44	M,F	13.2-21.4
			10-14 YEARS	36	M	12.6-19.0
			10-14 YEARS	23	F	12.9-18.9
			15-19 YEARS	55	M	10.1-18.4
			15-19 YEARS	31	F	11.3-25.2
Germany	1997	AAS	0-6 MONTHS	13	M,F	5.9-16.3
			6 MONTHS- 1 YEAR	18	M,F	3.8-23.8
			1-2 YEARS	15	M,F	11.9-30.3
			2-4 YEARS	23	M,F	13.7-29.3
			4-6 YEARS	19	M,F	18.8-30.0
			6-10 YEARS	25	M,F	18.4-28.4
			10-14 YEARS	21	M,F	13.7-28.5
			14-18 YEARS	17	M,F	11.7-29.3
Italy	2000	ICP-MS	TERM NEONATES	143	M,F	2.2-10.8
Italy	1997	ICP-MS	TERM NEONATES	40	M,F	1.6-12.6
			PRETERM NEONATES	20	M,F	1.2-15.1
Sweden	2002	ICP-MS	15 YEARS	342	M,F	12.3-23.6
UK			TERM NEONATES		M,F	3.2-11.0

			BY 7 DAYS'		M,F	4.7-17.3
			>6 MONTHS AND ADULTS		M,F	11.0-25.2
			PREGNANCY		F	25.2-39.3
Australia			0-7 DAYS		M,F	2.0-8.0
			> 7 DAYS		M,F	12.0-22.0
US			0-6 MONTHS		M,F	3.1-11.0
			7 MONTHS - 18 YEARS		M,F	14.2-29.9
			>18 YEARS		M,F	11.0-22.0
US			<6 MONTHS			6.0-16.4
			6 - 11 MONTHS			3.8-23.9
			1 YEAR			12.0-30.3
			2-3 YEARS			13.6-29.4
			3-4 YEARS			8.8-30.0
			4-5 YEARS			18.4-28.5
			6-9 YEARS			13.7-28.6
			10-13 YEARS			13.7-28.6
			14-17 YEARS			11.8-29.4
			ADULT			11.0-29.4
US			0-6 MONTHS		M,F	3.1-11.0
			7 MONTHS - 18 YEARS		M,F	14.2-29.9
			> 19 YEARS		M	11.0-22.0
			> 19 YEARS		F	12.6-24.4
South Africa			0-6 MONTHS			3.1-11.1
			1-5 YEARS			Pathologist's report
			6-11 YEARS			14.1-29.8
			12-17 YEARS			12.6-25.1
			18-59 YEARS		M	12.6-24.3
			18-59 YEARS		F	11.0-22.0
			>60 YEARS		M	13.3-39.8
			>60 YEARS		F	13.3-26.7

### Serum / Plasma Zinc Reference Intervals

Country	Year	Method	Age	n	Sex	2.5th - 97.5th Centiles
Australia	2005	ICP-MS	0-6 MONTHS	17	M,F	10.0-26.0
			6 MONTHS - 5 YEARS	56	M,F	10.3-31.7
			5-12 YEARS	23	M,F	12.0-32.0
			12-18 YEARS	16	M,F	12.0-25.0
Canada	1988	AAS	0-5 DAYS	27	M,F	9.9-21.4
			1-5 YEARS	77	M,F	10.3-18.1
			6-9 YEARS	44	M,F	11.8-16.4
			10-14 YEARS	36	M	11.6-15.4
			10-14 YEARS	23	F	12.1-18.0
			15-19 YEARS	55	M	9.8-15.4
			15-19 YEARS	31	F	9.2-15.4

