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Anthropometric Measures, Body Mass Index and Pancreatic Cancer: a Pooled Analysis from the Pancreatic Cancer Cohort Consortium (PanScan)

Alan A. Arslan[*,†,‡,1,2,3], **Kathy J. Helzlsouer**[†,‡,4], **Charles Kooperberg**[†,5], **Xiao-Ou Shu**[†,6], **Emily Steplowski**[†,7], **H. Bas Bueno-de-Mesquita**[‡,8], **Charles S. Fuchs**[‡,9,10], **Myron D. Gross**[‡,11], **Eric J. Jacobs**[‡,12], **Andrea Z. LaCroix**[‡,5], **Gloria M. Petersen**[‡,13], **Rachael Z. Stolzenberg-Solomon**[‡,14], **Wei Zheng**[‡,6], **Demetrius Albanes**[14], **Laufey Amundadottir**[14,15], **William R. Bamlet**[13], **Aurelio Barricarte**[16], **Sheila A. Bingham**[17], **Heiner Boeing**[18], **Marie-Christine Boutron-Ruault**[19], **Julie E. Buring**[20,21], **Stephen J. Chanock**[14,15], **Sandra Clipp**[22], **J. Michael Gaziano**[23], **Edward L. Giovannucci**[10,24,25], **Susan E. Hankinson**[10,25], **Patricia Hartge**[14], **Robert N. Hoover**[14], **David J. Hunter**[10,25], **Amy Hutchinson**[14,26], **Kevin B. Jacobs**[14,26,27], **Peter Kraft**[25,28], **Shannon M. Lynch**[29], **Jonas Manjer**[30], **JoAnn E. Manson**[25,31], **Anne McTiernan**[5], **Robert R. McWilliams**[32], **Julie B. Mendelsohn**[14], **Dominique S. Michaud**[33], **Domenico Palli**[34], **Thomas E. Rohan**[35], **Nadia Slimani**[36], **Gilles Thomas**[14], **Anne Tjønneland**[37], **Geoffrey S. Tobias**[14], **Dimitrios**

[*]**Corresponding Author:** Dr. Alan A. Arslan, Department of Obstetrics and Gynecology, New York University School of Medicine, 550 First Avenue, TH-528, New York, NY 10016, USA, Phone: 212-263-7763, Fax: 212-263-5742, alan.arslan@nyumc.org.
[†]Writing committee member
[‡]Steering committee member

Author Contributions:
Dr. Arslan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses.
Conception and Design: Patricia Hartge, Demetrius Albanes, Laufey Amundadottir, Stephen J. Chanock, Robert N. Hoover, Amy Hutchinson, Kevin B. Jacobs, Julie B. Mendelsohn, Gilles Thomas, Geoffrey S. Tobias, Kai Yu
Analysis and Interpretation of Data: Alan A. Arslan, Alpa V. Patel, Emily Steplowski, Charles Kooperberg, Kathy J. Helzlsouer, Xiao-Ou Shu
Drafting of the article: Alan A. Arslan, Alpa V. Patel, Kathy J. Helzlsouer, Charles Kooperberg, Xiao-Ou Shu, Emily Steplowski
Critical revision of the article for important intellectual content: Alan A. Arslan, Kathy J. Helzlsouer, Charles Kooperberg, Xiao-Ou Shu, Emily Steplowski, H. Bas Bueno-de-Mesquita, Eric J. Jacobs, Heiner Boeing, Edward L. Giovannucci, Amy Hutchinson, JoAnn E. Manson, Anne McTiernan, Julie B. Mendelsohn, Dominique S. Michaud, Thomas E. Rohan, Geoffrey S. Tobias, Dimitrios Trichopoulos, Jarmo Virtamo, Alpa V. Patel
Final approval of the article: Alan A. Arslan, Kathy J. Helzlsouer, Charles Kooperberg, Xiao-Ou Shu, Emily Steplowski, H. Bas Bueno-de-Mesquita, Charles S. Fuchs, Myron D. Gross, Eric J. Jacobs, Andrea LaCroix, Gloria M. Petersen, Rachael Z. Stolzenberg-Solomon, Wei Zheng, Demetrius Albanes, Laufey Amundadottir, William R. Bamlet, Aurelio Barricarte, Sheila A. Bingham, Heiner Boeing, Marie-Christine Boutron-Ruault, Julie E. Buring, Stephen J. Chanock, Sandra Clipp, J. Michael Gaziano, Edward L. Giovannucci, Susan E. Hankinson, Patricia Hartge, Robert N. Hoover, David J. Hunter, Amy Hutchinson, Kevin B. Jacobs, Peter Kraft, Shannon M. Lynch, Jonas Manjer, JoAnn E. Manson, Anne McTiernan, Robert R. McWilliams, Julie B. Mendelsohn, Dominique S. Michaud, Domenico Palli, Thomas E. Rohan, Nadia Slimani, Gilles Thomas, Anne Tjønneland, Geoffrey S. Tobias, Dimitrios Trichopoulos, Jarmo Virtamo, Brian M. Wolpin, Kai Yu, Anne Zeleniuch-Jacquotte, Alpa V. Patel
Provision of study materials or patients: Demetrius Albanes, Eric J. Jacobs, H. Bas Bueno-de-Mesquita, Aurelio Barricarte, Heiner Boeing, Marie-Christine Boutron-Ruault, Jonas Manjer, Dominique S. Michaud, Domenico Palli, Nadia Slimani, Anne Tjønneland, Dimitrios Trichopoulos, Jarmo Virtamo, Kathy J. Helzlsouer, Charles S. Fuchs, Gloria M. Petersen, Anne Zeleniuch-Jacquotte, Susan E. Hankinson, J. Michael Gaziano, Wei Zheng, Xiao-Ou Shu, Andrea LaCroix
Statistical expertise: Charles Kooperberg, Emily Steplowski, Peter Kraft, Kai Yu
Obtaining of funding: Patricia Hartge, Demetrius Albanes, Laufey Amundadottir, Stephen J. Chanock, Robert N. Hoover, Amy Hutchinson, Kevin B. Jacobs, Julie B. Mendelsohn, Gilles Thomas, Geoffrey S. Tobias, Kai Yu
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Trichopoulos[25,38], **Jarmo Virtamo**[39], **Brian M. Wolpin**[9,10], **Kai Yu**[14], **Anne Zeleniuch-Jacquotte**[2,3], and **Alpa V. Patel**[†,12]

[1]Department of Obstetrics and Gynecology, New York University School of Medicine, New York, NY, USA [2]Department of Environmental Medicine, New York University School of Medicine, New York, NY, USA [3]New York University Cancer Institute, New York, NY, USA [4]Prevention and Research Center, Mercy Medical Center, Baltimore, MD, USA [5]Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, WA, USA [6]Division of Epidemiology, Department of Medicine, Vanderbilt Epidemiology Center and Vanderbilt-Ingram Cancer Center, Vanderbilt University, Nashville, TN, USA [7]Information Management Services, Silver Spring, MD, USA [8]National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands and Department of Gastroenterology and Hepatology, University Medical Center Utrecht, Utrecht, The Netherlands [9]Department of Medical Oncology, Dana-Farber Cancer Institute, Boston, MA, USA [10]Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA [11]Department of Laboratory Medicine and Pathology, University of Minnesota, Minneapolis, MN, USA [12]Department of Epidemiology, American Cancer Society, Atlanta, GA, USA [13]Department of Health Sciences Research, Mayo Clinic, Rochester, MN, USA [14]Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department Health and Human Services, Bethesda, MD, USA [15]Laboratory of Translational Genomics, Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, MD, USA [16]Public Health Institute of Navarra, Pamplona, Spain and CIBER Epidemiología y Salud Pública (CIBERESP), Barcelona, Spain [17]MRC Centre for Nutrition and Cancer, University of Cambridge, UK [18]German Institute of Human Nutrition, Potsdam-Rehbrüecke, Nuthetal, Germany [19]Inserm (Institut National de la Santé et de la Recherche Médicale) and Institut Gustave Roussy, Villejuif, France [20]Divisions of Preventive Medicine and Aging, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA [21]Department of Ambulatory Care and Prevention, Harvard Medical School, Boston, MA, USA [22]George W. Comstock Center for Public Health Research and Prevention, Hagerstown, MD, USA [23]Physicians' Health Study, Divisions of Aging, Cardiovascular Medicine, and Preventive Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA and Massachusetts Veterans Epidemiology Research and Information Center, Veterans Affairs Boston Healthcare System, Boston, MA, USA [24]Department of Nutrition, Harvard School of Public Health, Boston, MA, USA [25]Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA [26]Core Genotyping Facility, Advanced Technology Program, SAIC-Frederick Inc., NCI-Frederick, Frederick, MD, USA [27]Bioinformed Consulting Services LLC, Gaithersburg, MD, USA [28]Department of Biostatistics, Harvard School of Public Health, Boston, MA, USA [29]Division of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health, Bethesda, MD, USA [30]Department of Surgery, Malmö University Hospital, Malmö, Sweden [31]Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA [32]Department of Oncology, College of Medicine, Mayo Clinic, Rochester, MN, USA [33]Division of Epidemiology, Public Health and Primary Care, Imperial College, London, UK [34]Molecular and Nutritional Epidemiology Unit, Cancer Research and Prevention Institute (ISPO), Florence, Italy [35]Department of Epidemiology and Population Health, Albert Einstein College of Medicine, Bronx, NY, USA [36]International Agency for Research on Cancer, Lyon, France [37]Diet, Cancer and Health, Institute of Cancer Epidemiology, Danish Cancer Society, Copenhagen, Denmark [38]Department of Hygiene and Epidemiology, University of Athens Medical School, Athens, Greece [39]Department of Chronic Disease Prevention, National Institute for Health and Welfare, Helsinki, Finland

Abstract

Background—Pooled data were analyzed from the NCI Pancreatic Cancer Cohort Consortium (PanScan) to study the association between pre-diagnostic anthropometric measures and risk of pancreatic cancer.

