

RESEARCH NOTE

**INFANT MORTALITY IN PERTH, WESTERN AUSTRALIA, 1870-1914:
A PRELIMINARY ANALYSIS**

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The purpose of this paper is to make available some of the preliminary data which have emerged from a research project which I have been working on for a number of years. The focus of my study has been an examination of the trends in infant mortality in Perth between 1870 and 1914. The project has some significance both for Perth during the period of its first massive expansion phase and for the global problem of why infant mortality declined so dramatically in most westernised countries by the second decade of the twentieth century. Ultimately I hope to produce a full-scale study of infant mortality during the period 1870 to 1914, using contemporary statistics from the eastern states, Great Britain and Europe, but having as the primary data base the statistics of Perth which are offered in this paper. However, in the meantime, it seems appropriate to offer my Perth data in tabular form, even though this paper represents no more than a very preliminary statement of my findings. The outstanding features of Perth's demographic history which emerge are a high infant mortality rate even before a rapid increase in Perth's population during the 1890s, a dramatic peak in mortality at the height of the goldrush, and a steep decline in infant mortality in the first decade of the twentieth century. Perinatal mortality remains high throughout the period examined. The decline in mortality occurs primarily in the post-neonatal period, as a consequence of fewer deaths from gastroenteritis and from the syndrome known as weaning diarrhoea.

Perth's demographic history between 1870 and 1914 can be divided into four phases: a traditional period lasting from 1870 to 1883; an intermediate, oscillating phase between 1884 and 1891; an expansionist phase between 1892 and 1898; and a period of consolidation from 1899 to 1914. In 1870 Perth was a tiny community with a population of 5007. It grew, primarily by natural increase, to 5822 by 1881 and was still only marginally over 6000 in 1884. Following the first gold discoveries there was a short period of population growth, which had ebbed by 1891 when the census reported

a population of 9617. The discovery of further goldfields in the early 1890s sparked off a massive immigration to Western Australia, although the rate of increase plunged after 1897. The population of Perth in this decade cannot be gauged with any certainty, but in 1901 the population of the magisterial district of Perth was 43798, an intercensal increase of 355%. By 1911 Perth's population had risen to about 87000. Thus, in the period under consideration, Perth grew from what one contemporary called 'a sleepy place . . . very pretty though', to a major city, 'from a sandbed to a first-class town'. Understandably, for a time in the late 1890s most social services, such as they were, failed to cope and Perth underwent an urban crisis of short, though painful, duration. Infant mortality, a sensitive indicator of poor social conditions, shows in graphic detail this crisis in goldrush Perth.

Methods

This paper presents an analysis of 1495 stillbirths and 5693 infant deaths in Perth between 1870 and 1914 inclusive. All data on infant deaths were extracted from the registers of the Western Australian Registrar General. The area under consideration is the Perth registration district of 1870. Data from districts which broke away from Perth as the city grew in the 1890s have been reincorporated.

Registration of births, deaths and marriages was compulsory in Western Australia from 1841. Although registration of vital data in many outlying districts of the colony was probably deficient even as late as the 1880s, with the exception of stillbirths in the 1870s and 1880s Perth's registration of white deaths was fairly complete. Official statistics of vital events in Perth were not published separately until 1896. For various reasons, including changing registration district boundaries, they are irritatingly deficient and thus statistics from the *Statistical Register of Western Australia* have been ignored in this paper.

Raw data which were available from the death certificates included the name, date of birth, age (in minutes, hours or days for the youngest), sex, occupation of father, maiden name of mother, forenames of parents, place of residence and of death, cemetery in which buried, and cause of death.

The problems of using some of these data have been discussed in an earlier paper. Stillbirths, for which certificates of both birth and death were necessary, were under-registered in the 1870s and 1880s and, if a strict definition of stillbirth is used, were probably over-registered from the mid-1890s, due to a changed interpretation of what constituted 'stillbirth' and 'prematurity'. Hence, more significance is attached to the perinatal death rate than to the neonatal death rate in the latter part of the period under discussion.

Accurate diagnosis of cause of death was very infrequent. Medical men were obliged to state cause of death on a certificate only if they had attended the patient during his final illness. Vague causes of death thus predominated. Disease classification changed over time, partly due to improved diagnosis, partly to new nosologies accepted by the Registrar General's Office. In this period four systems of classification were used: Farr's; Ogle's; Hayter's; and, from 1907, Bertillon's. In the process certain categories of disease were moved from one class of disease to another, thus undermining some of the continuity gained from using the cause of death categories on the death certificates. However, by breaking infant mortality down into seasonal incidence and into short age categories, it has been possible to make some points about the major causes of infant death in Perth.

