Prevalence and causes of Diabetes in Pacific people

Abstract: Diabetes is approaching epidemic proportions among Pacific people both in their traditional homelands as well as in metropolitan centres of their newly adopted Western countries. Although the risk factors associated with diabetes among individuals are reasonably well understood, the "upstream" causes needs to be critically appraised. While individual interventions and health education has its role, there is an urgent need to intervene at the upstream causes of diabetes and other ill health including social, trade, economic and political at the population, state and international level. Attempts to control diabetes in a vacuum without reference to socio-economic and political context is a convenient vehicle that has contributed to and will continue to fuel calories to the diabetes epidemic. (Pacific Health Dialog 2003, Vol 10. (2) Pg 87-95)

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Introduction

It is well recognised that diabetes is a major and increasing public health problem worldwide. Of particular importance is the increasing prevalence of diabetes throughout the Pacific in certain ethnic and sub-populations in a variety of changing cultural, socio-economic and political environments'. However, effective prevention and control of this condition remains difficult, both in the Pacific itself and for Pacific people living in other countries. This paper reviews current knowledge of prevalence and morbidity of diabetes in Pacific people. We commence by briefly discussing the origin and history of Pacific people, and definitions of diabetes. We then review the evidence on the prevalence and morbidity of diabetes in the Pacific and in Pacific people in other countries. Finally, we then consider possible explanations for the prevalence and morbidity patterns, and briefly discuss strategies for prevention and control.

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The Pacific

Theories as to the origin and the timing of the arrival of the early inhabitants of the Pacific vary and are a matter of considerable and continuing debate among historians, archaeologists and linguists. One such scenario concludes that settlement in New Guinea occurred at least 35 000 years ago by populations of Indonesian origin, with later migrant groups reaching Polynesia between 4000 and 1000 years ago[9]. The traditional inhabitants of the Pacific are usually arbitrarily divided into Melanesians, Micronesians and Polynesians. Polynesia roughly occupies a triangle which extends from Hawaii in the north, to Easter Island in the east and New Zealand in the South. In this paper we focus on the situation in Polynesia, since the great majority of studies have been conducted there, but we refer to studies in Melanesia and Micronesia where these are available.

It has been argued that all industrializing societies undergo various "epidemiological transition" stages in which the transition from Stage Two to Stage Three involves a change from "receding pandemics" to "degenerative and lifestyle diseases"[3]. Continued globalization will mean that more populations in the Pacific, and throughout the world, are adopting Westernized diets and lifestyles[2]. The dynamics of this transition in most Polynesian South Pacific islands has been relatively unprecedented. These countries are geographically scattered, with contrasting environmental, social, and political systems, and in varying stages of economic development, but all have been going through a rapid epidemiological transition. Processes that took place over thousands of years in Western countries have been very much compacted in time in the Pacific.

This situation provided a valuable "natural experiment" for the study of the effects of social and environmental change on disease patterns, and from the 1960s a series of studies were conducted to examine the health effects of these changes. These studies have documented the speed of the epidemiological transition, and the emergence of non-communicable "lifestyle diseases".

Some of these studies have since identified diabetes, coronary heart disease and cancer as priorities in terms of morbidity and mortality in the Pacifica.

Diabetes comprises a variety of metabolic conditions characterized by a state of chronic hyperglycemia, often arising as a result of environmental and genetic factors. The classification of diabetes mellitus has been modified several times in the last three decades. The World Health Organization (WHO) Expert Committee on Diabetes report in 1965 on the classification of diabetes, based on age of onset, was revised and adopted in the second report in 1980, then further modified in 1985[6]. Widely accepted and used internationally, the current classification represents a compromise between the clinical and aetiological classifications, allowing the classification of subjects in a clinically useful manner should specific cause or aetiology remained unknown. The current classification of disorders of glycaemia includes: Type 1 (formerly known as insulin-dependent or juvenile onset diabetes; Type 2 (formerly known as non-insulin dependent or adult onset diabetes; Other Type (underlying disease process); and Gestational Diabetes. The current values for the diagnosis of diabetes and other categories of hyperglycaemia are shown in Table 1. In this paper we focus on Type 2 Diabetes, which will be referred to henceforth as "diabetes".

