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Physical and Mental Quality of Life (QOL) in Chronic Pancreatitis(CP): A Case-Control Study from the NAPS2 cohort

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Abstract

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Objectives—Define the Quality of Life (QOL) in chronic pancreatitis (CP) subjects

Methods—We studied 443 well phenotyped CP subjects and 611 controls prospectively enrolled from 20 US centers between 2000–2006 in the North American Pancreatitis Study 2 (NAPS2). Responses to the SF-12 questionnaire were used to calculate the Mental (MCS) and Physical component summary scores (PCS) with norm based scoring (normal = 50). QOL in CP subjects was compared with controls after controlling for demographic factors, drinking history, smoking and medical conditions. QOL in CP was also compared with known scores for several chronic conditions.

Results—Both PCS (38 ± 11.5 vs. 52 ± 9.4) and MCS (44 ± 11.5 vs. 51 ± 9.2) were significantly lower in CP compared with controls ($p < 0.001$). On multivariable analyses, compared to controls, a profound decrease in physical QOL (PCS 12.02 points lower) and a clinically significant decrease in mental QOL (MCS 4.24 points lower) was seen due to CP. QOL in CP was similar to (heart, kidney, liver, lung disease) or worse than (non-skin cancers, diabetes mellitus, hypertension, rheumatoid arthritis) other chronic conditions.

Conclusions—The impact of CP on QOL appears substantial. The QOL in CP subjects appears to be worse or similar to the QOL of many other chronic conditions.

Keywords

Chronic pancreatitis; quality of life; SF12; prospective

Introduction

Chronic pancreatitis (CP) is a chronic disorder with a complex array of symptoms and unpredictable course^{1–4}. A dominant symptom that patients seek care for is chronic abdominal pain. A number of variables contribute to the clinical presentation of a patient's symptoms including perceptions of illness and physiologic changes/dysfunction leading to physical symptoms. Physicians are most comfortable evaluating and treating physical symptoms. With chronic conditions the patients perspective relative to treatments and outcome are becoming increasingly acknowledged^{5–7}. Indeed, taking patients views into account has been shown to increase satisfaction of care⁸, better compliance with treatment⁹ and maintenance of continuous relationships in health care¹⁰. Simply put by A. Stewart et al⁷ “that in chronic conditions the impact on health is substantial and involves all aspects of functioning and well being. This warrants further study and a comprehensive health assessment may be an appropriate outcome standard for patients with chronic conditions.”

In CP, defining general impairment from a patient's perspective may be as important as defining any specific problem. While there are a variety of specific outcome measures to quantify responses to medical, endoscopic and surgical interventions, broader and well validated measures are needed to place specific outcomes into perspective. With no cure available, quality of life (QOL) is one of the most important indicators of treatment success in CP. The importance of QOL in CP has been discussed in many editorials on the subject^{11–16}. Evaluating the global QOL of CP can be used to compare conditions across populations or even treatment approaches.

Few studies have evaluated QOL in CP patients^{17–24}. They have used different general measures (SF36, EORTC-C30, QLQ-PAN26, SF12) of which two were designed for pancreatic cancer (EORTC-C30, QLQ-PAN26) but may be reliable in CP^{21, 23, 24}. Most have no control group or comparison to historical non patient controls. One study confirmed the utility and robustness of the SF12 compared to the SF36¹⁹ in CP. SF-12 scores have been shown to not significantly change over time in CP patients²². A few studies have

attempted to look at the QOL in CP treated surgically^{24–29}. Many of the available studies are limited due to different patient populations, limited numbers of patients, lack of prospectively ascertained controls and the questionnaires that are not comparable or widely available. In addition, to add clinical perspective, the degree of impaired QOL in CP relative to other disease conditions has not been thoroughly investigated.

Our first objective was to evaluate global QOL in a prospectively enrolled cohort of CP patients and compare it with controls using a well established, validated, easily administered tool (SF12). Secondly, we compared the QOL in CP patients with historical population controls and with known scores for a variety of chronic debilitating conditions.