Results

Annual live births, infant deaths and infant mortality rates for the period 1870 to 1914 are shown in Table 1. The first twelve years reflect the trend in infant mortality of a small, economically stagnant community, which was self-contained and subject to population increment primarily through natural increase. The main features of this period were wide fluctuations in the infant mortality rate (IMR), from 112 per 1000 in 1881 to 232 per 1000 in 1874, and the effects of infectious diseases in the peak years. Tables 2 and 3 show that excess deaths in the high mortality years of 1870, 1873, 1874 and 1879 were confined to the post-neonatal period. In only one of these years, 1873, is there evidence of higher than average neonatal mortality, which coincided with a higher post-neonatal mortality rate caused by a whooping cough epidemic. (In only two other years, 1886 and 1891, were deaths from 'zymotic' diseases, that is, infectious diseases of early childhood, associated with significant infant mortality.) Excess mortality in the other three years was attributed to 'diarrhoea' (1870) or 'teething' and 'convulsions' (1874 and 1879). These probably reflected the presence of pathogenic micro-organisms affecting the gastrointestinal tract.

The 1880s saw a lower mean IMR (153 to 163), fewer annual fluctuations and a trend in infant mortality which corresponded closely with the rise and fall of population increment caused by the first mini-goldrush. Higher neonatal death rates were recorded in this decade, but once again the bulk of mortality occurred in the post-neonatal period. Table 4 shows that the distribution of deaths after one month altered in the early 1880s, with the second month of life becoming safer than in the 1870s, but this trend was reversed as the number of annual births increased. Deaths in the fifth, sixth and seventh months, the most likely ages for the partial weaning of children who had been breast-fed, also rose in the late 1880s. Table 3 shows that in these years the proportion of post-neonatal deaths from 'diarrhoea' rose substantially. A similar syndrome was to be repeated on a greater scale a decade later. The bulk of post-neonatal deaths in the 1880s was attributed to 'convulsions' (although this category declined from 1886), diarrhoea and dysentery. Other doubtful classifications such as 'atrophy' and 'debility' reached their peak in this decade and then declined, while 'teething' began to disappear altogether. These changes probably reflected the introduction of Hayter's new Australian nosology. The seasonal incidence of these classifications strongly suggests that they are all diseases of a similar type and they have thus been incorporated in the diarrhoea data in this paper.

Infant deaths from gastrointestinal infections peaked in the 1890s. The mean IMR for this decade was 185 per 1000, a full 3.2% higher than in the 1880s. Mortality was highest in 1896 and 1897, when at a conservative estimate 11% and 13% respectively of all live births ended in death from gastroenteritis before the age of one year. It is possible that in these years the normal pathogenic organisms affecting infants were supplemented by enteric fever, which was epidemic in Perth. In this decade, with one exception, all infant age groups suffered diminished life chances, although the youngest were the most susceptible (see Tables 4 and 5). The one exception, with a mortality rate doubling in the second quinquennium, was the group just reaching their first birthdays, who in normal times would already have survived the most dangerous period of infancy. The presence of typhoid in the community may help to explain this phenomenon. Most at risk were infants in their third, fourth and fifth months.

Between 1897 and 1899 deaths from gastroenteritis dropped by 50% (see Table 3), and the post-neonatal death rate returned to its pre-goldrush level. Table 7 shows that

the dramatic fall in infant mortality at the end of the decade occurred amongst the youngest. No decline in perinatal mortality was observed.

Table 6 shows the seasonal fluctuations in infant mortality from 1870 and from 1895 respectively. Trends are not so clear in the earlier period, due partly to the comparatively few number of vital events which allowed only a small increase in deaths in a particular month to have an abnormal seasonal impact, but from the mid-1880s clear trends of high mortality in late spring, early and high summer, and late autumn begin to appear. Table 8 shows that these peaks are primarily a consequence of seasonal variations in diarrhoea mortality. The temporary decline in the death rates in 1899 and 1900 reflects fewer summer deaths from diarrhoea, with the late autumn period remaining high.