Methods—PanScan applied a nested case-control study design and included 2,170 cases and 2,209 controls. Odds ratios (OR) and 95% confidence intervals (CI) were estimated using unconditional logistic regression for cohort-specific quartiles of body mass index (BMI), weight, height, waist circumference, and waist-to-hip ratio (WHR), as well as conventional BMI categories: underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), obese (30.0-34.9 kg/m^2), and severely obese (≥35.0 kg/m^2). Models were adjusted for potential confounders.

Results—Among all subjects, a positive association between increasing BMI and risk of pancreatic cancer was observed (adjusted OR for the highest vs. lowest BMI quartile = 1.33, 95% CI = 1.12-1.58, $P_{trend} < 0.001$). Among men, the adjusted OR for pancreatic cancer for the highest vs. lowest quartile of BMI was 1.33 (95% CI = 1.04-1.69, $P_{trend} < 0.03$). Among women, the adjusted OR for pancreatic cancer for the highest quartile of BMI was 1.34 (95% CI = 1.05-1.70, $P_{trend} = 0.01$). Increased WHR was associated with increased risk of pancreatic cancer among women (adjusted OR for the highest vs. lowest quartile = 1.87, 95% CI = 1.31-2.69, $P_{trend} = 0.003$) but less so in men.

Conclusion—The findings provide strong support for a positive association between BMI and pancreatic cancer risk. In addition, centralized fat distribution may increase pancreatic cancer risk, especially in women.

Keywords

Anthropometry; body mass index; cohort consortium; obesity; pancreatic cancer

INTRODUCTION

Pancreatic adenocarcinoma is the fourth leading cause of cancer death in the United States [1] and is responsible for about 227,000 deaths per year worldwide [2]. Because of the lack of effective screening tests for pancreatic cancer, it is often diagnosed at an advanced stage, contributing to a five-year survival rate that is less than 5% [3]. The incidence of pancreatic cancer is higher in men compared with women, and within the United States, it is higher in Blacks compared to Caucasians [3]. Smoking, diabetes, and family history of pancreatic cancer are known risk factors [4,5] but these factors do not account for all the cases of pancreatic cancer.

Obesity and high body mass index (BMI) have been proposed as additional risk factors for pancreatic cancer. Prospective studies have yielded conflicting results concerning the association between BMI and risk of pancreatic cancer. A majority of prospective epidemiological studies [6-15] have found that a high body mass index and/or a lack of physical activity are associated with an increased risk of pancreatic cancer incidence or mortality, independently of prior history of diabetes. However, several prospective studies have not confirmed a significant role of BMI in pancreatic cancer [16-23] or found that effect of BMI varied according to smoking status [24,25] or gender [26-28].

The purpose of the current study was to examine the association between BMI, other anthropometric factors, and pancreatic cancer risk by pooling data from nested case-control studies included in the NCI Pancreatic Cancer Cohort Consortium (PanScan). With 2,170 cases, this is one of the largest analyses to date of BMI and pancreatic cancer.

METHODS

Study Population

PanScan is an initiative that was funded jointly by the National Cancer Institute's Division of Cancer Control and Population Sciences and the Division of Cancer Epidemiology and Genetics in 2006. PanScan includes investigators from 12 prospective epidemiologic cohorts and one case-control study and was created to identify genetic markers of susceptibility through a genome-wide association scan and to investigate environmental, lifestyle, and genetic causes of pancreatic cancer.

Studies in the pooled analysis included: The Alpha-Tocopherol, Beta-Carotene Cancer Prevention Trial (ATBC) 29, CLUE II 30, Cancer Prevention Study II (CPS II) 31, European Prospective Investigation into Cancer and Nutrition (EPIC) 32, the Health Professionals Follow-up Study (HPFS) 33, the Mayo Clinic study (MAYO) 34, the New York University Women's Health Study (NYUWHS) 35, the Nurses' Health Study (NHS) 36, the Physicians' Health Study (PHS I) 37, the Prostate, Lung, Colorectal, Ovarian Cancer Screening Trial (PLCO) 38, Shanghai Men's and Women's Health Studies (SMWHS) 39,40, the Women's Health Initiative (WHI) 41, and the Women's Health Study (WHS) 42. A total of 2,170 cases and 2,209 controls were eligible for the current study (Table 1).

Case Ascertainment and Data Collection

Cases included all incident primary pancreatic adenocarcinoma (ICD-O-3 codes C25.0-C25.3, C25.7-C25.9). Endocrine pancreatic tumors (ICD-O-3 code C25.4, histology types 8150, 8151, 8153, 8155, 8240, and 8246) were excluded because the etiology of these cancers is thought to be different from that of exocrine tumors, which account for the vast majority of pancreatic tumors. Case ascertainment varied between studies but included linking participants to cancer registries and national death indices, and self and next of kin report. Most cases were histologically confirmed (ATBC, CLUE II, EPIC, NYUWHS, SMWHS, WHI) or confirmed through cancer registries (ATBC, CPS II, EPIC, SMWHS), death certificates (CPS II, EPIC), or review of medical records by medical personnel (ATBC, CPS II, EPIC, PLCO, SMWHS).

Controls were incidence density-sampled with a 1-to-1 control-to-case ratio and were alive and cancer-free on the date of diagnosis of the matched case. At a minimum, controls were matched to cases on calendar year of birth (±5 years), gender, race and ethnicity. Some cohorts employed more stringent matching on age and, additionally, on other relevant factors (for comparisons of blood levels of analytes of interest) such as age at baseline or age at blood draw (±5 years), date/time of day of blood draw, fasting blood draw, and length of follow-up (Table 1).

Data on anthropometry, demographics and possible confounders were collected through self-administered written questionnaires or in-person interviews. Detailed descriptions of data collection methods have been published previously by the individual studies [29,30,32,33,35-44]. From each study, baseline information on body mass index (BMI), weight, height, waist circumference, waist-to-hip ratio (WHR), history of cigarette smoking, gender, age, race, family history of pancreatic cancer, alcohol consumption, pancreatitis, and history of diabetes was requested. Individual datasets were checked for consistency with previously published results. A total of forty cases and forty six controls had missing data on BMI, resulting in 2,130 cases and 2,163 controls available for the main analyses.

The Special Studies Institutional Review Board (SSIRB) of the National Cancer Institute approved the pooled PanScan study. Each study also was approved by its local IRB.

Statistical Analysis

Odds ratios (OR) and 95% confidence intervals (95% CI) for pancreatic cancer risk were calculated using unconditional logistic regression, adjusting for cohort, age (categorical), gender, BMI source (self-reported, measured), and smoking (never, former, current) (Model 1). Several multivariate models were assessed to control the effects of potential confounders. Model 2 was additionally adjusted for diabetes history (yes, no). In model 3, cases diagnosed within the first 2 years of follow-up were excluded to address the possibility of an effect of early undiagnosed disease. In model 4, current smokers (at baseline) were excluded, and in model 5, both cases diagnosed within the first 2 years of follow-up and current smokers were excluded. Furthermore, models including waist circumference and waist-to-hip ratio were additionally adjusted for height to remove extraneous variation due to body size. There was no adjustment for family history of pancreatic cancer as few cohorts had this information. Trend tests were conducted using cohort-specific quartiles of BMI, weight, height, waist circumference, and WHR, as well as descriptive BMI categories: underweight (<18.5 kg/m^2), normal (reference, 18.5-<25.0 kg/m^2), overweight (25.0-<30.0 kg/m^2), obese (30.0-<35.0 kg/m^2), and severely obese (≥35.0 kg/m^2). To test for heterogeneity BMI quartile categories were modeled as a continuous variable and the risk estimates and standard errors from the cohort-specific models were used to generate the Q statistic.

