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Type 2 diabetes in Indigenous populations: quality of intervention research over 20 years.

Bridgette J McNamara[a], Rob Sanson-Fisher[b], Catherine D'Este[c], and Sandra Eades[a]

[a]Preventative Health, Baker IDI Heart and Diabetes Institute, PO Box 6492 St Kilda Road Central, Melbourne, Vic 8008, Australia
bridgette.mcnamara@bakeridi.edu.au, Sandra.eades@bakeridi.edu.au

[b]Priority Research Centre for Health Behaviour, University of Newcastle, Rm 267 David Maddison Building, King & Watt Streets, Newcastle NSW 2300, Australia
Rob.Sanson-Fisher@newcastle.edu.au

[c] School of Medicine and Public Health, University of Newcastle, Upper Level Bowman Building, Callaghan NSW 2308, Australia
Catherine.DEste@newcastle.edu.au

Correspondence to: Dr B McNamara, bridgette.mcnamara@bakeridi.edu.au
Preventative Health, Baker IDI Heart and Diabetes Institute,
PO Box 6492 St Kilda Road Central, Melbourne, Vic 8008.
Ph (03) 8532 1395 Fax (03) 8532 1100

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ABSTRACT

Background. A robust evidence base is needed to reduce the disproportionately high rates of diabetes-related mortality and complications among Indigenous peoples.

Objective. To evaluate the quantity and methodological quality of published intervention research on Type 2 and gestational diabetes in the Indigenous populations of Australia, Canada, New Zealand and the United States from 1989-2008.

Method. Systematic searches of Medline, Embase and EBM Reviews identified publications focused on Type 2 or gestational diabetes in Indigenous peoples published between 1 January 1989 and 31 December 2008. Total publication number and proportion of research involving interventions over time were examined. The quality of intervention studies was evaluated using Cochrane's Effective Practice and Organisation of Care (EPOC) criteria.

Results. Total publication number increased significantly over the 20 years ($p<0.004$). Research was predominantly descriptive (87%), with the proportion of research involving interventions increasing from 3% in 1989-1993 to 12% in 2003-2008 ($\chi^2=12.42$, df=3, $p=0.006$). However, only 25% (95%CI: 9%-41%) of intervention studies met the EPOC methodological quality criteria; other studies lacked sufficient controls or measurements over time.

Conclusions. Increases in the amount of high quality intervention research for prevention and treatment of Type 2 and gestational diabetes among Indigenous populations of these countries are needed.

200 words

INTRODUCTION

Type 2 Diabetes contributes to the health inequalities experienced by Indigenous peoples in developed countries. In Australia, Type 2 diabetes and ischemic heart disease contribute to 26% of the excess disease burden of Indigenous Australians and to a 13-year lower life expectancy than other Australians (Vos, et al., 2007). In New Zealand, the lower life expectancy in Maori men and women (8-9 years less than the general population) is partly attributed to different rates of diabetes and smoking (Ministry of Health, 2009; Statistics New Zealand, 2009). In the United States, the age-adjusted death rate for diabetes mellitus in American Indians/Alaskan Natives in 2006 was 1.9 times higher than in US non-Hispanic whites (39.6 and 20.4 per 100,000, respectively) (US Department of Health and Human Services, 2006). The severity of certain diabetic complications including end-stage renal disease and lower-extremity amputation tend to be significantly higher among Indigenous groups (Chaturvedi, et al., 2001; Naqshbandi, et al., 2008; Spencer, et al., 1998). Addressing Type 2 diabetes and the background risk factors (including obesity, sedentary behavior and gestational diabetes) is critical to reducing indigenous health inequalities in these countries.

Governments of Australia, Canada, New Zealand and the United States have identified Type 2 diabetes and Indigenous Health as priority areas for research and health services. These directives have principally occurred within the last ten years, and have resulted in a number of research funding collaboration initiatives and Indigenous-specific health service organizations, *including the National Center on Minority Health and Health Disparities (NCMHD) in the United States (established in 2000), the Institute of Aboriginal Peoples' Health in Canada (established in 2000) and the National Health and Medical Research Council (NHMRC) of Australia Strategic Plan 2003-2006* allocating at least 5% of research funding to Indigenous Health (Cunningham, et al., 2003).