Table 1: Values for diagnosis of diabetes mellitus and other categories of hyperglycaemia

Glucose concentration, mmol l^{-1} (mg dl^{-1})			
	Whole Blood		Plasma'
	Venus	*Capillary*	*Venus*
Diabetes Mellitus: Fasting OR 2 hour post-glucose load or both	6.1 (110) **10.0 (** 180)	6.1 (110) 11.1 (200)	7.0 (126) 11.1 (200)
Impaired Glucose Tolerance (IGT): Fasting concentration (if measured) AND 2 hour post-glucose load	<6.1 (<110) 6.7 (120) and <10.0 (<180)	<6.1 (<110) 7.8 (140) and <11.1 (<200)	<7.0 (<126) 7.8 (140) and <11.1 (<200)
Impaired Fasting Glycaemia (IFG): Fasting	5.6 (100) and <6.1 (<110)	5.6 (100) and <6.1 (<110)	6.1 (110) and <7.0 (<126)
2 hour (if measured)	<6.7 (<120)	<7.8 (<140)	<7.8 (<140)

We searched the Medline database in May 2002 for "all years". Keywords used were "diabetes mellitus," "non-insulin dependent diabetes mellitus", "Pacific Islander", "Pacific Islanders", "Polynesians" and "prevalence". Several searches were done using a combination of the above keywords and the name of specific Pacific Island countries such as "prevalence diabetes Samoa". Papers discussing prevalence, risk factors, interventions, studies on economic status, cultural barriers to diabetic health care, acculturation and social development were further sought out for review.

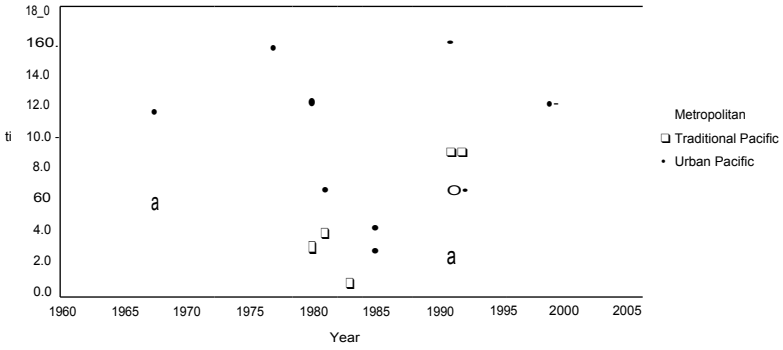
The studies identified spanned a period of more than 30 years with the first major study relating to diabetes in Polynesians reported by Sloan in 1963[7]. Although a very large number of studies have been conducted, most lacked a single standardized methodology, and methods of classification and criteria for determining diabetes were often different. Thus, most published studies could not be used to make prevalence comparisons over time or between countries, a problem that is of course not unique to the Pacific studies. Among the earlier studies that did use reasonably standardised methodology were those conducted by Prior and colleagues in the early 1960s4.[8,9], and those conducted by Zimmet and colleagues beginning in the mid 1970's[10.] ", although we have also been able to identify a number of other studies that used reasonably comparable methodology. The majority of these were conducted in Polynesian populations, either in Pacific Island countries or later on in New Zealand.

The early studies by Prior and colleagues from throughout the Pacific Islands beginning in the 1960s clearly showed that while diabetes was virtually non-existent in Polynesian populations maintaining a traditional lifestyle, the reverse was true for the urbanized Polynesian populations[4,9]. Zimmet and colleagues indicated that diabetes was virtually unknown prior to 1960, and they were unable to find evidence of any cases of diabetes in Funafuti, Western Samoa or Nauru before 194510.

Figure 1 summarizes the findings of studies of the prevalence of diabetes in various Polynesian Pacific countries including the Cook Islands, the Tokelau Islands, Wallis Island, New Caledonia, Tuvalu, Niue and Tonga, as well as studies of Pacific people in New Zealand6.'°,12-[22]. The figure also includes studies in Melanesia2324.26-26 including Papua New Guinea, Fiji Islands, and Vanuatu; and in Micronesia[25.36] including Guam, and Kiribati. In

some instances the study participants were of Polynesian (rather than Melanesian) ethnicity. We have presented the findings for males and females combined (where these were not reported we estimated these from the separate findings in males and females). As noted above, we have only included studies that used a reasonably standardised methodology, but nevertheless the studies are not always comparable since, although they were all primarily in adults, the age groups are not always exactly the same.