The most notable feature of the first decade of the twentieth century was the decline in the IMR, which occurred in two stages. The first quinquennium saw some diminution in the IMR, although there were two bad diarrhoea years in 1902 and 1903. The most obvious decline began in 1905 and, except for another diarrhoea year in 1912, was to proceed without interruption until 1914. The mean IMR for 1900-4 was 148 per 1000, for 1905-9 104 per 1000, and for 1910-14 84 per 1000. The rate in the final quinquennium was nearly half that of the 1870s. It is no exaggeration to say that a revolution had occurred. If it is accepted that because of changes in classification the neonatal death rate after 1895 is suspect and that the perinatal death rate is the correct measure to use, then it is clear from Table 3 that the revolution applied primarily to infants over the age of one month. The greatest danger was past when an infant reached his seventh month.

Discussion

The particular seasonal variations in deaths and the heavy incidence of death in the first six months of life suggest that infants in late nineteenth century Perth were suffering from the syndrome known as weanling diarrhoea, in which undifferentiated pathogenic micro-organisms eventually cause death. Weanling diarrhoea is still endemic in Third World countries today. Infants die of progressive weakening as diarrhoea and poor nutrition react together in a vicious spiral which is accelerated by poor environmental sanitation, inadequate hygiene within the home and parental ignorance. Most infants in Perth in the 1890s were artificially fed, usually with dried or condensed milk, supplemented by 'pap' and maizina. Water supplies did not begin to improve in Perth until after the turn of the century. By-laws regulating local dairies were not introduced until 1902. Their progressive enforcement reduced maternal suspicion of fresh milk and reliance on nutritionally poorer artificial foods. Increased propaganda on the benefits of breastfeeding, especially in a hot climate, began to be effective at the same time. Little evidence of parental indifference to the welfare of infants could be found. Perth, because of its climate and its flies, and because it was still in many ways a frontier town, retained the doubtful privilege of having the worst IMR in the Commonwealth, although positive action by health authorities and an increasing knowledge of health care practices amongst mothers by 1914 greatly reduced the threat of infant death from weanling diarrhoea.

Infant mortality rates throughout the western world began to decline at approximately the same time. Perth's data show that the decline resulted from fewer diarrhoea deaths caused by improvements in the socio-cultural environment.

TABLE 1

INFANT MORTALITY IN PERTH, 1870-1914,
PER 1000 LIVE BIRTHS

	<u>BIRTHS</u>	<u>DEATHS</u>	<u>RATE</u>
1870	127	23	181
1871	131	18	137
1872	152	23	151
1873	144	30	208
1874	142	33	232
1875	154	24	156
1876	186	23	124
1877	161	23	143
1878	154	19	123
1879	156	31	199
1880	160	21	131
1881	188	21	112
1882	208	25	120
1883	179	30	168
1884	225	38	169
1885	267	42	157
1886	328	55	168
1887	365	69	189
1888	328	50	152
1889	359	47	131
1890	336	52	155
1891	370	73	197
1892	462	86	186
1893	538	94	175
1894	560	101	180
1895	652	116	178
1896	802	164	204
1897	1122	280	250
1898	1478	271	183
1899	1439	201	140
1900	1430	194	136
1901	1495	193	129
1902	1673	277	166
1903	1932	331	171
1904	2057	272	132
1905	2299	264	115
1906	2311	269	116
1907	2382	269	113
1908	2256	205	91
1909	2280	188	82
1910	2185	181	83
1911	2473	193	78
1912	2817	284	102
1913	3118	269	86
1914	3061	217	71

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TABLE 2

NEONATAL AND PERINATAL DEATH RATES, 1870-1914
PER 1000 AT RISK

	<u>NEONATAL DEATH RATE</u>	<u>PERINATAL DEATH RATE</u>
1870	47	47
1871	38	45
1872	59	71
1873	63	63
1874	49	49
1875	45	45
1876	27	27
1877	19	19
1878	58	65
1879	45	51
1880	44	50
1881	27	37
1882	38	61
1883	39	65
1884	58	86
1885	49	73
1886	58	80
1887	58	78
1888	55	66
1889	31	47
1890	39	42
1891	43	48
1892	52	74
1893	41	53
1894	64	82
1895	43	63
1896	40	63
1897	54	81
1898	41	67
1899	43	64
1900	36	68
1901	30	68
1902	41	73
1903	35	68
1904	32	68
1905	32	71
1906	34	73
1907	31	71
1908	31	68
1909	23	58
1910	29	67
1911	30	68
1912	34	65
1913	26	59
1914	30	57