Research that develops and evaluates interventions aimed at preventing and managing the condition is fundamental to evidence based practice in this field. Policy makers, health service providers and Indigenous communities themselves seek a solid evidence base of "up-to-date information from relevant, valid research" (Cochrane, 1972) to guide their efforts in the prevention and treatment of Type 2 diabetes. Given the unique needs and designated health services for Indigenous populations there is a need for an evidence base for this group.

The level of evidence provided by an intervention study is based on the ability of the study to demonstrate causality or the effectiveness of the intervention. This can be assessed by

criteria that evaluate the methodological quality of the study design and the risk of bias in its conduction, and therefore the level of evidence it is able to provide. The Cochrane Collaboration's Effective Practice and Organisation of Care (EPOC) group provides guidelines for the evaluation of intervention research in community and education settings (McAuley, 2002).

In light of the increased funding for diabetes research and Indigenous health research, it is reasonable to expect that the amount of research in this field will have increased over time, and be reflected in the number of research publications produced. The aims of this study were to determine whether 1) the amount of research (total and original data-based) and 2) the proportion of research that tests the effectiveness of intervention strategies has changed over time; and 3) whether the intervention research is of sufficient methodological quality to contribute to an evidence base for prevention and management of Type 2 diabetes in Indigenous populations. Sufficient methodological quality was defined by the minimum standards set by Cochrane EPOC inclusion and quality criteria (McAuley, 2002).

METHODS

Data Sources

Searches of Medline, EMBASE and EBM Reviews databases identified articles published between 1 January 1989 and 31 December 2008 on the subject of Type 2 diabetes and/or gestational diabetes in Indigenous populations of Australia, Canada, New Zealand and the United States. A 20 year period, beginning in 1989, was examined to give sufficient time for trends in numbers of research publications over time to be observed.

Search Strategy

Search terms included a combination of MeSH and keywords to identify publications related to the Indigenous populations: Aborigines or Aboriginal, Torres Strait Islander or Torres Strait, Maori, American Indian, North American Indian, Alaska(n) Native, native Hawaii(an), native American, American Samoa(n), Eskimo, Inuit, Aleut, Metis, Indigenous, Indigenous health services; and a combination of MeSH *Diabetes Mellitus, Type 2/ or *Diabetes Mellitus/ or *Diabetes, Gestational/ (Medline, EBM Reviews) and keywords 'Type 2 diabetes', 'gestational diabetes' (EMBASE) to identify those related to Type 2 and gestational diabetes. Duplicate citations from the multiple databases were removed. The search identified 821 citations.

Selection Criteria

Inclusion and Exclusion criteria were applied to the titles and abstracts of identified citations. All types of published studies were included if they:

1. had Type 2 diabetes or gestational diabetes as their main focus/outcome, or they deliberately examined the effect of diabetes on another outcome (e.g. diabetic/non-diabetic cohorts)

2. had included all or predominantly Indigenous participants and/or compared Indigenous and non-Indigenous groups, and/or used ethnicity as a predictor

Publications were excluded if their main focus and outcome measures related to co-morbidities such as cardiovascular disease, hypertension, or obesity and they did not deliberately address the effect of diabetes (i.e. with diabetic/non-diabetic comparisons). Reports that focused on Type 1 diabetes or that did not differentiate between Type 1 and Type 2 were also excluded. Publications without abstracts were excluded if the appropriate information could not be gained from the title and relevant keywords in the full citation.

Data extraction

Publications meeting the inclusion criteria were classified by publication type into original research, reviews, discussion papers and cases studies. Original research publications were categorised by research type into *measurement research* - developing or testing a measure or measurement tool, *descriptive research* - characterising the nature of the condition and potential risk factors and causation, or *intervention research* – testing the effectiveness of clinical or public health intervention. Descriptions of the research types have been previously described in (Sanson-Fisher, et al., 2006).