Germany	1997	AAS	0-6 MONTHS	13	M,F	4.0-21.6
			6 MONTHS - 1 YEAR	18	M,F	4.5-20.1
			1-2 YEARS	15	M,F	4.8-18.4
			2-4 YEARS	23	M,F	4.4-17.6
			4-6 YEARS	19	M,F	7.4-18.2
			6-10 YEARS	25	M,F	7.3-19.7
			10-14 YEARS	21	M,F	3.9-22.7
			14-18 YEARS	17	M,F	7.1-19.9
France	1993	AAS	3-5 YEARS	38	M,F	10.9-22.8
			6-8 YEARS	43	M,F	10.7-19.6
			9-11 YEARS	52	M,F	9.8-19.0
			12-13 YEARS	24	M,F	6.9-19.1
			14-16 YEARS	29	M,F	6.4-9.1
			3-16 YEARS	186	M,F	10.2-21.6
Italy	2000	ICP-MS	TERM NEONATES	143	M,F	4.9-21.5
Italy	1997	ICP-MS	TERM NEONATES	40	M,F	6.0-19.7
			PRETERM NEONATES	20	M,F	9.5-18.2
Sweden	2002	ICP-MS	15 YEARS	340	M,F	11.9-19.9
UK			ALL AGES			10.7-7.6
						7.6-10.7
						<7.6
Australia			ALL AGES		M,F	10.0-18.0
US			0-6 MONTHS		M,F	4.0-21.6
			6-11 MONTHS		M,F	4.4-20.0
			1 YEAR		M,F	4.7-18.3
			2-3 YEARS		M,F	4.4-17.6
			4-5 YEARS		M,F	7.3-18.2
			6-9 YEARS		M,F	7.3-19.7
			10-13 YEARS		M,F	3.8-22.6
			14-17 YEARS		M,F	7.0-19.8
			ADULT		M,F	9.2-19.8
UK						12.0-18.0
UK			ALL AGES		M,F	11.4-24.8
South Africa			ALL AGES		M,F	8.2-23.0
US			ALL AGES		M,F	9.2-18.4

### Serum / Plasma Selenium Reference Intervals

Country	Year	Method	Age	n	Sex	2.5th - 97.5th Centiles
Australia	2005	ICP-MS	0-6 MONTHS	17	M,F	0.31-1.47
			6 MONTHS - 5 YEARS	56	M,F	0.61-2.27
			5-12 YEARS	23	M,F	0.72-1.87
			12-18 YEARS	16	M,F	0.58-1.59

Canada	1988	AAS	0-5 DAYS	20	M,F	0.72-1.20
			1-5 YEARS	30	M,F	1.22-1.82
			6-9 YEARS	30	M,F	1.29-2.05
			10-14 YEARS	30	M,F	1.31-2.35
			15-19 YEARS	27	M,F	1.31-2.35
Germany	1997	AAS	0-6 MONTHS	13	M,F	0.10-0.58
			6 MONTHS - 1 YEAR	18	M,F	0.00-0.87
			1-2 YEARS	15	M,F	0.20-0.96
			2-4 YEARS	23	M,F	0.12-1.36
			4-6 YEARS	19	M,F	0.08-1.64
			6-10 YEARS	25	M,F	0.31-1.55
			10-14 YEARS	21	M,F	0.30-1.50
			14-18 YEARS	17	M,F	0.27-1.55
France	1993	AAS	3-5 YEARS	38	M,F	0.25-1.57
			6-8 YEARS	43	M,F	0.02-1.52
			9-11 YEARS	52	M,F	0.30-1.70
			12-13 YEARS	24	M,F	0.51-1.35
			14-16 YEARS	29	M,F	0.51-1.35
			3-16 YEARS	186	M,F	0.28-1.70
Italy	2000	ICP-MS	TERM NEONATES	143	M,F	0.26-0.88
Italy	1997	ICP-MS	TERM NEONATES	40	M,F	0.28-0.86
			PRETERM NEONATES	20	M,F	0.25-0.61
Sweden	2002	ICP-MS	15 YEARS	340	M,F	0.82-2.03
UK			0-18 MONTHS		M,F	0.38-0.63
			18 MONTHS-4 YEARS		M,F	0.57-1.14
			5-16 YEARS		M,F	0.70-1.46
			ADULTS (>16)		M,F	0.89-1.65
Australia			0-4 MONTHS		M,F	0.2-0.6
			4 MONTHS - 2 YEARS		M,F	0.3-1.0
			2 - 16 YEARS		M,F	0.6-1.2
			> 16YEARS		M,F	0.75-1.35
UK						1.39-2.02
UK			0-2 YEARS		M,F	0.2-0.9
			2-4 YEARS		M,F	0.5-1.3
			4-16 YEARS		M,F	0.7-1.7
			ADULTS		M,F	0.9-2.0
UK			< 16 YEARS		M,F	0.44-1.43
			> 16 YEARS		M,F	0.89-1.65
South Africa						0.58-1.86
US						0.29-2.41
Germany			0-1 MONTH		M,F	0.19-1.35