Figure 1: Diabetes prevalence in Pacific people in traditional Pacific, Urban Pacific, and Metropolitan adopted environments



As figure 1 shows, much of the variety over time, and between Pacific countries, relates to the degree of Westernization of the populations studies'. This can be divided into three types of environments.

Traditional Pacific environment

The studies in traditional Pacific environments include studies in the Cook Islands [8, 13,14], Samoa [10], Wallis Islands [16], Tonga [18,19,23,24,26,27], Fiji Islands [28], Vanuatu [29], Guam [30] and Kiribati [25]. These generally show the lowest prevalences, although even in these populations prevalence has increased over time (figure 1). Studies conducted in Wallis Polynesians residing in the Wallis Islands as late as 1980 reported among the lowest recorded prevalence of diabetes in Polynesia - 2.7% among 25 to 64 year olds [21]. This is consistent with the estimates for rural Western Samoans10.

Urban Pacific Environment

Prevalence is generally higher in urban Pacific environments, including studies in the Cook Islands8.12, Samoa [70,22] Wallis Islands [16], Papua New Guinea [23.25], Fiji Islands [28], Vanuatu [29], Guam [30] and Kiribati [25]. Figure 2 shows studies in which surveys have been conducted at the same time in urban and rural areas in the same countries, and clearly shows the higher prevalence in urban areas in each country at each time point. In fact, some studies in urban areas in the Pacific show higher prevalence than in metropolitan adopted environments (figure 1). Thus, the change from traditional environments to a more urban and Western oriented environment appears to be accompanied by a striking increase in diabetic prevalence. Interestingly, urbanization had not occurred in the geographically isolated atoll of Manihiki (Cook Islands), but a change from traditional to a modern economy and way of life with a good cash income from copra and pearl shells was a probable cause for a high prevalence of abnormal glucose tolerance [13]. The indigenous people of Hawaii have the second highest rate of diabetes in the United States and a high prevalence of glucose intolerance associated with being overweight, even in rural communities31.

Prevalence **in Metropolitan Adopted Environments**

In addition to the comparison of residents of Wallis Islands and first generation migrants to New Caledonia' [6] the only available studies in metropolitan adopted environments we could identify are those in New Zealand [20]. These generally show a high prevalence of diabetes in Pacific people although, as noted above, prevalence is lower than in some urban Pacific environments (figure 1). . Diabetes prevalence figures of 12% and 20% were also reported among 25 to 64 year old Wallis Islanders who had migrated to Noumea [16] and 35 to 74 year old Tokelauans in New Zealand (20) respectively.

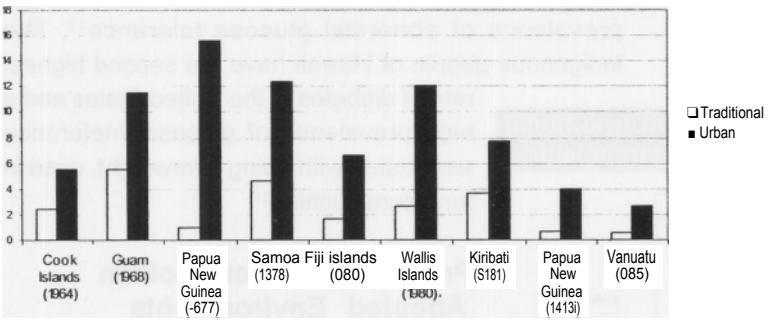
Comparisons between Pacific **people and other ethnic groups**

Some studies have also reported comparisons between Pacific people and other ethnic groups in the same metropolitan adopted environments. These have demonstrated a consistently higher prevalence of diabetes among Polynesians as compared to Caucasians. Across sectional household survey of over 25,000 residences in the multi-ethnic community of inner urban South Auckland (1992-1995) showed an age-adjusted prevalence of known diabetes of 1.9% in Caucasians, 5.2% among Maori, 4.0% among Pacific Islanders and 4.3% among other ethnic groups [32]. These prevalence figures are lower than those reported in a working population in the 1983 Christchurch Skellerup study which observed a prevalence of 4.9% among European/Asians and 16.7% for Maori/Pacific Islanders33.