Methods

Study Population and Data Collection

In the North American Pancreatitis Study 2 (NAPS2), nineteen US academic and clinical practice centers with specific interest in pancreatic diseases and one primary care practice prospectively enrolled 1000 pancreatitis patients (540 CP, 460 recurrent acute pancreatitis) and 695 controls from 2000 to 2006. Control subjects included spouse, any willing family members, accompanying friend or unrelated subjects. The methodology of this study has been published previously³⁰. CP was predefined by strict entry clinical criteria including definitive evidence of CP on imaging studies (primarily endoscopic retrograde cholangiogram [ERCP] or computed Tomography [CT] scan), or equivalent changes on magnetic resonance cholangiopancreatography (MRCP), endoscopic ultrasound (EUS) or histology. Written informed consent was obtained from all participants. The study was approved by institutional review boards for each center.

All study subjects completed a detailed questionnaire including information on demographics, risk factors, personal and family history, clinical symptoms (pain, diabetes, steatorrhea), hospitalization, disability, time off work, medication use and QOL. Self-reported alcohol use and smoking status was defined into categories as described previously³⁰. Briefly, ever drinkers were classified into five drinking categories based on alcohol consumption during the period of maximum drinking in life - *Abstainers*: no alcohol use or <20 drinks in a lifetime; *Light drinkers*: 3 drinks/week; *Moderate drinkers*: 4–7 drinks/week for females; 4–14 drinks/week for males; *Heavy drinkers*: 8–34 drinks/week for females; 15–34 drinks/week for males; *Very heavy drinkers*: 35 drinks/week for both sexes. Smoking status was stratified into categories (never, past, current) and the amount was quantified. The enrolling physician completed the physician questionnaire for CP subjects consisting of information on etiology, details of clinical and imaging features of CP including pain, exocrine and endocrine dysfunction³⁰.

The present study includes 443/540 (82%) CP and 611/695 (80%) control subjects from the NAPS2 cohort who provided complete responses to allow for calculation of QOL scores. Of the 611 controls, 34% were spouses, 27% were family members, 35% were either an accompanying friend or unrelated subjects and 4% were unrelated diabetic patients. The distribution of the demographics and disease related variables among cases and controls without QOL data were generally similar to those with QOL data except that older subjects and those who reported heavier drinking were significantly less likely to have completed the QOL questionnaire (data not shown).

Health-related QOL questionnaire

The SF12 v1 questionnaire was used in the NAPS2 study to assess QOL. SF 12 is a multipurpose generic QOL instrument derived from the SF36 Health Survey^{31, 32}. The SF 36 is validated in several languages and disease conditions, including CP^{7, 17–20, 27}. The

SF12 has been used in the study of CP previously^{22,33}. The SF 12 is shorter in length consisting of twelve questions, takes approximately two minutes to complete without a significant loss of information³¹. The SF 12 measures all 8 domains (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, mental health) of the SF 36 and derives two summary scores - a physical component summary (PCS) and a mental component summary (MCS). The SF 12 is based on a standard recall of 4 weeks. All scores were transformed to norm based scores. Simply put, a score below 50 indicates health status to be below average. The advantage of using norm based scores include - (1) results from all scales and summary scores have the same direct interpretation in relation to their distribution of scores in the general U.S. population, and, (2) they can be interpreted in relation to guidelines derived from numerous studies using SF-36, SF-12 and SF-8 already published³¹. With norm based scoring, the standard deviation is 10 for both PCS and MCS, therefore each one point difference in scores has a direct interpretation³¹.

Generic measures, such as the SF12, are well suited to permit comparisons across conditions and populations as well as provide clinicians with information they might not otherwise obtain⁵. The reference manual provides SF12V2 summary scores for common disorders. We compared the summary scores for selected chronic disorders from the reference manual (heart, kidney, liver, lung disease, non-skin cancers, diabetes, hypertension and rheumatoid arthritis) with those of CP patients in our study.

Statistics

Age, body mass index (BMI) and QOL scores are presented as mean $\pm$ standard deviation (SD). Categorical data are presented as proportions of study subjects with available data. The physical and mental QOL scores were computed using the scoring method provided in the SF12V2 reference manual³¹. The scores are weighted averages of the physical and mental components of the twelve questions comprising the SF12 instrument for measuring QOL. The scores are transformed to produce a normally distributed population score with mean 50 and standard deviation of 10. Each SF12 scale is standardized using a z-score transformation using the SF12 scale means and SD's from the 1998 general US population.

