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## Multiple regression formulae relating diet and lifestyle to cardiovascular risk

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**Introduction:** The precise quantification of how diet, exercise, tobacco use, Body Mass Index (BMI), and gender interact with each other and collectively correlate with Total Cholesterol/High-Density Lipoprotein Cholesterol ratio (TC/HDL-C), could facilitate cardiovascular disease risk prediction and inform disease prevention strategies. The objective of this study is to develop an evidence-based methodology to predict TC/HDL-C as a surrogate for cardiovascular disease risk from multiple regression analysis employing independent variables consisting of macronutrient profiles, exercise, tobacco use, BMI, and gender.

**Methods:** Data for the two components of this post hoc analysis came from (1) the Diabetes Control and Complications Trial (DCCT) and (2) Food and Agriculture Organization/World Health Organization (FAO/WHO). For the DCCT, 27 diabetes clinics in North America submitted data on 681 female and 760 male participants  $\geq 12$  years old from North America with type 1 diabetes (mean time on study=6.5 years). Data from the FAO/WHO databases included population-based samples of female and male cohorts (age $\geq 15$  years) from 167 countries worldwide. From each of these databases, cardiovascular disease risk factor data were submitted to multiple regression statistical analysis. Macronutrient profiles (protein, total carbohydrate, dietary fiber, total fat, polyunsaturated fatty acids, monounsaturated fatty acids, saturated fatty acids, and alcohol), exercise levels, tobacco use, BMI, and gender served as the independent variables while TC/HDL-C, as a surrogate for cardiovascular disease risk, was the dependent variable.

**Results:** DCCT database formula relating macronutrient profiles, exercise, tobacco use, BMI, and gender to TC/HDL-C was  $TC/HDL-C = ((23.44 \text{ protein (g)} + 25.856 \text{ carbohydrates (g)} - 44.72 \text{ fiber (g)} + 56.61 \text{ total fats (g)} - 23.535 \text{ polyunsaturated fatty acids (g)} - 45.248 \text{ alcohol (g)}) / \text{kilocalaries} - 0.11820 \text{ exercise (DCCT 1-4 scale)} + 0.36101 \text{ tobacco use (yes=1, no=0)} \times 1.00444 + 0.04782 \text{ BMI} \times 3.292444 - 0.45111 \text{ gender (female=1, male=0)}) \times 0.967857 - 17.8187$ ; (n=1441,  $R^2=0.12$ ,  $p < 0.0001$ ). FAO/WHO database formula relating simulated TC/HDL-C (countries worldwide) to the same independent variables was  $TC/HDL-C = ((51.744 \text{ protein (g)} + 75.36 \text{ carbohydrates} - 85.30 \text{ fiber} + 250.794 \text{ total fat} - 341.406 \text{ polyunsaturated fatty acids}) / \text{kilocalaries} + 0.01519 \text{ alcohol} - 0.09941 \text{ exercise (1-4 DCCT scale)} + 1.43433 \text{ tobacco use (1=yes, 0= no)}) \times 1.19127 - 16.99615 \times 0.80795 + 0.02070 \text{ BMI} \times 1.1896 - 0.48011 \times 0.82219 - 0.17610 \text{ gender (female=1, male=0)} \times 1.18239 + 0.20453$ ; (n=334,  $R^2=0.72$ ). Outputs of these two formulae strongly correlated with each other (DCCT database:  $r=0.73$ ,  $p < 0.0001$  and FAO/WHO database:  $r=0.88$ ,  $p < 0.0001$ ). An online method of using the above formulae to predict an individual's cardiovascular risk (using TC/HDL-C as a surrogate measure of cardiovascular risk) based on a person's macronutrient profile and other independent variables was derived using java-script computer programming. An interactive website was employed allowing users to input data on diet, exercise, tobacco use, BMI and gender. Utilizing the United State Department of Agriculture database of the macronutrient profiles of over 8000 foods and beverages, diet diary entries of people are converted to macronutrient profiles. With representative independent variable data entered into the website, a predicted TC/HDL-C will come out. Based on a normal distribution of TC/HDL-C values in both the DCCT and FAO/WHO databases, the TC/HDL-C outputs are converted into z scores, which are then converted into percentile rankings. Based on these percentile rankings of TC/HDL-C outputs, people receive outputs of their estimated risk for cardiovascular disease in percentiles (i.e., percentiles of risk: <1% - >99%) of the North American population (DCCT) and worldwide adult population (FAO/WHO).

**Conclusions:** Multiple regression derived formulae from two very different databases similarly predicted TC/HDL-C. A large online study should be initiated engaging people who want evidence-based estimates of their cardiovascular disease risk and who agree to allow their data to be utilized to prospectively determine the multiple regression formula that relates the independent variables (diet, etc.) to actual TC/HDL-C determinations. With tens of thousands of participants in this online study, a multiple regression formula relating the independent variables to actual TC/HDL-C levels, capturing a large amount of the variance, may be achievable within 1-2 years. The prospectively generated multiple regression formula could then be compared with the previous database derived formulae to see if correlations are sufficient to claim further validation for using these independent variables for predicting TC/HDL-C as a surrogate for cardiovascular risk. This further validated formula could, then, guide public health interventions to reduce the risk of cardiovascular disease risk.

### Biography

David K Cundiff practiced and taught internal medicine at the LA County + USC Medical Center during 1981–1998. While practicing, his research concerned the optimal use of morphine and other opioid pain medications for patients with cancer and AIDS. Since leaving clinical medicine, he has researched databases that contain data on diet, exercise, tobacco use, and clinical outcomes (e.g., body mass index, type 2 diabetes, cardiovascular disease). Multiple regression formulae derived from this research have been incorporated into his website (<http://grandbargainsbook.com/healthTool/public/>) to allow people to input their diet and lifestyle data and receive predictions of long-term health risks.

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