			1-2 MONTHS	M,F	0.19-1.27
			2-4 MONTHS	M,F	0.13-1.18
			4-12 MONTHS	M,F	0.17-1.47
			1-5 YEARS	M,F	0.43-1.63
			5-18 YEARS	M,F	0.53-1.57

## Blood Manganese Reference Intervals

Country	Year	Method	Age	n	Sex	2.5th - 97.5th Centiles
Denmark	1997	AAS	Adults	188	M,F	100-271
			IFCC ref interval			100-271
Japan	2002	AAS	Adults	46	M,F	34.6-105
Finland	1992	AAS	Adults	65	M,F	52.8-380
Australia	1988	AAS	Adults	15	M,F	80-350
US	1979	AAS		60	M,F	84-245
Australia	1999	AAS	10-20 weeks gestation	33	F	45.7-255
			20-25 weeks	29	F	54.5-288
			25-34 weeks	23	F	125-335
			Neonate	22	M,F	326-1149
Germany	2006	ICP-MS		130	M,F	104-266
Italy		AAS		88	M,F	129-191
Japan	2001	AAS	Neonates	14	M,F	411-1612
			1-11 months	21	M,F	0-1149
			1-18 years	36	M,F	133-404
South Korea	1991	AAS		16	M,F	81-345
Belgium	1987			104	M,F	74-200
France	2006	AAS	>38/40 Mothers (cord blood)	224	F	202-735
			Neonates	226	M,F	348-1296
Finland	1992	AAS		65	M,F	33-380
US	2007	ICP-MS		200	M	182-255
Mexico	2001	AAS	Adults	73	M,F	
UK		SSMS			M,F	73-218
South Africa					M,F	81.9-247.5
UK			< 1 year		M,F	127-328
			>1 year, adults		M,F	72.8-218

US		ICP-MS				127-346
Scotland		AAS			M,F	70-280
						>360 potentially toxic
		AAS			M,F	140-220
US					M,F	54.6-273
US		ICP-MS	Adult		M,F	76-300
UK					M,F	73-220
US					M,F	127-291
						>546
US					M,F	90-270
US					M,F	72-255
US					M,F	55-182

### Pregnancy / OCP Reference Intervals

Country	Year	Method	Gestation	n	Element	2.5th - 97.5th Centiles
Croatia	2005	AAS	1st trimester	28	Cu	12.2-42.0
			2nd trimester	29	Cu	15.6-47.3
			3rd trimester	25	Cu	21.5-45.9
			At delivery		Cu	18.9-48.7
Finland & Estonia	1999	AAS	1st trimester	30	Zn	7.6-20.8
			1st trimester	29	Cu	15.4-40.0
			3rd trimester		Cu	18.7-55.1
Spain	2001	AAS	3rd trimester	52	Cu	18.9-49.5
Italy	1990	AAS	1st trimester	41	Zn	8.5-17.8
			1st trimester	41	Cu	13.3-38.8
			3rd trimester	35	Zn	5.1-14.1
			3rd trimester	35	Cu	23.0-57.7
Chile	2000	AAS	27-32 weeks	34	Se	0.86-1.68
				34	Zn	6.2-26.2
				34	Cu	19.6-44.3
			33-35 weeks	47	Se	0.76-1.54
				47	Zn	6.6-27.1
				47	Cu	22.8-45.7
			>36 weeks	45	Se	0.59-1.57
				45	Zn	10.8-25.0