The association between BMI and time of onset for pancreatic cancer was also examined using logistic regression modeling. Differences in time of onset were examined for normal versus overweight versus obese categories of BMI as well as in a combined category of overweight and obese. The analyses were conducted using the SAS program version 9.1.3.

RESULTS

The study included 2,170 pancreatic cancer cases and 2,209 controls aged between 37 and 94 years (Table 1). Of the 2,170 pancreatic cancer cases, 1,059 were males and 1,111 were females. Cases and controls were similar in terms of age and racial distribution (Table 2). The majority of subjects were Caucasian, and 86% of the study population was 60 years of age or older. Compared to the controls, cases had a higher prevalence of current smoking (18% and 25%, respectively), diabetes (7% and 14%, respectively), history of pancreatitis (0.4% and 11%, respectively), and family history of pancreatic cancer (2% and 6%, respectively) based on data from cohorts with available information. The average age of pancreatic cancer onset among cases was 68.3 years and the average lag time between cohort enrollment and diagnosis of pancreatic cancer among cases was 6.3 years.

Table 3 describes baseline anthropometric characteristics of cases and controls. Weight, height, and corresponding BMI were self-reported in about 50% of subjects, measured in 29% of subjects, and measured and subsequently adjusted for difference in clothing in about 20% of subjects. Thirty-six percent of cases and 39% of controls had BMI in the normal range, 41% of cases and 39% of controls were overweight, and 21% of cases and 19% of controls were obese (Table 3). Cases had slightly higher mean weight compared to controls (76.8 kg and 75.5 kg, respectively), and larger mean waist circumference (86.9 and 85.7, respectively). Mean WHR and height were similar.

Table 4 displays odds ratios (ORs) and 95% confidence intervals (CIs) for pancreatic cancer according to baseline anthropometric factors for all subjects in the study. Among all subjects, a positive association between increasing BMI and risk of pancreatic cancer was observed (adjusted OR for the highest vs. lowest BMI quartile = 1.33, 95% CI = 1.12-1.58, $P_{trend} < 0.001$ in model 1). Statistically significant trends of increasing risk of pancreatic

cancer with increasing BMI (both quartiles and clinical categories) were observed in all five models analyzed.

Figures 1-3 demonstrate the individual study results (model 1) and pooled risk estimates for overweight, obese, and severely obese individuals, respectively.

Further adjustment for diabetes history (model 2) resulted in attenuation of risk estimates compared to model 1 but *P* values for trend were statistically significant for BMI quartiles and categories (Table 4). In addition, waist circumference and waist-to-hip ratio were positively associated with risk of pancreatic cancer among all subjects with top versus bottom quartile ORs = 1.23 (95% CI = 0.94-1.62) and 1.71 (95% CI = 1.27-2.30), respectively (Table 4). Stratification by BMI source (self-reported, measured) resulted in similar risk estimates: ORs (95% CIs) for obese vs. normal BMI were 1.24 (0.92-1.68) for measured BMI and 1.21 (0.95-1.53) for self-reported BMI. The OR per 5 kg/m^2 increase in BMI was 1.13 (95% CI = 1.11-1.14).

The risk estimates did not change significantly in the sensitivity analysis excluding the Mayo Clinic case-control study (data not shown), therefore we decided to include the Mayo subjects in the final analyses. There was no evidence of significant heterogeneity between different cohorts for the BMI-pancreatic cancer results (*P* heterogeneity = 0.36).

Tables 5 and 6 show ORs and 95% CIs of pancreatic cancer among males and females, respectively. Among men, adjusted risk estimate (model 1) for the top versus bottom quartile of BMI was 1.33 (95% CI = 1.04-1.69). Higher risk estimates were observed after exclusion of current smokers (model 4). Among males who never smoked, there was a statistically significant trend of increasing risk with increasing BMI (P_{trend} = 0.007) with the top versus bottom quartile OR = 1.51 (95% CI = 1.13-2.03). Height, waist circumference, and waist-to-hip ratio were not significantly associated with pancreatic cancer among males (Table 5).

Among women, statistically significant trends of increasing risk of pancreatic cancer with increasing BMI were observed overall (model 1) and after exclusion of cases diagnosed within the first 2 years of follow-up (model 3) or current and former smokers (model 4) (Table 6). Compared to normal BMI (model 1), the ORs of pancreatic cancer were 1.31 (95% CI = 1.07-1.60) for overweight women and 1.61 (95% CI = 1.12-2.33, P_{trend} = 0.003) for severely obese women. Increasing waist circumference and WHR were significantly associated with pancreatic cancer risk in women. Compared to the reference group, women in the highest quartile of WHR had an OR of 1.87 (95% CI = 1.31-2.69) after adjustment for cohort, age, BMI source, and smoking status. Inclusion of both BMI (categorical) and WHR (quartiles) in the same model suggested that the effect of increasing WHR is stronger (*P* = 0.006) compared to that of BMI categories (*P* = 0.44) after adjustment for cohort, age, gender, BMI source, smoking, and diabetes history.

We did not observe clinically meaningful differences in time of onset for pancreatic cancer between normal and overweight/obese individuals. Overweight and obese individuals together were diagnosed approximately 4 months earlier than normal weight individuals (data not shown). When comparing obese individuals only with normal weight individuals, obese subjects were diagnosed on average about one year earlier than normal weight individuals and the difference was statistically significant (p = 0.03).

COMMENT

Results from this large, pooled set of studies support the hypothesis that obesity is associated with an increased risk of pancreatic cancer. The present findings are consistent with the

majority of previous epidemiologic studies that found a positive association between BMI and pancreatic cancer risk [45] and support the conclusion from a recent review panel from the World Cancer Research Fund that the strength of the evidence supporting an association between obesity and pancreatic cancer is convincing [45].

Previous studies that did not observe a positive association between body mass index and pancreatic cancer were often limited by use of proxy respondents [46-49] or by inadequate statistical power to examine associations at BMI levels that correspond with obesity (fewer than 10 cases with BMI > 30.0) [7,10,17,50]. Controversy regarding the role of smoking in the BMI and pancreatic cancer relationship still remains. Many previous studies that did not observe an association with obesity did not properly control for smoking history [7,47,48,50]. It is possible that residual confounding due to improper adjustment for smoking history may have biased the association between body mass index and pancreatic cancer toward the null. When stratifying on smoking status, some previous studies found the relationship between BMI and pancreatic cancer was strongest among never smokers [24,25]. Our findings are consistent with previous reports that the association between BMI and pancreatic cancer is stronger among non-smokers (adjusted OR for BMI ≥30 = 1.37, 95% CI = 1.06-1.78) than smokers (adjusted OR for BMI ≥30 = 1.14, 95% CI = 0.91-1.78).

Unlike a recent report where the authors reported that individuals who were overweight or obese from the ages of 20 to 49 had an earlier onset of pancreatic cancer compared to those with normal body weight [51], we did not find a substantial difference in age of diagnosis between normal weight and the combined group of overweight/obese individuals.

In our study, BMI was assessed between the ages 37 and 94 and overweight or obese individuals were diagnosed on average 4 months earlier than normal weight individuals. The previous report by Li et al. [51], using a hospital-based case-control study design, found that overweight or obese patients from the ages 20 to 49 had a median age of pancreatic cancer onset 2 to 6 years earlier than normal weight patients. However, these differences were based on BMI as recalled from early adulthood and may have been subject to recall bias. Nevertheless, as suggested by Li et al., obesity at younger ages might have a more profound effect on risk and age of onset of pancreatic cancer than obesity at older ages.

There are established biologic pathways to support a relationship between excess body weight and the development of pancreatic cancer. Body fatness has a direct linear relationship with insulin production and is related to the development of insulin resistance [52]. Furthermore, insulin resistance and abnormal glucose metabolism, even in the absence of diabetes, is associated with pancreatic cancer risk [8,53,54]. *In vitro* studies have also shown that insulin has growth-promoting effects in the pancreas [55]. A hyperinsulinemic state allows increased insulin to pass through the pancreas and trigger mitotic activity [8,53,56]. Additionally, excess insulin can also down-regulate insulin-like growth factor-I binding proteins, which would result in more bioavailable insulin-like growth factor-I that has been associated with cell proliferation and pancreatic cancer risk [54,57].

The results of this study also support a specific role of central adiposity in pancreatic cancer risk, especially among women. In addition to general body fatness, there is a direct linear relationship between intra-abdominal fat deposits, insulin production, and the development of insulin resistance [52].