Comparison of CP patients and controls was done using chi-square or Fisher's exact test for categorical variables, and Kruskal-Wallis test for continuous variables. The continuous data was non-normally distributed. Bivariate comparisons for continuous data were performed using Kruskal-Wallis test. Correlations between SF12 scores for groups with different attributes were done using Kruskal-Wallis test. Determination of independent predictors of PCS and MCS was done using general linear modeling techniques. Variables that were available for use in the analyses included demographics (age, sex, race, BMI), drinking and smoking attributes, and concomitant or prior medical histories. There were some missing data in variables but in no case did it exceed ~7%. Concomitant medical conditions which were reported in very small numbers (<5%) of the control populations were not included in the models. Of the available data on concomitant medical conditions only diabetes, gallbladder stones or removal and prior heart attack or stroke occurred in numbers which were sufficient for meaningful analyses. Initial variables entered into the models included those which were significantly different between patients and controls and were significantly correlated with SF12 scores. All first degree interactions between the presence of CP and other variables were also investigated. For easier interpretation, the final models presented in this manuscript are centered at age of 50 years and BMI of 25. The final models consisted of those variables with a p-value of <0.05. All data analyses were performed with R Project software (www.r-project.org) and SAS system version 9.2 (SAS Software Institute, Cary, NC).

Results

Demographics, risk factors and co-morbidities

The study population comprised 611 controls and 443 CP subjects from the NAPS2 cohort. The socio-demographic information, QOL scores and medical histories for controls and CP patients is presented in Table 1. Over 85% of controls and CP subjects were White. CP subjects were more likely to be younger, male and Black. About two-third of controls were overweight or obese, but a majority of CP subjects had a normal or low BMI. CP patients were more likely to be very heavy drinkers, and were twice as likely to be current smokers. The prevalence of a history of several medical conditions was significantly higher among CP patients. Over 50% of CP subjects had CP for 5 years or more.

QOL in controls and CP patients

The QOL scores for NAPS2 controls were comparable to the populations controls (Figure 1a,b). The mental and physical QOL for CP subjects were significantly poor compared to NAPS2 controls (Table 1 and Figure 1a,b) and historical population controls as reflected by lower (PCS) and physical (MCS) composite scores (Figure 1a,b). The QOL in CP subjects was much worse for physical than mental QOL, reflected by a larger mean difference between CP subjects and controls for PCS (mean difference 14) than MCS (mean difference 7 points) on univariate analyses.

Multivariable analyses of QOL in CP patients and controls

Data on multivariable regression analyses for physical QOL are provided in Table 2. The effect of CP on physical QOL when compared to controls remained substantial (12.02 points lower) after controlling for demographic factors, drinking and smoking habits and concomitant medical illnesses. Other significant predictors in the order of magnitude included a history of diabetes, current smoking, history of gallstones or gallbladder removal, drinking category, gender, BMI and age. A significant interaction was seen for CP with age and current BMI. While an increase in one year of age and one unit BMI in a control resulted in a decrease of PCS score by 0.16 and 0.29 points respectively, for a CP patient the effective change for one year increase in age was an increase by 0.02 points ($-0.16 + 0.18$) and for one unit increase in BMI was an increase by 0.10 points ($-0.29 + 0.39$). Therefore, a 55 year old Caucasian male control who is an abstainer, never smoker, with a BMI of 30 and no co-morbidities will have a PCS score of 51.50 ($52.81 + 0.94$ [for White] $- 5 \times 0.16$ [for age] $- 5 \times 0.29$ [for BMI]), while a 55 year old Caucasian CP patient with similar characteristics will have a PCS score of 41.13 ($52.81 - 12.02$ [for CP] $+ 5 \times 0.02$ [for age] $+ 5 \times 0.10$ [for BMI] $+ 0.94$ [for White]). Representative PCS scores for a 50 year old control and CP patient who is a Caucasian male with a BMI of 25 without and with additional attributes is shown in Figure 3a. The model explained over one-third of the variance (adjusted-R² - 37%) in the PCS scores.

