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Population-based weight loss and gain do not explain trends in asthma mortality in Cuba: a prospective study from 1964 to 2014

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Background: The increase in prevalence of obesity is a possible risk factor for asthma in developed countries. As the people of Cuba experienced an acute population-based decrease in weight in the 1990s, we tested the hypothesis that national weight loss and subsequent weight gain was associated a reciprocal changes in asthma mortality.
Methods: Data were obtained on mortality rates from asthma and COPD in Cuba from 1964 to 2014, along with data on prevalence of obesity for this period. Joinpoint analysis was used to identify inflexion points in the data.
Results: Although the prevalence of obesity from 1990 to 1995 decreased from 14% to 7%, over the same time period the rate of asthma mortality increased from 4.5 deaths per 100,000 population to 5.4 deaths per 100,000 population. In 2010, the obesity prevalence subsequently increased to 15% in 2010, while the asthma mortality rate dropped to 2.3 deaths per 100,000 population. The optimal model for fit of asthma mortality over time gave an increasing linear association from 1964 to 1995 (95% confidence interval for inflexion point: 1993 to 1997), followed by a decrease in asthma mortality rates from 1995 to 1999 (95% confidence interval for inflexion point: 1997 to 2002).
Conclusions: These national data do not support the hypothesis that population-based changes in weight are associated with asthma mortality. Other possible explanations for the large decreases in asthma mortality rates include changes in pollution or better delivery of medical care over the same time period.

Introduction

The global role of the obesity epidemic [1] on asthma remains unclear, as this is a gradual phenomenon and confounded by concurrent lifestyle changes. There have not been any longitudinal studies in which a clear intervention results in population-based weight loss followed by societal weight gain along with reliable measures of asthma control.

In the 1990s Cuba suffered a severe economic depression when the Soviet Union withdrew economic support abruptly, resulting in a shortage of food [2] which led to widespread population-based weight loss. In the period from 1991 to 1995, a fall in average body mass index by 1.5 kg/m^2 was observed, equivalent to a mean weight loss of 5.5Kg. Since 1995 however, as food has become more available again, average BMI increased by 2.6 kg/m^2 by 2010 [3]. These events thus present a unique opportunity to study the effects of a period of weight loss and subsequent gain on national asthma mortality, over a period when high quality health statistics continued to be collected [4]

Methods

Study population

The study used national mortality data for all deaths from asthma in Cuba from 1964 to 2014. Data were extracted on deaths from asthma (before 2001 = 493 (ICD-9), 2001-2014 = J45-46 (ICD-10)) and also on deaths from emphysema and chronic bronchitis (before 2001 = 490-492 (ICD-9), 2001-2014 = J40-43 (ICD-10)), to explore the possibility of diagnostic misclassification. Data on population weight, body mass index and cigarette smoking prevalence were obtained from Franco *et al* [3] and Cuban national surveys.

Statistical analysis

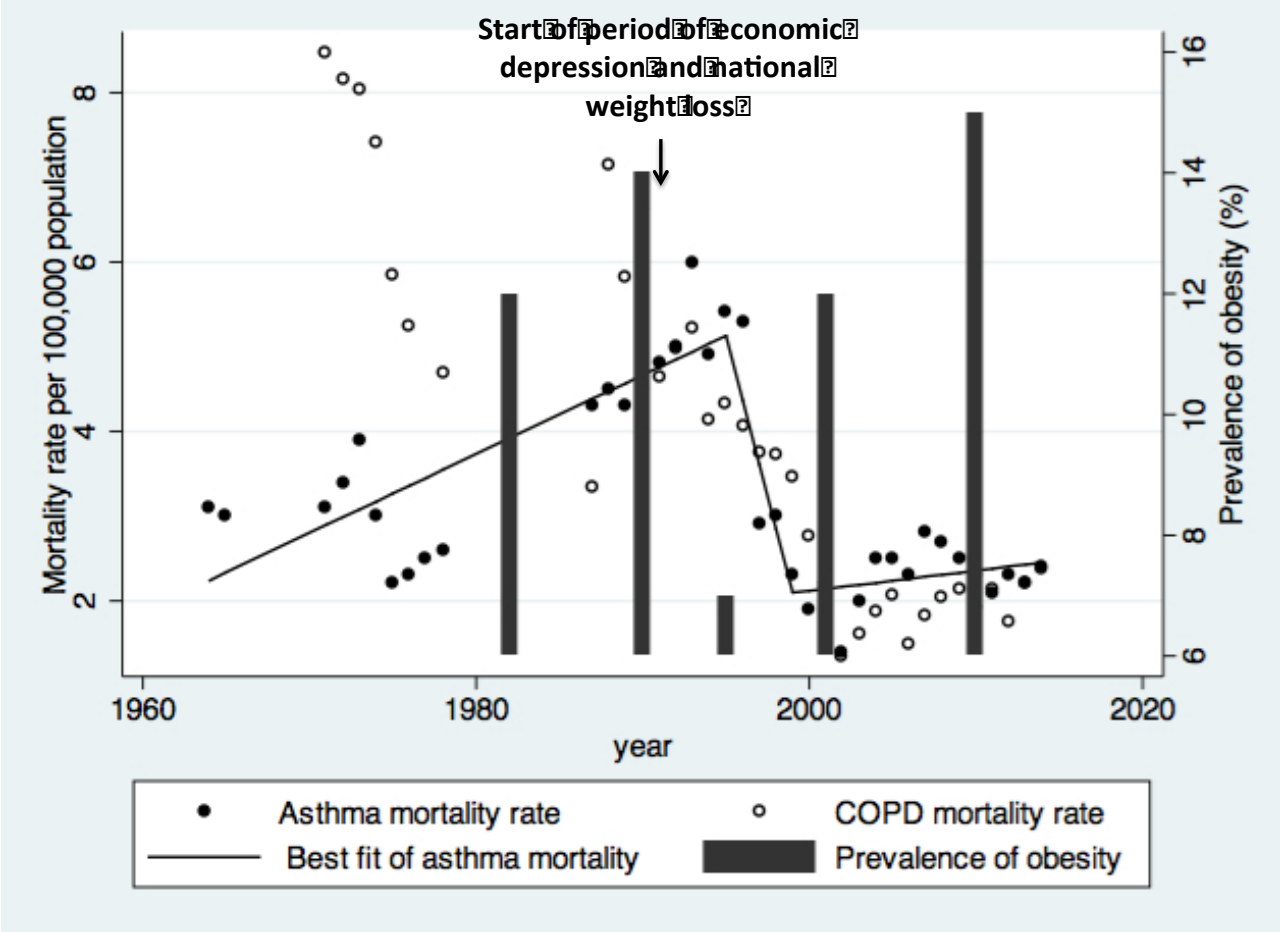
Joinpoint regression analysis with two *a priori* breakpoints was used to investigate the impact of the period of severe economic depression that began in 1991, with population-based weight loss and subsequent gain. This provides a hypothesis free estimate of when linear trends change.