There are several strengths of the current study including the very large sample size, the wide range of BMI, and the ability to control for most known or suspected pancreatic cancer risk factors. Additionally, our population was largely a nested sample from various prospective cohort studies, so that BMI was measured prior to pancreatic cancer diagnosis, thus reducing differential reporting of past exposure information. Limitations include the use

of some self-reported exposure information; however, adjusting for source of exposure information (self-reported or measured), did not alter the association. Another potential limitation is the wide range of lag periods between BMI measurement (collected at baseline for each cohort) and the date of diagnosis; however, sensitivity analyses examining this lag time by excluding the first 2 years of follow-up did not change the point estimates appreciably, thus arguing against an influence of pre-diagnostic disease-related changes in anthropometric measures (reverse causation). Participating cohorts had different coding systems for physical activity that were not readily comparable; therefore we could not assess whether the association between BMI and pancreatic cancer vary by level of physical activity. To address potential residual confounding by smoking, we have performed the analyses in never smokers and found slightly stronger association between BMI and pancreatic risk. Lastly, only a few cohorts had data available on waist and hip circumference, so that there was limited statistical power to examine these relationships.

In summary, the results of this study provide additional evidence that obesity is associated with increased risk of pancreatic cancer. In addition, the association between waist circumference and pancreatic cancer risk, especially in women, suggests a possible association with the distribution of body fat. These findings, along with those from previous studies, strongly support the role of obesity in pancreatic cancer development.

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Abbreviations

ATBC	Alpha-Tocopherol, Beta-Carotene Cancer Prevention Trial
BMI	Body Mass Index
CPS II	Cancer Prevention Study II
CI	Confidence Interval
EPIC	European Prospective Investigation into Cancer and Nutrition
Clue II	Give Us a Clue to Cancer and Heart Disease Study
HPFS	Health Professionals Follow-up Study
MAYO	Mayo Clinic study
NYUWHS	New York University Women's Health Study
NHS	Nurses' Health Study
OR	Odds Ratio
PanScan	Pancreatic Cancer Cohort Consortium
PHS I	Physicians' Health Study
PLCO	Prostate, Lung, Colorectal, Ovarian Cancer Screening Trial
SMWHS	Shanghai Men's and Women's Health Studies
SSIRB	Special Studies Institutional Review Board
WHI	Women's Health Initiative
WHS	Women's Health Study
WHR	Waist-to-hip ratio

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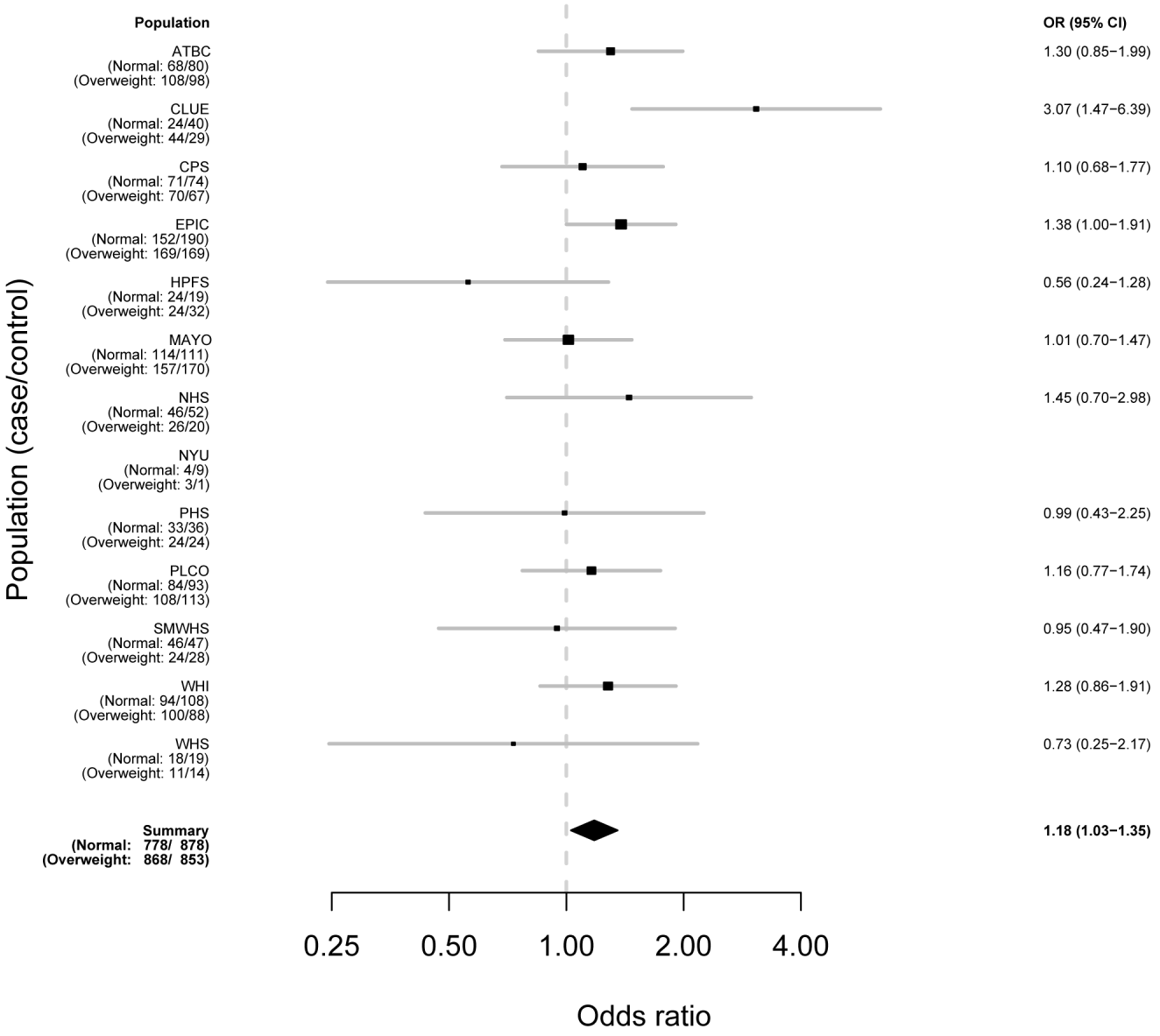

Figure 1. Risk Estimates for Pancreatic Cancer Associated with BMI by Study for Overweight People (25–<30 kg/m^2) As Compared to Normal (<=25 kg/m^2)