Data on multivariable regression analyses for significant predictors of mental QOL are provided in Table 3. Although the effect of CP on mental QOL was smaller than on physical QOL (4.24 points lower vs. 12.02 points), it was clinically and statistically significant when compared with controls after controlling for confounding factors. Other significant predictors in order of magnitude included a history of heart attack or stroke, current smoking, gender, and age. A significant interaction was seen for CP with current smoking status. Therefore, the mental QOL of a CP who is also a current smoker will be lower by an additional 3.85 points when compared to a control who is a current smoker. Therefore, a 55 year old Caucasian male control who is an abstainer, current smoker, with a BMI of 25 and no co-morbidities will have a MCS score of 51.4 ($52.39 + 0.51$ [for White] $+ 5 \times 0.09$ [for age] $- 2.45$ [for current smoker]), while a 55 year old Caucasian CP patient with similar

characteristics will have a PCS score of 43.23 ($52.81 - 4.24$ [for CP] + 0.51 [for White] + 5×0.09 [for age] - 6.30 [for current smoking]). Representative MCS scores for a 50 year old control and CP patient who is a Caucasian male with a BMI of 25 without and with additional attributes is shown in Figure 3b. In contrast to Physical QOL, no significant effect on mental QOL was seen from BMI, drinking categories, history of diabetes and gallstones or gallbladder problems. The model explained about 19% of the variance (adjusted-R² - 18.8%) in the MCS scores.

QOL in CP and other chronic conditions

Figure 2(a,b) presents PCS and MCS scores for CP subjects compared to selected chronic conditions. The physical QOL in CP subjects was significantly poor compared to individuals with non-skin cancers, diabetes, hypertension, rheumatoid arthritis and similar to those with heart disease, kidney, liver and lung disease. The mental QOL in CP subjects was significantly poor compared to individuals with non-skin cancers, diabetes, heart disease, hypertension, rheumatoid arthritis, and similar to patients with kidney, liver and lung disease.

Discussion

To our knowledge this is the largest prospective study to date evaluating the global HRQOL in CP. Our results indicate a clinically significant impact on physical and mental QOL from CP when compared with controls independent of sociodemographic factors and selected medical problems. Presence of additional attributes with a negative impact results in further decrease in QOL. Moreover, the QOL in patients with CP was similar or worse when compared with other chronic debilitating disorders.

Previous studies compared the QOL in CP patients only to historical controls^{18, 19, 20} and were unable to determine the independent effect due to CP after controlling for demographic and risk factors as well as presence of select medical problems. In addition to the well-phenotyped CP patients prospectively enrolled by expert physicians, a unique feature of our study was control subjects who were ascertained using similar data collection procedures. This allowed us to tease out the effect on QOL due to CP independent of other confounding factors. Moreover, the QOL in our control population was fairly similar to the historical population controls thereby validating our study sample. Our results show a profound decrease in physical QOL due to CP as demonstrated by the magnitude of the difference (12 points), given that a difference of 3 points in SF 36 summary scores is clinically significant.¹⁷ The effect on mental QOL was smaller but still clinically significant.

Two interesting associations for physical QOL in our study need further discussion. Firstly, a history of light-moderate alcohol consumption resulted in a higher physical QOL when compared with lifetime abstainers independent of the presence of CP. These data are similar to those published in a primary care setting and in the 1992 NLAES³⁴⁻³⁶. They could potentially reflect the beneficial effects of lower amounts of alcohol consumption or are reflective of other unmeasured lifestyle habits not captured in our study. Unlike previous reports, no significant decrease in QOL was seen in the heavy-very heavy drinkers when compared with lifetime abstainers. This could partly be related to our choice of time period to classify patients into drinking categories, i.e. the maximum lifetime drinking period which may have been remote from the time of patient enrollment. Patients who were heavy-very heavy drinkers may have reduced their alcohol consumption after the diagnosis of pancreatitis. Moreover, due to small number of controls in the very heavy drinking group, we did not analyze the data by individual drinking category to assess for independent effects at very heavy drinking level. Secondly, abdominal pain is an important component of CP symptomatology. Many subjects with abdominal pain symptoms (with or without CP) with

coexistent gallstone disease undergo an empiric cholecystectomy³⁷. It is likely that the impairment in physical QOL from a history of gallstones or gallbladder removal seen in our study is a surrogate marker of pain. In fact, the self-reported use of analgesic medications for pain symptoms was significantly higher in CP patients and controls that had pain when compared to corresponding subjects without pain (data not shown).