				45	Cu	20.4-48.3
US	1994		2nd trimester	76	Cu	23.3-42.1
				76	Zn	7.7-16.7
Poland	1992	AAS	At delivery	64	Se	0.17-0.72
				64	Cu	15.3-45.5
				64	Zn	3.2-14.7
US	1993	AAS	On OCP or oestrogen therapy		Cu	15.7-31.5
			Women not on OCP or oestrogen therapy			10.7-26.6
US	2000		Pregnancy			18.5-47.7
			Women of child-bearing age			12.6-22.4
UK			Pregnancy			25.2-39.3

## Geriatric Reference Intervals

Country	Year	Element	Method	Age	n	Sex	2.5th - 97.5th Centiles
Spain	1997	Selenium	AAS	<80	8	M	0.51-1.45
				<80	24	F	0.58-1.54
				>=80	45	F	0.36-1.43
				>=80	16	M	0.45-1.49
				63-93	24	M	0.47-1.49
				63-97	69	F	0.45-1.47
				63-97	93	M,F	0.45-1.47
UK	1989	Zinc	AAS	69-85	24	M,F	10.6-11.6
		Copper	AAS	69-85	24	M,F	18.0-20.8
UK	1989	Selenium	AAS	<65	75	M,F	1.15-1.25
				>65	28	M,F	0.94-1.12
Italy	1994	Selenium	AAS	20-39	26	M,F	0.81-1.55
				40-59	26	M,F	0.80-1.62
				60-75	28	M,F	0.80-1.38
				>75	25	M,F	0.53-1.27
Norway	2000	Copper	ICP-AES	All ages	141	M,F	12.0-27.9
				21-40	67	M,F	11.6-28.5
				41-60	46	M,F	14.5-22.0
				61-87	28	M,F	14.9-25.6
				21-50	52	M	10.4-20.0
				21-50	42	F	14.4-28.5
				51-87	17	M	
				51-87	30	F	15.1-26.5
				All ages	69	M	10.4-20.8

				All ages	72	F	14.2-28.5
		Selenium	ICP-AES	All ages	141	M,F	0.95-1.78
				21-40	67	M,F	0.92-1.54
				41-60	46	M,F	1.10-1.77
				61-87	28	M,F	1.13-1.74
				21-50	52	M	1.00-1.77
				21-50	42	F	0.96-1.47
				51-87	17	M	
				51-87	30	F	1.13-1.63
				All ages	69	M	0.98-1.77
				All ages	72	F	0.92-1.63
		Zinc	ICP-AES	All ages	141	M,F	10.9-16.6
				21-40	67	M,F	11.1-16.7
				41-60	46	M,F	11.1-15.5
				61-87	28	M,F	11.5-14.9
				21-50	52	M	10.8-16.8
				21-50	42	F	11.6-14.4
				51-87	17	M	
				51-87	30	F	11.3-14.9
				All ages	69	M	10.8-16.7
				All ages	72	F	11.3-15.8
US	1992	Copper	AAS	Young adults		M	11.0-22.0
				Young adults		F	12.6-24.4
				60-90	53	M	13.5-27.2
				60-91	57	F	16.8-29.7
				>=90	15	M	11.8-29.0
				>=91	32	F	15.7-31.0
		Zinc	AAS	Young adults		M,F	10.7-23.0
				60-90		M,F	9.6-16.4
				>=90		M,F	8.0-15.1
Switzerland	1988	Zinc	AAS	>64	53	M,F	9.8-17.3
South Africa				>60 YEARS		M	13.3-26.7
				>60 YEARS		F	13.3-29.8
US				>60 YEARS		M	13.3-26.8
				>60 YEARS		F	13.3-29.9

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