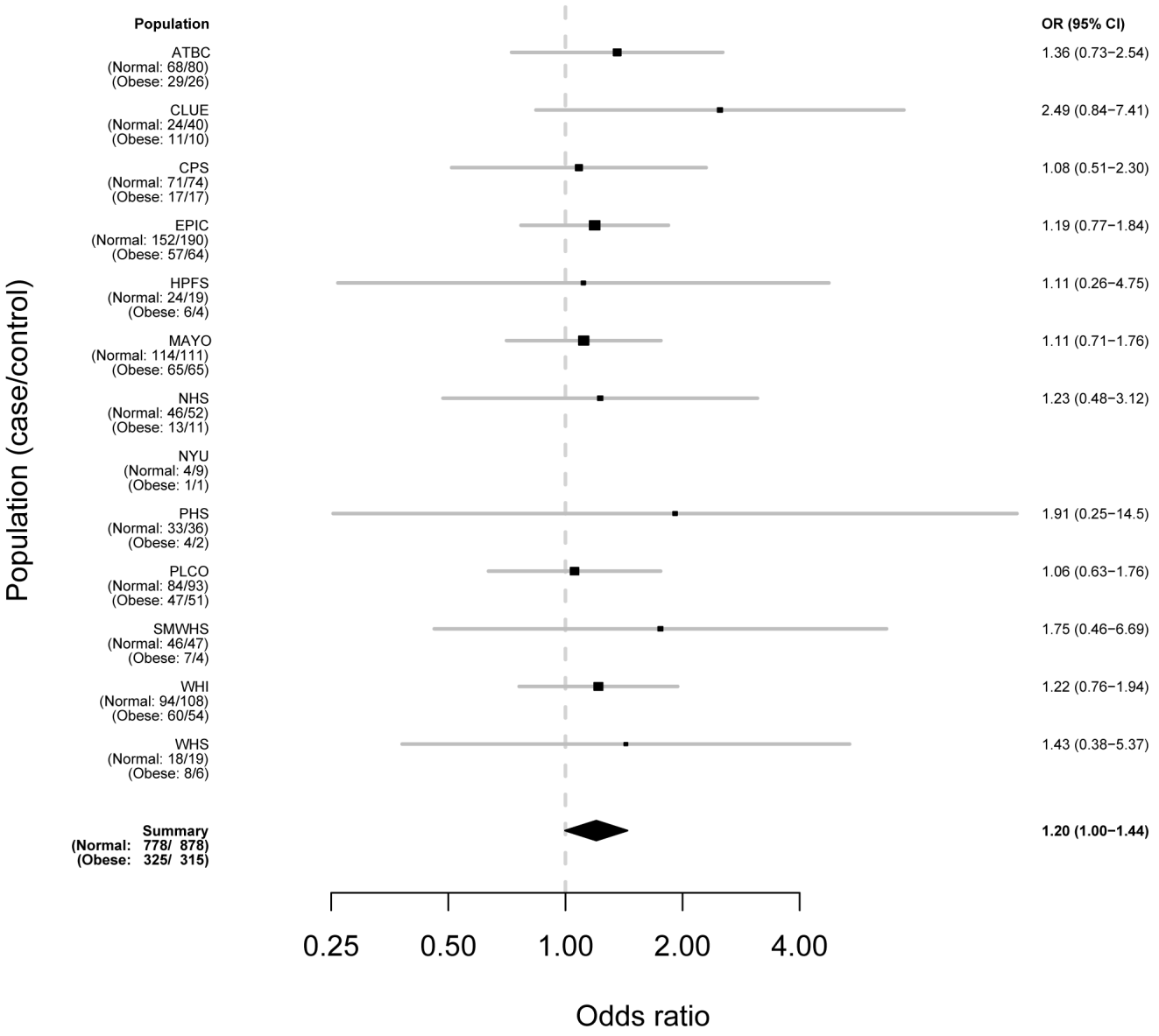

Figure 2. Risk Estimates for Pancreatic Cancer Associated with BMI by Study for Obese People (30–<35 kg/m^2) As Compared to Normal (<=25 kg/m^2)

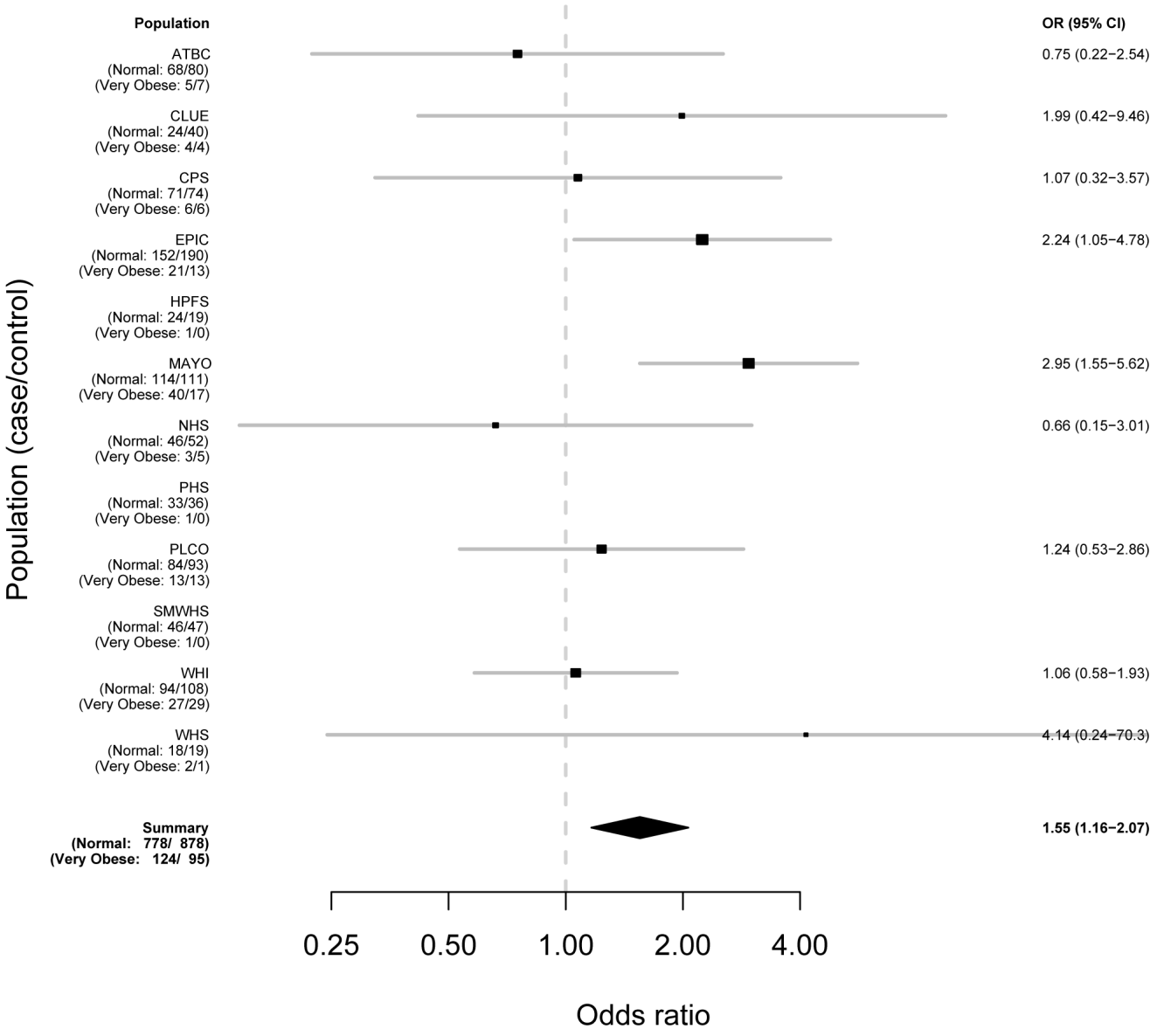

Figure 3. Risk Estimates for Pancreatic Cancer Associated with BMI by Study for Very Obese People (35+ kg/m^2) As Compared to Normal (<=25 kg/m^2)

Table 1

Characteristics of the Cohorts Included in the PanScan Pooled Analysis

Cohort	Center	Location	Enrollment years[a]	Mean follow-up (years)	Race (%)	Age range	Available anthropometric data	Cases/Controls 2170/2209	Matching
The Alpha-Tocopherol, Beta-Carotene Cancer Prevention Trial (ATBC)	National Cancer Institute, National Institute for Health and Welfare	Finland	1985-1988	11.8	100% Caucasian	57-85	BMI	210/211	Race, age at randomization (1-5 years), month, year of baseline blood draw (+30 days)
CLUE II	John Hopkins Bloomberg School of Public Health	USA	1989	8.3	100% Caucasian	42-94	BMI	83/83	Race, gender, age
Cancer Prevention Study (CPS II)	American Cancer Society	USA	1992-1993	10.0	97.6% Caucasian 1.2% African-American 0.6% Asian 0.6% Other	64-90	BMI	165/165	Race, self-reported ethnicity, gender, date of birth (± 6 months), DNA source (blood or buccal), DNA sample provided during the same season and year
European Prospective Investigation Into Cancer and Nutrition (EPIC)	International Agency Research on Cancer and Imperial College London	Europe	1992-2000 (varied by center)	6.8	100% Caucasian	37-84	BMI[b], WHR[c]	440/459	Gender, center, age at recruitment (± 1 month), date of blood donation (± 1 month), time of blood draw (± 1 hour), hours between blood draw and last food or drinks (<3, 3-6, >6)
Health Professionals Follow-up Study (HPFS)	Harvard University	USA	1986	12.7	100% Caucasian	55-87	BMI, WHR	55/55	Race, gender, year of birth (+/− 5 years) smoking status (never/former/ current) fasting status, month and hour of blood draw
Mayo Clinic study (MAYO)	Mayo Clinic	USA	2000-2006	0	99.3% Caucasian 0.5% African-American 0.3% Asian	39-86	BMI	400/400	Clinic-based controls, frequency matched to cases on age, race, gender, and residence
The New York University Women's Health Study (NYUWHS)	New York University	USA	1985-1991	11.6	76.7% Caucasian 7.7% Other 15.4% Missing	48-82	BMI, WHR	13/13	Age at enrollment (± 6 months), date of enrollment (± 3 months), menopausal status at enrollment, race/ethnicity
Nurses' Health Study (NHS)	Harvard University	USA	1976-2003	21.6	85.2% Caucasian 1.1% Other 13.6% Missing	47-80	BMI, WHR	88/88	Race, gender, year of birth (+/− 5 years)