If a publication focused on descriptive or measurement research in addition to intervention research, it was classified as intervention research, and publications that focused on both measurement and descriptive issues were coded as measurement research.

Selection and classification were performed by a principal reviewer, with a random sample of 100 publications (12%) reanalysed by a second independent reviewer and assessed using the Kappa statistic (K).

Quality of intervention studies

Full text versions of intervention research publications published between 1989 and 2008 (inclusive) were assessed separately by two independent reviewers using the Cochrane Collaborations Effective practice and Organisation (EPOC) criteria relating to methodological design and quality (Table 1)(McAuley, 2002). EPOC inclusion criteria describe a variety of

robust study designs, including interrupted times series (ITS) designs, controlled before and after (CBA) designs and randomized controlled trials (RCTs), and designate minimum requirements for each.

Statistical Methods

Statistical analysis was undertaken using Stata 10.1 (StataCorp LP, Texas). Change in total publication number and original research publications over time was examined using linear regression of number of publications versus year for the four countries combined and for each country individually. A coefficient estimate for the slope that was statistically significantly greater than zero would indicate an increase in the number of publications over time. Change in the proportion of research that was intervention-based compared to non-intervention based (including descriptive and measurement research) over the four five-year time periods (1989-1993, 1994-1998, 1999-2003, 2004-2008) was assessed using a Chi-square test. The proportion of intervention studies fulfilling the EPOC inclusion criteria was determined with 95% confidence interval. To test whether the majority of studies fulfilled these criteria, confidence intervals of proportion were compared to a benchmark of 75% - If the upper limit of the confidence interval was less than 75%, we conclude that the majority of intervention studies did not meet appropriate standards. The trend over time in the proportion of intervention studies meeting inclusion criteria was assessed using a Fisher's exact test comparing the first and second decades.

RESULTS

The search terms identified 821 publications, from these a total of 613 publications relating to Type 2 diabetes (92%) or gestational diabetes (5%), or both (3%) in Indigenous populations of Australia, Canada, New Zealand and the United States were included based on the selection criteria and 208 were excluded (**Figure 1**). *Inter rater reliability:* Agreement between reviewers was strong (inclusion criteria 92%, K=0.80; publication type 87%, K=0.78; research type 91%, K=0.85).

Has the total number of publications increased over time? The total number of publications (β(estimate)=0.99 (SE 0.30), p<0.004) and the number of original research papers (β(estimate)=0.69 (SE 0.25), p<0.01) in the four countries combined increased linearly over the 20 years, as did the number of publications within Australia, Canada and New Zealand. Original data-based research accounted for 77% (n=470) of the total publications. Reviews (11%), program descriptions (5%), discussion papers and commentaries (7%), and one case report constituted the remainder (Table 2).

Has there been an increase in the proportion of intervention studies? Descriptive research predominated across all four countries in each time period, accounting for 87% of total original research publications (Table 2). There was a statistically significant change in the type of studies across the four time periods (χ^2=12.42, df=3, p=0.006). A decrease in the proportion of descriptive research corresponded with an increased proportion of both intervention and measurement research in the later ten years (Table 2). Intervention research publications were very scarce in the earlier ten year period (1989-1998); no intervention studies relating to diabetes and the Indigenous populations of Australia, Canada and New Zealand were published during this time. However, the number of intervention research publications increased to 5-7 within these countries in the later 10 years (1999-2008), and from 5 publications to 11 publications in the United States. In the later 10 year period, intervention research constituted between 8% and 17% of data-based research in each country.

Were the intervention studies of sufficient quality? Over the 20 year period, 28 separate intervention studies were presented within 32 publications (4 studies had two related publications, Table 3). Only seven of the 28 studies fulfilled the inclusion criteria for an EPOC review of evidence (Table 3 – studies in bold font). Therefore the observed proportion of studies fulfilling the inclusion criteria was 25% (CI: 9%-41%); significantly below the hypothesized benchmark value of 75% (designating a majority). There was no change in the proportion by decade of publication (1989-1998 and 1999-2008) (p=0.71).