TABLE 3

POST-NEONATAL GENERAL AND DIARRHOEA MORTALITY RATES,
1870-1914, PER 1000 AT RISK

	TOTAL POST- NEONATAL DEATH RATE (i)	DIARRHOEA POST- NEONATAL DEATH RATE (ii)	(ii) as % of (i)
1870	132	99	75
1871	103	71	69
1872	98	56	57
1873	156	59	38
1874	193	126	65
1875	116	61	53
1876	99	83	84
1877	127	82	65
1878	69	28	41
1879	161	107	66
1880	92	65	71
1881	87	60	69
1882	85	70	82
1883	134	35	26
1884	118	66	56
1885	114	63	55
1886	117	81	69
1887	140	102	73
1888	103	71	69
1889	103	84	82
1890	121	68	56
1891	161	96	60
1892	142	94	66
1893	140	76	54
1894	124	103	83
1895	141	98	70
1896	171	145	85
1897	206	163	79
1898	148	128	86
1899	101	79	78
1900	103	77	75
1901	102	79	77
1902	130	98	75
1903	142	107	75
1904	103	82	80
1905	85	70	82
1906	86	68	79
1907	84	53	63
1908	61	45	74
1909	60	49	82
1910	56	33	59
1911	49	37	76
1912	69	54	78
1913	62	40	65
1914	42	24	57

TABLE 4

AGE-SPECIFIC INFANT MORTALITY RATES, 1870-1914,
FIVE-YEAR PERIODS, PER 10000 AT RISK

	<u>2nd</u> <u>MTH</u>	<u>3rd</u> <u>MTH</u>	<u>4th</u> <u>MTH</u>	<u>5th</u> <u>MTH</u>	<u>6th</u> <u>MTH</u>	<u>7th</u> <u>MTH</u>	<u>8th</u> <u>MTH</u>	<u>9th</u> <u>MTH</u>	<u>10th</u> <u>MTH</u>	<u>11th</u> <u>MTH</u>	<u>12th</u> <u>MTH</u>
1870-4	258	136	167	106	106	106	61	136	167	91	45
1875-9	218	115	103	90	141	51	103	90	77	103	51
1880-4	141	174	185	98	43	76	76	76	109	65	22
1885-9	173	128	115	128	102	160	77	70	70	83	38
1890-4	191	158	200	144	125	116	107	84	79	88	28
1895-9	164	185	211	170	154	143	112	88	95	91	91
1900-4	142	136	139	133	148	118	89	80	64	64	53
1905-9	74	79	98	84	75	64	75	61	55	38	49
1910-4	68	51	60	69	65	54	35	51	39	41	23

TABLE 5

AGE-SPECIFIC INFANT MORTALITY RATES, 1895-1914,
PER 10000 AT RISK

	<u>2nd</u> <u>MTH</u>	<u>3rd</u> <u>MTH</u>	<u>4th</u> <u>MTH</u>	<u>5th</u> <u>MTH</u>	<u>6th</u> <u>MTH</u>	<u>7th</u> <u>MTH</u>	<u>8th</u> <u>MTH</u>	<u>9th</u> <u>MTH</u>	<u>10th</u> <u>MTH</u>	<u>11th</u> <u>MTH</u>	<u>12th</u> <u>MTH</u>
1895	112	160	112	208	96	160	144	80	80	128	144
1896	208	169	247	208	195	169	117	156	65	91	130
1897	245	283	236	207	302	132	207	94	160	75	104
1898	176	212	296	148	85	162	92	78	71	92	71
1899	87	102	131	123	116	109	44	58	94	87	58
1900	145	160	123	145	123	80	58	36	36	58	58
1901	131	124	131	69	131	90	138	69	48	34	55
1902	150	106	206	131	156	150	131	106	44	56	62
1903	220	118	113	193	193	172	70	102	86	86	59
1904	70	171	126	116	131	90	60	75	85	75	35
1905	72	85	72	121	99	76	58	72	90	45	58
1906	72	94	103	107	90	81	81	81	36	54	58
1907	95	95	147	61	74	56	78	65	65	39	65
1908	69	41	78	78	59	32	78	32	46	27	55
1909	63	76	85	54	54	72	81	54	36	27	9
1910	85	47	75	47	33	42	38	47	61	38	42
1911	67	46	46	54	42	58	38	29	33	38	38
1912	70	74	88	92	96	48	48	74	55	44	11
1913	76	53	43	89	92	69	36	53	33	46	23
1914	47	37	51	54	51	47	20	51	17	37	10