Also interesting to note was interactions between CP and demographic and risk factors. While the negative impact on physical QOL due to increasing age and BMI in non-diseased individuals could be related to a lack of physical strength and ability, better physical QOL for such attributes in patients with CP could be related to less symptomatic disease in late-onset CP and better nutritional status in patients with CP who do not have exocrine insufficiency. The negative impact of smoking, especially current smoking provides additional evidence for counseling for smoking cessation and using other strategies (e.g. medications to assist in quitting) in patients with CP who continue to smoke.

Our multivariable models explained 37% of the variability in PCS scores and 18% of the variability in MCS scores. The unaccounted variability is likely due to factors that were not measured in our study. Such factors could potentially include physical factors (e.g. pain), psychological factors (e.g. depression, guilt with alcohol use, effect of weight loss) or social factors (e.g. disability, effects on family, time with children, social activities and family plans), work issues such as absenteeism. Future studies should explore the role of these factors on QOL in patients with CP.

When we compared the QOL scores to other debilitating diseases, the QOL in CP patients was similar or significantly *worse* than many other chronic conditions. These data provide an important perspective to the impairment in QOL in CP patients when compared to other chronic debilitating conditions.

We evaluated QOL in CP using a standardized questionnaire, the SF12. The SF12 offers several advantages - it is a practical 2 minute questionnaire; it measures the same domains as SF36 and with norm based scoring can be directly comparable to SF36 and the shorter version (SF8) scores; it can be incorporated into clinical practice and followed serially over time²².

One of the limitations of the current analysis is that it evaluates a chronic condition at a single point in time. This is a snapshot but is valuable in defining the general QOL in subjects with CP. In addition to evaluating effect of variables not assessed in our study, future studies should also focus on the temporal changes in QOL of CP patients and factors determining such changes. One such measure is pain, and recently our group has defined the effect on QOL relative to patterns of pain, intensity or duration of pain³⁷. Deeper understanding of these and other factors will allow focused therapy to improve the QOL in individuals with CP.

In summary, this large prospective study revealed that the QOL in CP patients is significantly poor when compared with control subjects. The QOL in CP patients is similar or worse when compared with many chronic disorders. Our data shows that a diagnosis of CP results in poor QOL independent of demographic factors, drinking and smoking habits and common medical conditions. Future studies should evaluate the role of variables not measured in our study, define temporal changes and their determinants in QOL of CP patients.

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References

1. Etemad B, Whitcomb DC. Chronic pancreatitis: diagnosis, classification, and new genetic developments. *Gastroenterology*. 2001; 120:682–707. [PubMed: 11179244]
2. Ammann RW, Akovbiantz A, Largiader F, et al. Course and outcome of chronic pancreatitis. Longitudinal study of a mixed medical-surgical series of 245 patients. *Gastroenterology*. 1984; 86:820–8282. [PubMed: 6706066]
3. Steer ML, Waxman I, Freedman S. Chronic pancreatitis. *New England Journal of Medicine*. 1995; 332(22):1482–1490. [PubMed: 7739686]
4. Witt H, Apte M, Keim V, et al. Chronic pancreatitis: Challenges and advances in pathogenesis, genetics, diagnosis, and therapy. *Gastroenterology*. 2007; 132:1557–1573. [PubMed: 17466744]
5. Guyatt GH, Feeny DH, Patrick DL. Measuring Health-related Quality of Life. *Annals of Internal Medicine*. 1993; 118:622–629. [PubMed: 8452328]
6. Fischer D, Stewart AL, Bloch DA, et al. Capturing the patient's view of change as a clinical outcome measure. *JAMA*. 1999; 282(12):1157–1162. [PubMed: 10501119]
7. Stewart AL, Greenfield S, Hays RD, et al. Functional status and well-being of patients with chronic conditions. Results from the medical outcomes study. *JAMA*. 1989; 262(7):907–913.
8. Hall JA, Roter DL, Katz NR. Meta-analysis of correlates of provider behavior in medical encounters. *Med Care*. 1988; 26:657–675. [PubMed: 3292851]
9. Becker MH. Patient adherence to prescribed therapy. *Med Care*. 1985; 23:539–555. [PubMed: 4010350]
10. Kaplan SH, Greenfield S, Gandek B, et al. Characteristics of physicians with participatory decision-making styles. *Ann Intern Med*. 1996; 124:497–504. [PubMed: 8602709]
11. Forsmark CE. Chronic pancreatitis and quality of life. *Digestive and Liver Disease*. 2006; 38:116–118. [PubMed: 16301009]
12. Pezzilli R, Fantini L. Chronic pancreatitis: Assessing the quality of life. *Journal of the Pancreas*. 2005; 6(4):406–409. [PubMed: 16006695]
13. Glassbrenner B, Adler G. Evaluating pain and quality of life in Chronic Pancreatitis. *International Journal of Pancreatolgy*. 1997; 22(3):163–170. [PubMed: 9444546]
14. Frey C, Pitt H, Prinz R. A plea for uniform reporting of patient outcome in chronic pancreatitis. *Archives of Surgery*. 1996; 131:233–234. [PubMed: 8611085]
15. Talamini G, Bassi C, Butturini G, et al. Outcome and quality of life in chronic pancreatitis. *Journal of Pancreas*. 2001; 2(4):117–123.
16. Mariani A. The quality of life in chronic pancreatitis: the endoscopist's point of view. *Journal of Pancreas*. 2006; 7(1):117–119.
17. Wehler M, Reulbach U, Nichterkein N, et al. Health-Related quality of life in chronic pancreatitis: A psychometric assessment. *Scand J Gastroenterol*. 2003; 38:1083–1089. [PubMed: 14621285]
18. Wehler M, Nichterlein R, Fischer B, et al. Factors associated with health-related quality of life in chronic pancreatitis. *American Journal of Gastroenterology*. 2004; 99:138–146.