All seven studies fulfilling the inclusion criteria had randomized, controlled designs, which were either randomized control trials (of individuals) or randomized cluster trial design [RCT (Cluster)] with health services randomized in place of individuals (1 study). These studies fulfilled most of the EPOC quality criteria for RCTs. However, 'protection against contamination' which entails ensuring controls are not exposed to the intervention was lacking in two studies as the treatment in one study was being given to both arms by the same physician, therefore risking a possible halo effect in prescribing patterns (Tobe, et al., 2006). In the other study, individuals were randomized within a community-based setting rather than larger clusters, which meant that there was a high likelihood that knowledge presented in the intervention was shared with control participants (Thompson, et al., 2008).

Three quarters (n=21) of the intervention studies relating to Type 2 and gestational diabetes in Indigenous populations did not fulfil EPOC requirements for contributing to the evidence base. Single group study designs with either pre- and post-tests, or post-tests alone lacked

a control comparison and did not present sufficient measures across multiple time points to ensure reliable conclusions. Similarly the other ITS designs lacked sufficient measures before and after the intervention to be included (a minimum of 3 time points pre- and 3 post-intervention are required). The CBA intervention studies did not undertake the intervention in a sufficient number of sites (a minimum of two control and two intervention sites are required) or controls were not studied in the same time period. Therefore, according to EPOC criteria (Table 1), these 21 studies do not provide a sufficient level of evidence to contribute substantially to the evidence base for Type 2 diabetes among Indigenous populations.

DISCUSSION

This evaluation of the research output relating to prevention and treatment of Type 2 and gestational diabetes in the Indigenous populations of Australia, Canada, New Zealand and the United States produced three main findings: 1) That the number of publications in this field has increased over the selected 20 year period (1989-2008); 2) That while there continues to be a predominance of descriptive research in this field, the proportion of intervention research compared to non-intervention research has increased significantly over time; and 3) That only 25% (CI: 9%-41%) of the intervention studies met criteria from the Cochrane Collaboration for methodological quality sufficient to contribute to the evidence base for prevention and treatment of Type 2 and gestational diabetes in Indigenous people.

The current study was limited to published literature indexed in the three database searched. While it is possible that research output relating to diabetes in Indigenous people may have been published in other forms such as in the 'grey literature', peer-reviewed journals are the most common way to disseminate important research findings and databases such as those chosen for this study are typically the main resource accessed by researchers, clinicians and government conducting systematic reviews or formulating guidelines. The systematic nature of the search and the use of two large medical databases (Medline, EMBASE) and one database of medical reviews (EBM Reviews) means that the substantial bulk of peer-reviewed research would have been identified. The 20 year period assessed by this study allowed sufficient estimated time to assess the change in publication number and type.

Previous reviews of Indigenous health research output with a broader focus (all areas of Indigenous health research), but a more limited time frame, also found that the total research numbers of peer-reviewed publications increased over time (Sanson-Fisher, et al., 2006), and a lack of high quality intervention research (Paul, et al., 2010). These studies and

another looking at three major preventative health issues – tobacco use, alcohol use, inadequate physical activity - in the wider community (including non-Indigenous people) have also found a preponderance of descriptive research in all time periods (Sanson-Fisher, et al., 2008), for which many reasons have been suggested including ease of conception, short term funding structures and expertise of the majority of trained researchers in the field. Our review, which uses a particularly important health issue for Indigenous populations in four countries to examine research output, showed findings consistent with those in the previous studies, but was able to provide a more detailed picture across the entire time period. Like these studies we have found an urgent need to increase the amount of high quality intervention research in this field, which is currently at low levels. Yet encouragingly, we found that there was a change in the type of studies over the 20 year time period studied; with an increase in the proportion of intervention studies.