Cohort	Center	Location	Enrollment years[a]	Mean follow-up (years)	Race (%)	Age range	Available anthropometric data	Cases/Controls 2170/2209	Matching
									smoking status (never/former/ current) fasting status, month and hour of blood draw
Physicians' Health Study (PHS I)	Brigham and Women's Hospital	USA	1982-1983	13.6	61.2% Caucasian 1.6% African-American 37.1% Missing	49-88	BMI	62/62	Race, year of birth (+/− 5 years) smoking status (never/former/current) fasting status, month and hour of blood draw
Prostate, Lung, Colorectal, Ovarian Cancer Screening Trial (PLCO)	National Cancer Institute	USA	1993-2001	6.2	90.9% Caucasian 4.7% Asian 3.2% African-American 1.2% Other	56-84	BMI	253/271	Race, gender, ethnicity, center, frequency samples by calendar year of birth (5 years block), gender, broad categories of race, source of DNA (blood or buccal cell), study arm, study center. For intervention arm additionally stratified sampled by age
Shanghai Men's and Women's Health Study (SMWHS)	Vanderbilt University	China	1996 (F) 2001 (M)	3.6	100% Asian	43-77	BMI, WHR	78/79	Race, ethnicity, gender, year of birth (<2 years), menopausal status at baseline, date of sample collection (<30 days), time of sample collection (am/pm), time interval after the last meal (<2 hours)
Women's Health Initiative (WHI)	WHI Clinical Centers	USA	1992-1998	3.8	85.5% Caucasian 7.4% African-American 4.2% Asian 1.8% Other 1.0% Missing	53-88	BMI, WHR	283/283	Gender, center, race, ethnicity, age at screening, enrollment date, study component, hysterectomy status, menopausal status
Women's Health Study (WHS)	Harvard University	USA	1992-1993	5.1	95% Caucasian 2.5% African-American 2.5% Missing	47-82	BMI	40/40	Race, year of birth (+/− 5 years) smoking status (never/former/current) fasting status, month and hour of blood draw

NOTE: M, male; F, Female; NA, not available

[a] Study years refer to years of study included in this nested case-control study. Some studies have ongoing recruitment.

[b] In EPIC: BMI correction for differences in clothing for people with direct measurements of weight or prediction of BMI from self-reports for the Oxford health conscious group.

[c] In EPIC: WHR was available in EPIC-IARC and EPIC-Denmark subcohorts.

Table 2
Participants' Characteristics, the PanScan Consortium

Characteristic	Cases	Controls	*P*-value[b]
N	2170	2209	
Gender, n (%)			
Male	1059 (49%)	1080 (49%)	
Female	1111 (51%)	1129 (51%)	0.95
Race, n (%)			
European	1979 (91.2%)	2046 (92.6%)	
African	35 (1.6%)	34 (1.5%)	
Asian	104 (4.8%)	108 (4.9%)	
Other	11 (0.5%)	8 (0.4%)	
Unknown	41 (1.9%)	13 (0.6%)	0.30
Age categories, n (%)			
<55	150 (7%)	119 (5%)	
55-59	188 (9%)	154 (7%)	
60-64	338 (16%)	325 (15%)	
65-69	443 (20%)	473 (21%)	
70-74	491 (23%)	552 (25%)	
75-79	368 (17%)	399 (18%)	
≥80	192 (9%)	187 (8%)	<0.05
Cigarette smoking status, n (%)[a]			
Never smoker	829 (39%)	970 (45%)	
Former Smoker	767 (36%)	812 (37%)	
Current Smoker	530 (25%)	397 (18%)	<0.0001
Diabetes mellitus, n (%)[a]			
No	1762 (86%)	1973 (93%)	
Yes	288 (14%)	157 (7%)	<0.0001
History of pancreatitis, n (%)[a]			
No	862 (89%)	963 (99.6%)	
Yes	109 (11%)	4 (0.4%)	<0.0001
Family history of pancreatic cancer, n (%)[a]			
No	1107 (94%)	1162 (98%)	
Yes	76 (6%)	43 (2%)	<0.006
Age at diagnosis of pancreatic cancer, years			
Mean	68.3		
SD	8.8	--	

Characteristic	Cases	Controls	*P*-value[b]
Median	69		
Range	37-93		
Lag time between diagnosis and enrollment, years			
Mean	6.3		
SD	5.7	--	
Median	6.0		
Range	0-28		

[a] Data were missing for smoking status (44 cases, 30 controls), diabetes status (120 cases, 79 controls), history of pancreatitis (1199 cases, 1242 controls), family history of pancreatic cancer (974 cases, 991 controls).

[b] Chi square test.

Table 3
Baseline Anthropometric Characteristics by Gender, the PanScan Consortium

Characteristic	Females		Males	
	Cases	Controls	Cases	Controls
N	1111	1129	1059	1080
BMI source, n (%)				
Self-reported	533 (48%)	518 (46%)	544 (51%)	559 (52%)
Measured	384 (35%)	396 (35%)	250 (24%)	251 (23%)
Adjusted	178 (16%)	187 (17%)	241 (23%)	252 (23%)
Unknown	16 (1%)	28 (2%)	24 (2%)	18 (2%)
BMI Mean	26.8	26.2	27.0	26.7
SD	5.3	4.9	4.1	3.9
Median	25.8	25.4	26.6	26.3
Range	14.0-67.5	15.0-54.6	16.8-53.4	15.4-51.5
BMI, quartiles, **cohort- and gender-specific**				
Q1 (low)	251 (23%)	286 (25%)	251 (24%)	285 (26%)
Q2	257 (23%)	269 (24%)	247 (23%)	257 (24%)
Q3	273 (25%)	279 (25%)	251 (24%)	261 (24%)
Q4 (high)	314 (28%)	267 (24%)	286 (27%)	259 (24%)
Unknown	16 (1%)	28 (2%)	24 (2%)	18 (2%)
BMI, categories, n (%)				
Underweight (<18.5 kg/m^2)	14 (1%)	21 (2%)	5 (0.5%)	4 (0.4%)
Normal (18.5-24.9 kg/m^2)	445 (40%)	507 (45%)	327 (31%)	356 (33%)
Overweight (25.0-29.9 kg/m^2)	381 (34%)	339 (30%)	505 (48%)	524 (49%)
Obese (30.0-34.9 kg/m^2)	175 (16%)	175 (16%)	153 (14%)	141 (13%)
Severely obese (≥35.0 kg/m^2)	80 (7%)	59 (5%)	45 (4%)	37 (3%)
Unknown	16 (1%)	28 (2%)	24 (2%)	18 (2%)
Weight source, n (%)				
Self-reported	537 (48%)	526 (47%)	622 (59%)	626 (58%)
Measured	561 (51%)	581 (51%)	428 (40%)	440 (41%)
Unknown	13 (1%)	22 (2%)	9 (1%)	14 (1%)
Weight, kg				
Mean	70.0	68.5	83.8	82.7
SD	14.7	13.5	14.6	13.3
Median	67.5	66.5	81.9	81.0
Range	41.4-167.5	38.0-134.1	43.9-172.4	48.0-171.0
Weight, quartiles, **cohort- and gender-specific**				
Q1 (low)	270 (24%)	291 (26%)	260 (25%)	292 (27%)

Characteristic	Females		Males	
	Cases	Controls	Cases	Controls
Q2	244 (22%)	284 (25%)	253 (24%)	257 (24%)
Q3	286 (26%)	274 (24%)	237 (22%)	262 (24%)
Q4 (high)	298 (27%)	258 (23%)	300 (28%)	255 (24%)
Unknown	13 (1%)	22 (2%)	9 (1%)	14 (1%)
Height source, n (%)				
Self-reported	541 (49%)	536 (47%)	613 (58%)	629 (58%)
Measured	560 (50%)	581 (51%)	428 (40%)	441 (41%)
Unknown	10 (1%)	12 (1%)	18 (2%)	10 (1%)
Height, cm				
Mean	162	162	176	176
SD	6.6	6.8	7.0	6.8
Median	162	163	176	176
Range	132-184	140-198	136-199	152-201
Height, quartiles, **cohort- and gender-specific**				
Q1 (low)	349 (31%)	340 (30%)	290 (27%)	309 (29%)
Q2	251 (23%)	266 (24%)	300 (28%)	305 (28%)
Q3	256 (23%)	272 (24%)	249 (24%)	251 (23%)
Q4 (high)	245 (22%)	239 (21%)	202 (19%)	205 (19%)
Unknown	10 (1%)	12 (1%)	18 (2%)	10 (1%)
Waist circumference at baseline, cm				
Mean	83.4	81.4	96.2	96.8
SD	16.4	14.8	10.8	9.6
Median	83.3	80.0	96.0	96.0
Range	38.1-129.0	38.1-134.0	64.0-144.8	65.2-131.0
Unknown	515	523	836	846
Waist-to-hip ratio				
Mean	0.83	0.82	0.95	0.95
SD	0.09	0.09	0.06	0.06
Median	0.82	0.80	0.95	0.95
Range	0.43-1.25	0.65-1.73	0.76-1.12	0.78-1.15
Unknown, n	577	586	836	846

Table 4

Odds ratios and 95% CIs of Pancreatic Cancer according to Baseline Anthropometric Factors, the PanScan Consortium, All Subjects