An earlier cross-sectional survey (1988-1990) among a multiracial workforce at various worksites in and Auckland and Tokoroa showed the prevalence of new and known diabetes was lower in Caucasians, at 1.9%,

with Maori and Pacific Islanders at 9.9% and 8.9% respectively and Asians showing a prevalence of 7.5%34. A review of studies in New Zealand suggests an overall prevalence of diabetes of 5-10% and 4-8% for Maori and Pacific people respectively35

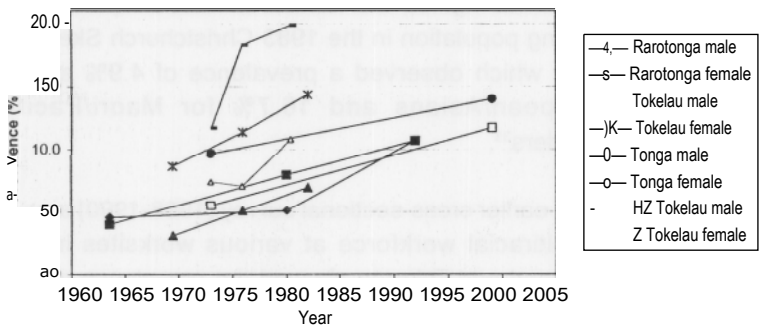
Figure 2: Prevalence studies in urban and rural areas in Pacific countries



Prevalence data for Pacific people in other countries are limited. The available evidence indicates higher figures for Hawaiians than Asians, non-Hispanic whites or Caucasians 7'36'37.

Figure 3 shows the findings for studies that have been repeated over time in selected populations using reasonably comparable methodology in terms of age groups studied, diagnostic criteria for diabetes and ethnicity. The figures for Tokelau are taken from the Tokelau Island migrant study in which major surveys were carried out in the Tokelau Islands in 1968, 1971, 1976 and 1982[20]. Similarly, the same diagnostic criteria and age group were applied to studies between 1972 and 1981 of male and female Tokelauans who had migrated and lived in New Zealand[420]. Other populations in Figure 3 are the 1973[78] and 1999[19] studies of Tongan urban males and females, as well as the Rarotongan study of males and females in 1962-63, 1980 and 1 9878'12'38'39. These studies examined patterns of diabetes prevalence in both traditional and urban environments as well as Polynesians in adopted metropolitan environments. All of the studies show clear increases in prevalence over time.

Figure 3: Changes in diabetes prevalence in Pacific populations over time



Relatively little information is available on morbidity from diabetes in Pacific people. While there have been reports on the complications associated with diabetes for more than three decades, the majority of these are based on clinic or hospital data which may not be representative of diabetics in general. A significant proportion of people with diabetes in the community will remain undiagnosed, of those diagnosed only some will be treated, and only some of those will receive adequate treatment. Nonetheless there is evidence of a high prevalence of vascular complications of diabetes and the WHO identifies diabetes as the major cause of blindness, renal failure and lower limb amputations in the Pacific region40.

A population-based study in Western Samoa reported a high prevalence of diabetic retinopathy and nephropathy[41]. A further study of New Zealand Maori and Pacific Islanders in New Zealand however suggests that predisposition to nephropathy in this group was associated with familial history of renal disease and not diabetes42.

The only available studies from Western countries are those from New Zealand. These indicate that Pacific people in general experience greater morbidity than others with diabetes. Cardiovascular and eye disease related to diabetes, including diabetic foot disease, has also been identified as more common among Pacific Islanders with diabetes living in New Zealand as compared to Caucasians. A 1983 study of Middlemore Hospital inpatients with diabetes reported that 28% of Pacific people compared with 1% of Caucasians with diabetes had chronic renal failure. Among working groups with normal glucose tolerance, microalbuminuria and nephropathy were also more common in Polynesians in comparison to Europeans (12% vs 3%) or newly diagnosed diabetics (35-50% vs 7%)[42"]. It also appears that Pacific Islanders experience a more rapid decline in renal function than Europeans when patients develop chronic renal failure". Undiagnosed diabetes in pregnancy had also been implicated as a major cause of morbidity and stillbirth among Pacific women in New Zealand. Of major concern is the high mortality and morbidity among both Maori and Pacific people in New Zealand from potentially avoidable diabetes related complications, particularly end-stage renal failure, sepsis and macrovascular disease[45]. Despite a perceived better income in Metropolitan Centres, Pacific patients in Auckland and Wellington ranked cost among the most important barriers to diabetes care'.