19. Pezzilli R, Morselli-Labate AM, Frulloni L, et al. The quality of life in patients with chronic pancreatitis evaluated using the SF-12 questionnaire: A comparative study with the SF-36 questionnaire. *Digestive and Liver Disease*. 2006; 38:109–115. [PubMed: 16243011]
20. Pezzilli R, Morselli-Labate AM, Ceciliato R, et al. Quality of life in patients with chronic pancreatitis. *Digestive and Liver Disease*. 2005; 37:181–189. [PubMed: 15888283]
21. Fitzsimmons D, Kahl S, Butturini G, et al. Symptoms and quality of life in chronic pancreatitis assessed by structural interview and the EORTC QLQ-C30 and the QLQ-PAN26. *American Journal of Gastroenterology*. 2005; 100:918–926. [PubMed: 15784041]
22. Pezzilli R, Morselli-Labate AM, Fantini L, et al. Quality of life and clinical indicators for chronic pancreatitis patients in a 2-year follow up study. *Pancreas*. 2007; 34(2):191–196. [PubMed: 17312457]
23. Mokrowiecka A, Pinkowski D, Malecka-Panas E, et al. Clinical, emotional and social factors associated with the quality of life in chronic pancreatitis. *Pancreatology*. 2010; 10:39–46. [PubMed: 20332660]
24. Rutter K, Ferlitsch A, Sautner T, et al. Hospitalization, frequency of interventions and quality of life after endoscopic, surgical or conservative treatment in patients with chronic pancreatitis. *World J Surg*. 2010; 34(11):2642–2647. [PubMed: 20645098]
25. Bloechle C, Izbicki JR, Knoefel WT, et al. Quality of life in chronic pancreatitis – Results after duodenum-preserving resection of the head of the pancreas. *Pancreas*. 1995; 11(1):77–85. [PubMed: 7667246]
26. Witzigmann H, Max D, Uhlmann D, et al. Quality of life in chronic pancreatitis: A prospective trial comparing classical Whipple procedure and duodenum-preserving pancreatic head resection. *Journal of Gastrointestinal Surgery*. 2002; 6(2):173–180. [PubMed: 11992802]
27. Broome A, Eisen GM, Harland R, et al. Quality of life after treatment for pancreatitis. *Annals of Surgery*. 1996; 223(6):665–672. [PubMed: 8645040]
28. Huang JJ, Yeo CJ, Sohn TA, et al. Quality of life and outcomes after pancreatoduodenectomy. *Annals of Surgery*. 2000; 231:890–898. [PubMed: 10816633]
29. Strate T, Taherpour Z, BLoeche C, et al. Long-term follow up of a randomized trial comparing the Beger and the Frey procedures for patients suffering from chronic pancreatitis. *Ann Surg*. 2005; 241:591–598. [PubMed: 15798460]
30. Whitcomb DC, Yadav D, Slivka A, et al. for the North American Pancreatic Study Group. Multicenter approach to recurrent acute and chronic pancreatitis in the United States: The North American Pancreatitis Study 2 (NAPS2). *Pancreatology*. 2008; 8:520–531. [PubMed: 18765957]
31. Ware JE, Kosinski M, Turner-Bowker DM, et al. How to score version 2 of the SF 12 Health Survey with a supplement documenting version 1. Quality Metric Incorporated (Rhode Island) and Health Assessment Lab (Boston, Massachusetts). 2002
32. Ware, JE.; Kosinski, M.; Keller, SD. SF-36 physical and mental summary scales: a user's manual. Boston, MA: The Health Institute; 1994.
33. Pezzilli R, Morselli-Labate AM, Fantini L, et al. Assessment of the quality of life in chronic pancreatitis using SF-12 and EORTC Q1q-C30 questionnaires. *Dig Liver Dis*. 2007; 39:1077–1086. [PubMed: 17692582]
34. Dawson DA, Grant BF, Chou SP, et al. Subgroup variation in U.S. drinking patterns: results of the 1992 national longitudinal alcohol epidemiologic study. *J Subst Abuse*. 1995; 7(3):331–344. [PubMed: 8749792]
35. Volk RJ, Cabor SB, Steinbauer JR, et al. Alcohol use disorders, consumption patterns and health-related quality of life of primary care patients. *Alcohol Clin Exp Res*. 1997; 21(5):889–905.
36. Lahmek P, Berlin I, Michel L, et al. Determinants of improved quality of life of alcohol-dependent patients during an inpatient withdrawal programme. *Int J Med Sci*. 2009; 6(4):160–167. [PubMed: 19461935]
37. Mullady DK, Yadav D, Amann ST, et al. for the NAPS2 Consortium. Type of pain, pain-associated complications, quality of life, disability and resource utilization in chronic pancreatitis: a prospective cohort study. *Gut*. 2011; 60:77–84. [PubMed: 21148579]