Issues faced with developing intervention research among Indigenous populations may contribute to the low quantity and quality of intervention research publications in contrast to descriptive research. These issues may include ethical, logistical, cultural and financial difficulties. Ethical issues may make it difficult or even inappropriate to use controls and randomization. For example, some Indigenous communities are reluctant to offer a potentially beneficial health intervention to some members of the community whilst withholding the intervention from other members. Logistic issues also contribute to the difficulties conducting intervention research. Many interventions require a large sample size of individuals or communities to test the effectiveness. Such studies may require multi-site trials. However many Indigenous communities operate as autonomous entities in keeping with a philosophy of self-determination as opposed to the imposition of colonial rule and lack of autonomy. We found no evidence of formal mechanisms to facilitate multi-center intervention studies for Type 2 diabetes with Indigenous communities in any of the four countries. However, the 'Pathways' intervention for prevention of childhood obesity in American Indians exemplifies a large multisite intervention trial for improving the health behaviors of school-aged children (Caballero, et al., 2003; Steckler, et al., 2003), and may provide an example of effective organizational processes for future diabetes research studies.

Methodological issues may be more difficult to address when implementing intervention studies in the Indigenous setting. For example contamination of the intervention effect may be more likely when delivering an intervention to Indigenous minorities, particularly in rural and remote settings. Family and kinship systems and residential and social clustering, present even in some urban centers, may result in greater contact between indigenous

community members than the wider community and as such consideration of the anticipated extent of communication between intervention and control participants is particularly important in the Indigenous health setting. The burden of research on Indigenous communities may also impede intervention research. Many intervention studies are conducted with population groups who do not experience the profound levels of social and economic disadvantage that is common to Indigenous people in these four countries. In this context, the impost of large scale intervention studies on individuals, families, organisations and communities is likely to be greater. Finally, intervention studies are expensive and it is likely that higher costs will be associated with conducting intervention studies with Indigenous communities; for example, the cost of travel and personnel support within a multi-site study with different sites located in remote, rural and urban Indigenous communities across different states and territories within these four countries may be prohibitively high.

A major finding in this review was the large proportion of intervention studies that did not meet the basic quality criteria for methodological quality devised by the Cochrane EPOC group. These criteria were published in their current form in 2002, therefore the year in which the intervention studies were undertaken needs to be considered in the evaluation. Many of the studies in this 20 year review were developed and funded prior to the publication of the EPOC criteria. Thus Indigenous communities, researchers and research funding agencies may not have had the opportunity to consider such stringent quality criteria when deciding on the value of time and resource allocation to give intervention research opportunities as they arose. However, opportunity now exists for the value and relevance of the EPOC and other related intervention research quality criteria to be debated and implemented more rigorously in the Indigenous health field. Whilst in this study only randomised controlled trials met the EPOC quality criteria it is possible that other intervention study designs such as controlled before and after and interrupted time series designs may be more appropriate for some intervention studies in this setting. The results of this review show that researchers using these designs need to make modifications such as increasing the number of measures conducted before and after the implementation of the intervention or increasing the number of different sites participating in the study to comply with quality criteria. In order for the quality of intervention studies to improve it will be necessary for researchers, research funding agencies and communities to be aware of the quality criteria and to debate reasonable quality expectations for this field. Research funding agencies in particular may be well placed to facilitate that debate within each country with the aim, in the long term, of increasing the value of their investment in Indigenous health research in terms of the quality of research outputs in coming decades.

CONCLUSIONS

The amount of intervention research relating to diabetics in Indigenous populations is increasing. However consideration needs to be given to improving the methodological quality of the studies conducted. Developing a robust evidence base upon which health professionals and community leaders can base their decisions for the prevention and treatment of diabetes in Indigenous people of these four countries will require a concerted effort from researchers, funding bodies, health organisations and Indigenous community leaders to encourage intervention research of sufficient methodological quality that is culturally appropriate. This review highlights the deficiencies in the current evidence base and has used the EPOC quality criteria as a basis for discussion of methodological issues.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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Ethics Approval

Ethics Approval was not required for this study.