Characteristic	Cases	Controls	OR (95% CI)				
	2095	2141	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]
BMI, kg/m^2, cohort-specific quartiles							
Q1	500	563	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	496	523	1.09 (0.92-1.30)	1.09 (0.92-1.31)	1.09 (0.90-1.33)	1.12 (0.91-1.36)	1.04 (0.82-1.32)
Q3	515	534	1.13 (0.95-1.34)	1.08 (0.90-1.29)	1.13 (0.93-1.38)	1.11 (0.91-1.35)	1.03 (0.81-1.31)
Q4	584	521	**1.33 (1.12-1.58)**	**1.21 (1.01-1.44)**	**1.29 (1.06-1.57)**	**1.43 (1.18-1.74)**	**1.39 (1.10-1.77)**
P trend			**<0.001**	**0.049**	**0.008**	**<0.001**	**0.004**
BMI, kg/m^2, categories							
Underweight (<18.5 kg/m^2)	19	24	0.83 (0.45-1.55)	0.84 (0.44-1.59)	0.65 (0.31-1.35)	0.71 (0.33-1.50)	0.48 (0.18-1.24)
Normal (≥18.5 and <25.0 kg/m^2)	759	854	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Overweight (≥25.0 and <30.0 kg/m^2)	868	853	**1.18 (1.03-1.35)**	**1.15 (1.00-1.33)**	**1.22 (1.04-1.42)**	**1.19 (1.02-1.40)**	1.15 (0.95-1.39)
Obese (≥30.0 and <35.0 kg/m^2)	325	315	**1.20 (1.00-1.44)**	1.13 (0.93-1.37)	1.22 (0.98-1.51)	**1.25 (1.02-1.55)**	1.28 (0.99-1.67)
Severely obese (≥35.0)	124	95	**1.55 (1.16-2.07)**	1.26 (0.93-1.71)	1.32 (0.94-1.87)	1.62 (1.19-2.21)	1.53 (0.99-2.36)
P trend			**<0.001**	**0.047**	**0.008**	**<0.001**	**0.003**
Weight, kg, cohort-specific quartiles							
Q1	522	575	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	485	530	1.03 (0.86-1.22)	1.02 (0.85-1.22)	1.06 (0.87-1.29)	1.01 (0.83-1.23)	1.02 (0.80-1.29)
Q3	512	528	1.10 (0.92-1.30)	1.08 (0.91-1.29)	1.10 (0.90-1.34)	1.15 (0.95-1.40)	1.10 (0.87-1.40)
Q4	576	508	**1.30 (1.09-1.54)**	**1.19 (1.00-1.42)**	**1.34 (1.10-1.63)**	**1.32 (1.09-1.60)**	**1.34 (1.05-1.71)**
P trend			**0.002**	**0.035**	**0.003**	**0.002**	**0.01**
Height, cm, cohort-specific quartiles							
Q1	622	635	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	543	556	0.98 (0.83-1.16)	0.99 (0.84-1.18)	1.01 (0.84-1.23)	0.96 (0.79-1.15)	0.92 (0.73-1.17)
Q3	495	514	0.98 (0.83-1.16)	1.00 (0.84-1.18)	1.04 (0.86-1.27)	0.94 (0.78-1.13)	0.96 (0.76-1.21)
Q4	435	436	0.99 (0.83-1.18)	1.02 (0.85-1.22)	1.06 (0.87-1.30)	0.95 (0.78-1.16)	0.93 (0.72-1.18)
P trend			0.93	0.81	0.41	0.58	0.65

Characteristic	Cases	Controls	OR (95% CI)				
	2095	2141	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]
Waist circumference, cm, cohort-specific quartiles[f]							
Q1	215	224	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	172	208	0.87 (0.66-1.15)	0.89 (0.67-1.18)	0.82 (0.61-1.10)	0.88 (0.65-1.20)	0.82 (0.58-1.16)
Q3	200	198	1.10 (0.83-1.45)	1.08 (0.81-1.44)	1.04 (0.77-1.40)	1.09 (0.81-1.47)	1.05 (0.75-1.48)
Q4	225	200	1.23 (0.94-1.62)	1.21 (0.91-1.60)	1.21 (0.90-1.61)	1.20 (0.89-1.61)	1.14 (0.81-1.59)
P trend			**0.04**	0.09	0.07	0.10	0.22
Waist-to-hip ratio, cohort-specific quartiles[f]							
Q1	186	206	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	172	196	1.01 (0.75-1.35)	1.07 (0.79-1.44)	1.01 (0.74-1.37)	1.07 (0.79-1.47)	1.05 (0.74-1.49)
Q3	167	207	0.90 (0.67-1.21)	0.88 (0.65-1.19)	0.89 (0.65-1.22)	0.87 (0.63-1.20)	0.87 (0.60-1.24)
Q4	225	158	**1.71 (1.27-2.30)**	**1.69 (1.24-2.30)**	**1.62 (1.18-2.22)**	**1.83 (1.32-2.53)**	**1.57 (1.09-2.26)**
P trend			**0.001**	**0.004**	**0.007**	**0.001**	0.06

NOTE: Statistically significant results are in bold.

[a] Adjusted for cohort, age (categorical), gender, anthropometry source (self-reported, measured), and smoking (never, former, current).

[b] Adjusted for cohort, age (categorical), gender, anthropometry source (self-reported, measured), smoking (never, former, current), and diabetes history (no, yes).

[c] Adjusted for cohort, age (categorical), gender, anthropometry source, smoking, and excluding the first 2 years of follow-up.

[d] Adjusted for cohort, age (categorical), gender, anthropometry source, and excluding current and former smokers.

[e] Adjusted for cohort, age (categorical), gender, anthropometry source, and excluding the first 2 years of follow-up, current and former smokers, and people with diabetes.

[f] Models for waist circumference and waist-to-hip ratio were additionally adjusted for height.

Table 5

Odds ratios and 95% CIs of Pancreatic Cancer according to Baseline Anthropometric Factors by Gender, the PanScan Consortium, Males

Characteristic	Cases	Controls	OR (95% CI)				
	1031	1055	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]
BMI, kg/m^2, cohort- and gender specific quartiles							
Q1	251	283	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	247	256	1.13 (0.88-1.45)	1.15 (0.89-1.48)	1.09 (0.82-1.45)	1.20 (0.89-1.63)	1.01 (0.70-1.47)
Q3	249	259	1.12 (0.88-1.44)	1.07 (0.83-1.38)	1.04 (0.78-1.38)	1.12 (0.83-1.52)	0.88 (0.60-1.29)
Q4	284	257	**1.33 (1.04-1.69)**	1.23 (0.96-1.58)	1.22 (0.92-1.62)	**1.51 (1.13-2.03)**	1.27 (0.88-1.84)
P trend			**<0.03**	0.16	0.19	**0.007**	0.21
BMI, kg/m^2, categories							
Underweight (<18.5 kg/m^2)	5	4	1.45 (0.37-5.68)	1.89 (0.42-8.48)	0.90 (0.14-5.60)	0.92 (0.15-5.66)	0.73 (0.06-8.33)
Normal (≥18.5 and <25.0 kg/m^2)	326	354	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Overweight (≥25.0 and <30.0 kg/m^2)	503	520	1.09 (0.89-1.33)	1.06 (0.86-1.30)	1.08 (0.87-1.35)	1.08 (0.85-1.38)	0.96 (0.71-1.29)
Obese (≥30.0 kg/m^2)	152	141	1.23 (0.93-1.63)	1.13 (0.85-1.51)	1.21 (0.87-1.68)	1.26 (0.89-1.77)	1.29 (0.82-2.03)
Severely obese (≥35.0)	45	36	1.48 (0.92-2.39)	1.26 (0.77-2.06)	1.07 (0.58-1.97)	1.65 (0.96-2.84)	0.90 (0.40-2.02)
P trend			0.07	0.33	0.32	**0.047**	0.54
Weight, kg, cohort- and gender specific quartiles							
Q1	257	290	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	250	254	1.14 (0.89-1.46)	1.12 (0.87-1.44)	1.28 (0.96-1.69)	1.10 (0.82-1.49)	1.29 (0.89-1.87)
Q3	233	259	1.05 (0.82-1.34)	1.04 (0.81-1.35)	1.03 (0.77-1.38)	1.12 (0.83-1.51)	1.06 (0.72-1.56)
Q4	291	252	**1.36 (1.07-1.74)**	1.27 (0.99-1.63)	**1.42 (1.07-1.88)**	**1.43 (1.07-1.91)**	1.36 (0.93-1.98)
P trend			**0.02**	0.09	**0.046**	**0.015**	0.21
Height, cm, cohort- and gender-specific quartiles							
Q1	284	305	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	298	301	1.05 (0.83-1.32)	1.08 (0.85-1.37)	1.13 (0.87-1.48)	1.05 (0.79-1.38)	1.10 (0.78-1.57)
Q3	247	249	1.07 (0.84-1.37)	1.08 (0.85-1.39)	1.15 (0.87-1.52)	1.00 (0.75-1.34)	0.90 (0.63-1.30)
Q4	202	200	1.05 (0.81-1.36)	1.08 (0.83-1.41)	1.19 (0.88-1.60)	1.02 (0.74-1.41)	1.04 (0.69-1.56)
P trend			0.63	0.54	0.23	0.92	0.98