Results

There were 232 deaths from asthma in Cuba in 1964 and 267 deaths in 2014, giving rates of 3.1 and 2.4 deaths per 100,000 population respectively (Figure). The prevalences of obesity for 1982, 1990, 1995, 2001 and 2010 were 12%, 14%, 7%, 12% and 15% respectively (Figure).

Although the prevalence of obesity from 1990 to 1995 decreased from 14% to 7%, over the same time period the rate of asthma mortality increased from 4.5 deaths per 100,000 population to 5.4 deaths per 100,000 population. The obesity prevalence subsequently increased to 15% in 2010, while the asthma mortality rate had dropped to 2.3 deaths per 100,000 population by this date. The optimal model for fit of asthma mortality over time gave an increasing linear association from 1964 to 1995 (95% confidence interval for inflexion point: 1993 to 1997), followed by a decrease in asthma mortality rates from 1995 to 1999 (95% confidence interval for inflexion point: 1997 to 2002). However, there was no increase in asthma rates after 1999 (p=0.49 for slope), a period when the obesity prevalence increased to 15% by 2010.

Figure. *Per capita* deaths from asthma and chronic obstructive pulmonary disease in Cuba from 1964 to 2014



Discussion

This is the first study to use national data to explore the impact of a well-defined period of large population-based weight loss followed by a period of weight gain, and the association of this period with asthma mortality. The data demonstrate that the period of severe economic depression and weight loss was not directly associated with a decrease in asthma mortality, and in particular there was no reciprocal increase in asthma mortality when the population's weight subsequently recovered, and eventually the prevalence of obesity increased to much higher than the baseline values.

The strengths of these data are the national nature of the datasets from a country that has a good reputation for providing medical care and reliable health statistics, including mortality data [4], increasing confidence in the reliability of the coding of cause of death. The availability of data on deaths from chronic bronchitis and emphysema is also a strength, as this permits evaluation of the possibility of misclassification between the two disease categories.However, as with any study that uses routinely collected data, we do not have independent validation of the diagnosis of asthma as the cause of death, although we have eliminated the most obvious category of misclassification.

The observation that death rates from asthma are not associated with population-based weight loss is an interesting one, and the plateauing of asthma mortality rates at approximately 30% of the baseline in 2001, coincides with a period of population weight gain. Hence, these data are not consistent with the hypothesis that population-based weight gain is associated with asthma mortality with a substantial increase in population weight after 1995, from 7% being classed as obese in 1995, increasing to 12% in 2001 and 15% of the population in 2010 [3], yet no associated increase in asthma deaths rates was observed.

Hence, it is necessary to consider alternative explanation for these large changes in trends in national asthma mortality. The period of economic depression that Cuba experienced during the 1990s was also characterized by a decrease in manufacturing and availability of motorized transport resulting in lower levels of atmospheric pollution which also is known to increase asthma severity [5]. One other factor that may have contributed to the decrease in asthma mortality rates that we observed is tobacco smoking, as this also decreased during the period of economic depression, and is well known to be an independent risk factor for asthma symptoms, both when consumed directly [6] and also by increasing levels of passive smoke exposure [7,8]. In addition, during this difficult period the Cuban medical system remained active and responsive to chronic diseases such as asthma, and hence better delivery of medical care may also have contributed to the substantial decrease in asthma mortality observed during this period.

In summary, we have observed a large decrease in asthma mortality rates associated with a period of economic depression in Cuba, but this period was not associated with changes in the weight of the population, an observation that has been observed previously for asthma [9]. Understanding the underlying causes of these trends may help identify effective public health interventions to improve asthma control.

Conflicts of interest

There are no conflicts of interest.

Authorship contributions

All authors (SF, RS, JB, AF) contributed to the conception of the study and the writing of the manuscript. SF and RS obtained the data and AF and RS analysed the data.

Role of the funding source

The funding source had no influence on the analysis or interpretation of the results.

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