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Table 1: Summary of Cochrane Effective Practice and Organisation of Care (EPOC) Review Group study design inclusion criteria and methodological quality criteria (McAuley, 2002)

Study design standards (minimum requirements for inclusion into an EPOC review):

Randomised controlled trial (RCT) or Controlled clinical trial (CCT)

1) Random or quasi-random allocation

Controlled before and after study (CBA)

1) Contemporaneous data collection for study control sites
2) Appropriate choice of control site
3) Minimum of two control sites and two intervention sites

Interrupted time series (ITS)

1) Clearly defined point in time when the intervention occurred
2) At least three data points before and three after the intervention

Methodological quality criteria (for studies meeting the above study design standards):

For RCT or CCT or CBA

Concealment of allocation *(RCT only)*
random process, centralised randomisation scheme
Characteristics of study and control sites *(CBA only)*
characteristics reported and similar
Follow up
outcome measures obtained for 80-100% of subjects randomised or began in the study
Blinded assessment of primary outcomes or objective outcome variables
assessed blindly or outcome variables were objective (e.g. length of hospital stay, drug levels by a standardized test)
Baseline measurement
measured prior to intervention, no substantial differences that would undermine post intervention finding
Reliable primary outcome measure
two or more raters & at least 90% agreement or kappa ≥ 0.8, OR outcome measured by automated system
Protection against contamination
allocation by community, institution or practice, and/or unlikely that control received intervention due to communication between groups

For ITS

Protection against secular changes over time
intervention occurred independently of other changes over time
Data analysed appropriately
ARIMA models or time series regression models and serial correlation was adjusted/tested
Reason for the number of points pre and post intervention given
a specific rationale (eg. length of decay of effect) or sample size calculation
Shape of the intervention effect was specified
A rational explanation for shape of effect was given
Intervention unlikely to affect data collection
same sources and methods for data collection before and after intervention
Blinded assessment of primary outcome or objective outcome
assessed blindly or outcome variables were objective(e.g. length of hospital stay, drug levels by a standardized test)
Completeness of data set
covers 80-100% of total number of patients or episodes of care
Reliable primary outcome measure
two or more raters with ≥90% agreement or kappa ≥0.80 or outcome measured by an automated system

Table 2: Number and type of publications relating to Type 2 and gestational diabetes in Indigenous populations of Australia, Canada, New Zealand and the United States by publication period.

Period of publication[a]	Type of original research				Other types of publications					All publications
	Measurement	Descriptive	**Intervention**	All	Review	Program Descript.	Discussion paper	Case Report	All	Total
	n (%)	n (%)	**n (%)[b]**	n (%)	n	n	n	n	n	n
1989-1993	4 (4)	86 (93)	**3 (3)**	93 (100)	17	1	7	0	25	118
1994-1998	4 (4)	108 (95)	**2 (2)**	114 (100)	11	8	10	1	30	144
1999-2003	11 (9)	105 (83)	**11 (11)**	127 (100)	19	11	17	0	47	174
2004-2008	12 (9)	108 (79)	**16 (12)**	136 (100)	21	10	10	0	41	177
Total	31 (7)	407 (87)	**32 (7)**	470 (100)	68	30	44	1	143	613

[a]Numbers of publications for the four countries combined are presented in 5 year time intervals. [b]Significant increase in the proportion of research that was Intervention-based vs. non-intervention-based over time (chi-squared, p=0.006)

Table 3: Intervention research publications relating to Type 2 and gestational diabetes in Indigenous populations of Australia, Canada, New Zealand and the United states published from 1989 to 2008 by study design and country.