Little evidence is available regarding morbidity from diabetes in Pacific people in other Western countries, but the available evidence indicates that there are significant problems of diabetes diagnosis and management in other ethnic minorities, and there is no reason to believe that the situation is different for Pacific people. For example, African-Americans with diabetes have up to 30% more severe retinopathy, 30-300% more blindness, and a four times greater risk of end stage renal disease than white Americans with the same condition47.

Explanations for the prevalence and morbidity patterns

Thus the available epidemiological evidence indicates that: (i) prevalence is generally lowest in traditional Pacific environments, and is higher in both urban Pacific and adopted metropolitan environments; (ii) in the latter environments, prevalence is markedly higher in Pacific people than in Caucasians; (iii) prevalence has been increasing rapidly in all three environments; and (iv) amongst those with diabetes, Pacific people experience greater morbidity and more complications. In this section we consider the various explanations that have been proposed for these patterns.

Genetics

In 1962 James Neel" proposed that a "thrifty" metabolism among hunter-gatherer societies frequently facing intermittent periods of feast-or-famine alimentations enabled them to store excess energy in times of plenty for subsequent utilization in times of want. This hypothesis suggests that Pacific Islanders traditionally experienced alternating periods of abundance and famine, but now increasingly have greater access to high energy, low-fibre refined food and decreasing traditional/physical activity. As a result, they are at greater risk of obesity and life-style related non-communicable diseases including diabetes."

Alternative, if not totally opposing, views include the "thrifty phenotype" hypothesis [50], which proposes that Type 2 diabetes originates in poor nutrition in foetal life, and infancy resulting in impaired pancreatic beta cell development, insulin resistance and accompanying changes in glucose and lipid metabolism. The individual's ability to be "thrifty" is no longer beneficial in later life given an increased energy intake, decreased exercise and obesity, resulting in an increased susceptibility to diabetes.

The increasingly influential work of McMichael51 further inverts Neel's hypothesis. The cultivation of barley and wheat and a more glycaemic diet may have originated in Middle Eastern European areas 10,000 years ago resulting in a selection pressure among European farmers of greater insulin sensitivity. European populations, with ancestors traced to the oldest agrarian centres and the longest history of farming, have lower rates of diabetes than all other population groups. Populations that had not farmed (some Amerindian groups, Eskimos and Australian Aborigines) as well as groups that either farmed recently or only partially (West Africans, Japanese, Polynesians and Micronesians) are particularly at risk then for developing diabetes [51]. Middle Eastern farmers were also apparently the first to domesticate dairy animals. A diet high in simple sugars as well as whole milk intensified the selection pressure for increased insulin sensitivity and lactose tolerance. This suggests that European populations with lower susceptibility to diabetes might be the exception, rather than the rule [51], i.e. almost everyone may have the "thrifty genotype" except Europeans.

Lifestyle

Although the "thrifty genotype" and "thrifty phenotype" hypotheses differ, they both involve a genetic susceptibility to "Western" diet and lifestyle, which is strongly associated with an increased risk of developing diabetes, both for Pacific people and for others. Due to rapid changes in lifestyle, risk factors such as obesity, unhealthy diets and physical inactivity have become widespread throughout the region. This is particularly evident in the populations with the greatest social and economic changes. Pacific populations have been reported to be among the most obese populations in the world [52], and Bell et al [53] found a higher prevalence of obesity among Pacific people living in New Zealand than in native Hawaiians or Pima Indians, with women having a higher prevalence than men [53]. Bell's findings were consistent with those from previous New Zealand studies, which found that Pacific people were less involved in leisure-time activities than Maori or Caucasians with women being less active than men among Pacific Islanders [53]. Likewise, Taylor et a121 reported obesity, a diet high in calorie and animal fat, decreased exercise, smoking and stress to be endemic in Pacific people.