TABLE 6
MONTHLY POST-NEONATAL MORTALITY RATES, 1870-1914,
FIVE-YEAR PERIODS, PER 10000 AT RISK

	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
1870-4	61	121	197	136	182	167	30	45	30	30	182	197
1875-9	359	77	90	128	64	64	0	38	64	51	64	141
1880-4	87	65	87	120	141	54	33	33	22	65	98	228
1885-9	115	134	141	122	96	6	26	51	38	109	166	141
1890-4	177	107	112	121	88	46	37	79	37	74	195	256
1895-9	170	107	112	166	187	99	74	48	65	118	170	190
1900-4	115	106	92	125	144	57	47	40	56	72	156	157
1905-9	75	74	60	97	98	58	34	26	22	39	68	106
1910-4	59	46	48	79	69	46	38	23	20	23	45	60

TABLE 7
AGE-SPECIFIC DIARRHEOA DEATH RATES, 1895-1914,
PER 10000 AT RISK

	<u>2nd</u> <u>MIH</u>	<u>3rd</u> <u>MIH</u>	<u>4th</u> <u>MIH</u>	<u>5th</u> <u>MIH</u>	<u>6th</u> <u>MIH</u>	<u>7th</u> <u>MIH</u>	<u>8th</u> <u>MIH</u>	<u>9th</u> <u>MIH</u>	<u>10th</u> <u>MIH</u>	<u>11th</u> <u>MIH</u>	<u>12th</u> <u>MIH</u>
1895	96	112	80	160	32	144	112	16	64	64	96
1896	208	130	247	195	156	156	78	91	52	78	65
1897	198	254	207	132	207	104	160	85	132	57	85
1898	155	183	261	148	78	113	85	71	42	78	71
1899	51	94	116	80	109	73	44	36	65	73	51
1900	102	145	94	94	87	58	44	29	22	44	51
1901	103	97	103	48	103	62	117	41	48	21	41
1902	106	94	187	106	125	106	94	75	25	31	44
1903	150	80	86	166	172	113	54	75	64	59	48
1904	55	95	105	95	116	65	50	55	75	55	30
1905	49	53	58	94	94	63	58	58	72	36	49
1906	49	72	90	94	72	76	63	54	18	49	40
1907	61	61	100	56	52	39	43	35	30	22	35
1908	37	41	73	55	50	27	50	18	41	23	37
1909	45	72	72	49	49	58	54	40	27	22	4
1910	33	28	47	38	19	28	24	28	38	28	14
1911	42	33	38	50	29	46	33	25	21	25	29
1912	37	70	77	74	77	37	37	44	58	40	4
1913	33	33	33	69	66	40	26	20	13	40	20
1914	27	24	20	34	34	27	10	20	10	20	10

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TABLE 8

POST-NEONATAL DIARRHOEA DEATH RATES, 1895-1914,
BY MONTH, PER 10000 AT RISK

	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
1895	80	16	32	128	144	80	48	0	32	48	144	224
1896	286	91	117	65	182	143	65	0	52	169	143	143
1897	198	160	151	189	226	85	38	47	47	28	198	254
1898	113	113	120	197	120	56	63	49	71	127	155	99
1899	73	58	51	116	131	65	51	22	29	65	51	80
1900	73	80	36	131	131	58	22	0	36	22	102	80
1901	97	41	110	62	131	41	28	0	7	34	131	103
1902	62	62	94	118	162	50	31	25	56	69	156	106
1903	102	166	139	102	97	43	21	11	16	27	155	188
1904	116	55	45	110	95	25	35	35	50	55	85	116
1905	85	108	40	117	81	36	0	0	9	40	85	103
1906	81	63	49	90	90	31	31	4	13	22	81	121
1907	52	48	61	56	113	61	9	13	9	13	26	74
1908	59	41	41	50	55	14	18	5	9	23	64	73
1909	18	16	18	50	34	23	11	9	5	14	11	41
1910	33	14	28	66	66	9	5	14	5	19	24	42
1911	42	25	50	42	17	29	21	13	21	13	54	46
1912	44	40	33	96	96	48	33	7	11	15	44	77
1913	66	36	36	82	59	23	10	10	3	13	23	36
1914	30	20	24	24	7	13	20	7	7	17	30	37

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