	Study design	Country	Population[a]	Focus of intervention
A	**RCT Cluster(McDermott, et al., 2001)**	**Australia**	**ATSI Australians**	**Diabetes management - recall system**
	RCT(Tobe, et al., 2006)	**Canada**	**First Nations**	**Hypertensive treatment in diabetics**
	RCT(Simmons, et al., 2000)	**New Zealand**	**Maori and Pacific Islanders**	**Medication packaging – blister packs**
	RCT(Grossi, et al., 1997)	**United States**	**Native Americans (Pima heritage)**	**Treatment of periodontal disease on HBA1C**
	RCT(Mayer-Davis, et al., 2004)	**United States**	**American Indians**	**Dietary and lifestyle modification**
B	**RCT(Fleg, et al., 2008)**	**United States**	**American Indians**	**Lowering blood pressure & cholesterol in diabetics**
B	**RCT(Howard, et al., 2008)**	**United States**	**American Indians**	**Lowering blood pressure & cholesterol in diabetics**
	RCT(Thompson, et al., 2008)	**United States**	**American Indian women**	**Dietary and lifestyle modification**
	CBA(Daniel, et al., 1999)	Canada	Aboriginal Canadians	Dietary and lifestyle modification
	CBA(Heath, et al., 1991)	United States	Zuni Indians	Dietary and lifestyle modification
C	CBA(Paradis, et al., 2005)	Canada	Mohawk children (Kahnawake)	Dietary and lifestyle modification
	CBA(Robertson, et al., 2007)	United States	American Indians (Northern Plains)	Diabetes management – interactive website
	CBA(Wilson, et al., 2005)	United States	American Indians/Alaska natives	Nurse case managers
	CBA (Gilliland, et al., 2002)	United States	Native Americans (New Mexico)	Dietary and lifestyle modification
	CBA (self selected control)(Beckham, et al., 2008)	United States	Native Hawaiian/Samoan	Diabetes management – community health workers
	CBA (historical control)(Gray-Donald, et al., 2000)	Canada	Cree (James Bay, Quebec)	Gestational diabetes - Dietary and lifestyle modification
C	CBA (historical control)(Jimenez, et al., 2003)	Canada	Mohawk children (Kahnawake)	Dietary education
D	ITS (1 base, 2 post)(Ritenbaugh, et al., 2003)	United States	Zuni Indian youth	Dietary and lifestyle modification
	ITS (1 base, 2 post)(Shand, et al., 2007)	New Zealand	Maori-Polynesian	Efficacy of treatment (Pioglitazone)
	ITS (1 base, 2 post) & CBA (self selected controls)(Rowley, et al., 2000)	Australia	Aboriginal Australians	Dietary and lifestyle modification
	ITS (1 base, 4 post)(Bailie, et al., 2004)	Australia	Aboriginal Australians	Diabetes management - recall system
A	ITS (pre & post test)(McDermott, et al., 2003)	Australia	ATSI Australians	Diabetes management - recall systems
	ITS (pre & post test)(Simmons, 2003)	Australia	ATSI Australians	Integrated diabetes care service
	ITS (pre & post test)(Chan, et al., 2007)	Australia	Indigenous Australians	Dietary and lifestyle modification
	ITS (pre & post test)(McAuley, et al., 2003)	New Zealand	Maori	Dietary and lifestyle modification
	ITS (pre & post test)(Agban, et al., 2008)	New Zealand	Maori and Pacific Islanders	Diabetes management – guideline implementation
	ITS (pre & post test)(Simmons, et al., 2008)	New Zealand	Maori	Dietary and lifestyle modification
	ITS (pre & post test)(Baker, 1991)	United States	Alaskan natives	Diabetes management – guideline implementation
	ITS (pre & post test)(Acton, et al., 1993)	United States	American Indians	Diabetes management – guideline implementation
D	ITS (pre & post test)(Teufel and Ritenbaugh, 1998)	United States	Zuni Indian youth	Dietary and lifestyle modification
	ITS (pre & post test)(Carrel, et al., 2005)	United States	Native American youth (Ho-Chunk tribe)	Dietary and lifestyle modification
	ITS (post test only)(Bachar, et al., 2006)	United States	Cherokee Indians	Dietary and lifestyle modification

A, B, C, D denote related publications of a single intervention; Publications relating to studies that met EPOC inclusion criteria are in bolded font; [a]Terms used are those in the publication and population refers to male and female adults unless otherwise specified; ATSI: Aboriginal and Torres Strait Islanders; RCT Randomized control trial; CBA Controlled before and after study; ITS Interrupted time series

Figure Legend

Figure 1: Study flow diagram showing selection and classification of publications by publication type and research type.

Author/s:
McNamara, BJ; Sanson-Fisher, R; D'Este, C; Eades, S

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