Characteristic	Cases	Controls	OR (95% CI)				
	1031	1055	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]
Waist circumference, cohort- and gender specific quartiles[f]							
Q1	68	62	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	55	65	0.79 (0.47-1.34)	0.78 (0.45-1.34)	0.82 (0.47-1.42)	0.94 (0.50-1.74)	0.96 (0.49-1.88)
Q3	47	50	1.04 (0.60-1.80)	0.98 (0.55-1.76)	0.98 (0.54-1.78)	1.05 (0.55-2.01)	0.84 (0.40-1.74)
Q4	52	53	1.04 (0.61-1.79)	1.11 (0.63-1.96)	1.02 (0.58-1.80)	1.09 (0.58-2.06)	1.08 (0.55-2.14)
P trend			0.72	0.61	0.84	0.72	0.86
Waist-to-hip ratio, cohort- and gender specific quartiles[f]							
Q1	67	63	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	52	65	0.76 (0.45-1.29)	0.83 (0.47-1.44)	0.79 (0.45-1.38)	0.74 (0.40-1.38)	0.76 (0.39-1.48)
Q3	41	53	0.80 (0.46-1.39)	0.78 (0.43-1.40)	0.78 (0.44-1.41)	0.76 (0.39-1.46)	0.64 (0.31-1.35)
Q4	62	49	1.41 (0.83-2.40)	1.46 (0.83-2.56)	1.39 (0.79-2.44)	1.57 (0.85-2.89)	1.50 (0.77-2.93)
P trend			0.20	0.19	0.24	0.12	0.29

NOTE: Statistically significant results are in bold.

[a] Adjusted for cohort, age (categorical), anthropometry source (self-reported, measured), and smoking (never, former, current).

[b] Adjusted for cohort, age (categorical), anthropometry source (self-reported, measured), smoking (never, former, current), and diabetes history (no, yes).

[c] Adjusted for cohort, age (categorical), anthropometry source, smoking, and excluding the first 2 years of follow-up.

[d] Adjusted for cohort, age (categorical), anthropometry source, and excluding current and former smokers.

[e] Adjusted for cohort, age (categorical), anthropometry source, and excluding the first 2 years of follow-up, current and former smokers, and people with diabetes.

[f] Models for waist circumference and waist-to-hip ratio were additionally adjusted for height.

Table 6

Odds ratios and 95% CIs of Pancreatic Cancer according to Baseline Anthropometric Factors by Gender, the PanScan Consortium, Females

Characteristic	Cases	Controls	OR (95% CI)				
	1064	**1086**	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**	**Model 4[d]**	**Model 5[e]**
BMI, kg/m^2, cohort- and gender specific quartiles							
Q1	249	280	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	249	267	1.07 (0.83-1.36)	1.06 (0.82-1.36)	1.11 (0.84-1.48)	1.07 (0.82-1.39)	1.08 (0.79-1.47)
Q3	266	275	1.13 (0.89-1.44)	1.08 (0.85-1.39)	1.24 (0.94-1.64)	1.10 (0.85-1.43)	1.16 (0.85-1.57)
Q4	300	264	**1.34 (1.05-1.70)**	1.19 (0.93-1.53)	**1.37 (1.03-1.81)**	**1.39 (1.08-1.80)**	**1.52 (1.11-2.10)**
P trend			**0.01**	0.17	**0.02**	**0.008**	**0.007**
BMI, kg/m^2, categories							
Underweight (<18.5 kg/m^2)	14	20	0.75 (0.37-1.51)	0.72 (0.35-1.48)	0.65 (0.29-1.44)	0.68 (0.29-1.55)	0.45 (0.16-1.29)
Normal (≥18.5 and <25.0 kg/m^2)	433	500	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Overweight (≥25.0 and <30.0 kg/m^2)	365	333	**1.31 (1.07-1.60)**	**1.27 (1.03-1.55)**	**1.40 (1.12-1.76)**	**1.30 (1.05-1.61)**	**1.34 (1.04-1.72)**
Obese (≥30.0 kg/m^2)	173	174	1.19 (0.93-1.54)	1.12 (0.87-1.46)	1.23 (0.92-1.64)	1.25 (0.96-1.63)	1.29 (0.93-1.79)
Severely obese (≥35.0)	79	59	**1.61 (1.12-2.33)**	1.29 (0.88-1.89)	1.50 (0.98-2.30)	**1.65 (1.13-2.40)**	**1.98 (1.17-3.36)**
P trend			**0.003**	0.08	**0.01**	**0.002**	**0.001**
Weight, kg, cohort- and gender specific quartiles							
Q1	265	285	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	235	276	0.92 (0.72-1.18)	0.93 (0.73-1.20)	0.89 (0.67-1.18)	0.94 (0.72-1.21)	0.86 (0.62-1.18)
Q3	279	269	1.14 (0.90-1.46)	1.12 (0.87-1.43)	1.16 (0.88-1.52)	1.18 (0.91-1.52)	1.14 (0.84-1.54)
Q4	285	256	1.23 (0.96-1.56)	1.12 (0.87-1.44)	1.27 (0.96-1.68)	1.24 (0.96-1.61)	1.34 (0.98-1.84)
P trend			**0.03**	0.22	**0.03**	**0.03**	**0.02**
Height, cm, cohort- and gender specific quartiles							
Q1	338	330	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	245	255	0.91 (0.72-1.16)	0.89 (0.70-1.14)	0.89 (0.67-1.17)	0.89 (0.69-1.15)	0.79 (0.57-1.09)
Q3	248	265	0.89 (0.71-1.13)	0.92 (0.72-1.17)	0.95 (0.73-1.24)	0.89 (0.69-1.14)	0.98 (0.73-1.32)
Q4	233	236	0.92 (0.72-1.17)	0.95 (0.74-1.21)	0.95 (0.72-1.25)	0.89 (0.69-1.16)	0.85 (0.63-1.16)
P trend			0.45	0.69	0.80	0.38	0.52

Characteristic	Cases	Controls	OR (95% CI)				
	1064	1086	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]
Waist circumference, cohort- and gender specific quartiles[f]							
Q1	147	162	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	117	143	0.89 (0.64-1.25)	0.92 (0.66-1.30)	0.81 (0.56-1.16)	0.85 (0.60-1.22)	0.77 (0.51-1.14)
Q3	153	148	1.14 (0.83-1.58)	1.14 (0.82-1.58)	1.08 (0.76-1.54)	1.12 (0.80-1.57)	1.14 (0.77-1.68)
Q4	173	147	1.31 (0.95-1.80)	1.26 (0.91-1.75)	1.28 (0.91-1.80)	1.24 (0.88-1.73)	1.17 (0. 79-1.73)
P trend			0.04	0.09	0.06	0.10	0.19
Waist-to-hip ratio, cohort- and gender specific quartiles[f]							
Q1	119	143	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Q2	120	131	1.14 (0.80-1.63)	1.21 (0.84-1.74)	1.15 (0.78-1.68)	1.20 (0.83-1.75)	1.20 (0.80-1.82)
Q3	126	154	0.96 (0.67-1.36)	0.94 (0.66-1.34)	0.96 (0.66-1.39)	0.92 (0.63-1.33)	0.97 (0.64-1.47)
Q4	163	109	**1.87 (1.31-2.69)**	**1.85 (1.27-2.69)**	**1.77 (1.20-2.61)**	**1.95 (1.33-2.86)**	**1.61 (1.03-2.50)**
P trend			**0.003**	**0.008**	**0.01**	**0.005**	0.11

NOTE: Statistically significant results are in bold.

[a] Adjusted for cohort, age (categorical), anthropometry source (self-reported, measured), and smoking (never, former, current).

[b] Adjusted for cohort, age (categorical), anthropometry source (self-reported, measured), smoking (never, former, current), and diabetes history (no, yes).

[c] Adjusted for cohort, age (categorical), anthropometry source, smoking, and excluding the first 2 years of follow-up.

[d] Adjusted for cohort, age (categorical), anthropometry source, and excluding current and former smokers.

[e] Adjusted for cohort, age (categorical), anthropometry source, and excluding the first 2 years of follow-up, current and former smokers, and people with diabetes.

[f] Models for waist circumference and waist-to-hip ratio were additionally adjusted for height.