Seasonal Changes in Preprandial Glucose, A1C and Blood Pressure in Diabetic Patients

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The American Diabetes Association has recommended glycemic goals for non-pregnant diabetic individuals. These goals are aimed at controlling blood glucose levels, blood pressure and lipid profile. Seasonal variation of blood pressure has been recognized and is visible in both normotensive subjects and hypertensive patients. However, blood pressure patterns among diabetic patients remain unclear. Blood glucose levels or lipid profiles in diabetic patients with a seasonal cycle also remain unclear.

We collected data from all patients who received treatment in our Clinics of Endocrinology and Metabolism, at least two times per year from 2003 to 2006. Our clinics began in May, 2002. Our data was retrieved from our hospital data bank. We did not obtain personal information from the data bank. This procedure was approved by our hospital. There are diabetic patients seen in 2003 (n=465), 2004(n=615), 2005 (n=599) and 2006 (n=662). Some patients (n=212) were retained throughout the entire study period while others were only partial during the 2003-2006 timeframe. Mean diabetes duration in these patients was 7.89 years. Mean age of these diabetes patients was 66.7 years old. Laboratory tests were performed and drug therapy was administered for hypertension, hyperglycemia and hypercholesterolemia according to ADA recommendations. Doses and regimens were adjusted for blood pressure, blood sugar level, A1C and lipid profile. For each patient, blood pressure and plasma glucose (preprandial or postprandial) was measured during visits to the clinic. Data was collected when the A1C was checked. A1C levels were checked at intervals of three to six months. Lipid profiles were collected in annual examinations of every diabetic patient. So the lipid profile data was available since October 2003. We analyzed the monthly mean values for blood pressure, A1C, and lipid profile in relation to the monthly values for mean temperature. Systolic and diastolic blood pressures were measured with a fully automated sphygmomanometer (BP203RV-II).

The study area (Miaoli) is in Taiwan. Taiwan is located southeast of China and has a subtropical monsoon climate. The data on climate used in this study was obtained from the Central Weather Bureau of the ROC, Taiwan. Mean yearly temperature from 1971 to 2000 was 22.2°C. The highest mean monthly temperature, over this period, was in July (28.3°C) while the lowest was in January (15.1°C). Summers are generally very hot. The monthly means of the daily averages were all used in this study.

The data was analyzed with Microsoft Excel 2003. Univariate correlations were assessed using Pearson’s r test. We used linear regression to evaluate the relation between blood pressure, fasting glucose,
A1C and lipid profiles and the monthly average temperatures. All P values are two-sided. Average systolic and diastolic blood pressure was highest during winter and lowest during summer. A seasonal pattern was evident throughout the four-year period. Blood pressure was correlated inversely with monthly mean temperature ($r^2=0.44$ and $P<0.001$ for systolic pressure; $r^2=0.24$ and $P<0.001$ for diastolic pressure). Preprandial glucose was correlated inversely with monthly mean temperature ($r^2=0.12$ and $P=0.018$ for preprandial glucose); A1C was correlated with reversion of three-monthly mean temperature ($r^2=0.09$ and $P=0.042$ for A1C). There was a consistent cyclic variation in preprandial glucose and A1C during this four-year study period. LDL-C was correlated inversely with monthly mean temperature ($r^2=0.23$ and $P=0.002$ for LDL cholesterol). However, HDL-C and triglyceride are not related to temperature. ($r^2=0.007$ and $P=0.615$ for triglyceride and $r^2=0.005$ and $P=0.173$ for HDL cholesterol). In our study, we also found that the relationship between blood pressure and monthly mean temperature was stronger when blood pressure was under better control. We compared patients from 2003-2004 and 2005-2006 (the former for two years and the latter for two years). We found that the correlation of systolic blood pressure and monthly mean temperature in the former was lower than the latter. We compared other factors in the two groups and found better blood pressure control in the latter case (diastolic blood pressure: 79.51 vs 77.36 $P<0.001$; systolic blood pressure: 138.27 vs 134.71 $P<0.001$). However, monthly mean temperature did not show any significant changes (22.68 vs 22.52 $P=0.9124$).

Temperature changes showed similar patterns every year. Festivals may play a role in patient lifestyle. There are three main traditional festivals in the region and their dates shift somewhat from year to year as the traditional calendar is lunar. Chinese New Year may be in January or February; the Dragon Festival can be in May to July and the Moon Festival may be in September or October. Festivals seem to play less of a role in the results. In conclusion, in patients with diabetes receiving treatment in clinics, blood pressure, preprandial glucose, A1C and LDL-C varied seasonally, with higher values in winter and lower values in summer.
Reference
1. American Diabetes Association, Standards of Medical Care in Diabetes—2007, Diabetes Care, 30: SUPPLEMENT 1, 4-41 2007
Figure Legends

Figure a: Mean (±SE) Systolic Blood Pressure According to Calendar Month in Diabetic Patients.

Figure b: Mean (±SE) Diastolic Blood Pressure According to Calendar Month in Diabetic Patients.

Figure c: Mean (±SE) Preprandial Blood Sugar According to Calendar Month in Diabetic Patients.

Figure d: Mean (±SE) LDL According to Calendar Month in Diabetic Patients.