Social and Economic causes

Although obesity and individual lifestyle are clearly major risk factors for diabetes, they do not occur in a vacuum [54, 55]. This is shown by the differences in prevalence of obesity and diabetes in Pacific people depending on the situation in which they are living. Evans et a1 [56], concluded from a study in Tonga that the consumption of foods linked to non-communicable diseases occurred despite people's preferences or

perceptions of nutritional value, as they are cheaper. Hence, poor diet is not simply a health or health education driven decision. It is also very much an economic issue[54,55]. In one Pacific country, the leasing of certain traditional and easily accessible shallow waters alongside villages makes fishing for food illegal in these areas, because of a monopoly established by a fishing company whose major share holder is a local political leader. In fact, inequitable land distribution supported by the constitutionalisation of traditional land monopoly ownership is not uncommon in most Pacific Island countries. It is therefore unrealistic to promote a traditional diet when excess land is not made available for the people to grow traditional food items or fish for food. Traditional landholders meanwhile ensure that excess fertile land is unavailable except for perhaps a few head of cattle and occasional "renting" of arable land to economically powerful cash crop farmers.

Vested commercial interests are not confined within countries, but also affect trade policy. Healthier, low-fat sources of proteins such as fish generally cost 15% and 50% more than either mutton flaps or imported chicken parts, which are also more easily accessible and available than fish or indigenous chicken in some Pacific countries. Fiji's decision to ban the importation of mutton flaps immediately resulted in New Zealand threatening a complaint to the World Trade Organization [57]. For the 10-year period 1 989-1 999 25% of imports in Tonga were food items[56]. Over the same period, the cost of imported meat doubled while per capita consumption had increases by over 60% from 35 to 56 kilos per person. As members, and others eager to be members soon of the World Trade Organization (WTO) Pacific nations are required to comply with the General Agreement on Trade and Tariffs (GATT). Article XX (b) of the General Exemptions section of the General Agreement on Tariffs and Trade (GATT) and subsequent agreements states that hazardous imports can be regulated, but this option is overshadowed by the general liberalization of trade globally. Overall, GATT makes it very difficult to oppose or restrict the importation of unhealthy food products. Hence, diabetes is not only a problem associated with the local economy[56] but also with trade regulations.

We have recently reviewed options for prevention and control of diabetes in Pacific people [54] and these will therefore only be considered briefly here.

Although often isolated geographically, modernization and development has changed, and will continue to change, the Pacific peoples' ways of life. Diabetes and its associated complications are a major concern in Pacific Island nations in terms of health and the economy. Diabetes is the leading cause of blindness, cardiovascular diseases and renal disease in the Pacific region[40]. The demographic transition to an ageing population will result in an increase in the number of diabetes patients further compromising and already compromised health budget. In addition to the health burden, premature deaths and disability from diabetes have significant implications for productivity as well as social costs to communities and individual families.

The epidemic of diabetes in the Pacific, and in Pacific people in other countries, requires that we reconsider the options for prevention and control of this condition in Pacific people[54]. While the patterns of diabetes occurrence are often attributed to genetic factors and individual behaviours; and are therefore addressed by community prevention and health promotion programs; they are also caused by broader political and social factors[55]. While we should not invest all our resources upstream, a balanced distribution of resources across the range of intervention points is urgently needed. This includes social action for equity in addition to programmes "targeted" at individual lifestyle. The WHO has stated that the prevention and control of non-communicable diseases cannot be achieved by the medical profession alone, but rather requires active participation from the public and social planners, the private sector, economists and politicians[58]. The early studies of diabetes in the Pacific suggested the need for a broad ecological approach to studying and preventing diabetes. Government commitments in coordinating and following through such activities may have been lacking. Rather, respective countries focused on traditional medical approaches at the expense of preventive medicine and community health programmes9.

While the impact of diabetes and its complications on individuals, the economy and the health budget is clearly visible, emphasis should be placed on supportive political and social environments in which unhealthy diets, physical inactivity and obesity can be modified. In most Pacific Island countries there is a reasonably well-established infrastructure and facilities for Primary Health Care (PHC) whereby diabetes prevention and control including basic diagnostic and treatment could be channelled. There is now an urgent need for a comprehensive and integrated approach to diabetes prevention and control, that takes into account all of the relevant risk factors, at the individual, the country and the international levels.

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That it will never come again is what makes life so sweet
(Emily Dickson 1830 - 1886)