1b

Figure 1.
 Quality of life scores for controls (population, NAPS2) and chronic pancreatitis patients in the NAPS2 study
 1a) MCS
 1b) PCS

2a

2b

Figure 2.
Quality of life scores for chronic pancreatitis patients in the NAPS2 study compared with other chronic conditions

2a) MCS

2b) PCS

3a

3b

Figure 3.

Incremental decrease in quality of life scores with additional attributes in a representative control and chronic pancreatitis patient. A PCS or MCS score of 50 (dark solid line in the graphs) is considered to represent an average (normal) score for a population control.

3a) Physical quality of life: PCS scores in –

- A. 50 year old Caucasian control or chronic pancreatitis patient with BMI of 25 who is a lifetime abstainer, non-smoker and has no history of diabetes, heart attack/stroke or gallstones/gallbladder removal
- B. Subject in A who is also a current smoker
- C. Subject in B who also has diabetes
- D. Subject in C who also has a history of heart attack or stroke and gallstones or gallbladder removal

3b) Mental quality of life: MCS scores in –

- A. 50 year old Caucasian control or chronic pancreatitis patient with BMI of 25 who is a lifetime abstainer, non-smoker and has no history of diabetes, heart attack/stroke or gallstones/gallbladder removal
- B. Subject in A who is also a current smoker
- C. Subject in B who also has a history of heart attack or stroke

- D.** Subject in C who also has a history of diabetes and gallstones or gallbladder removal

Table 1

Sociodemographic characteristics and Quality of life scores for Controls and Chronic Pancreatitis patients in the NAPS2 study

Variable	Controls (n = 611)	Chronic Pancreatitis (n = 443)	p-value
Age (years)	51.8±14.3	50.0±15.7	0.06
<46	197(32.2)	175(39.5)	.047
46–60	251(41.1)	158(35.7)	
>60	163(26.7)	110(24.8)	
Gender – Male (%)	224 (36.7)	236(53.3)	<0.0001
Race (%)	529(86.7)	376(85.1)	0.01
White	37(6.1)	46(10.4)	
Black	43(7.1)	20(4.5)	
Other			
Body Mass Index (Current) (%)	219(35.8)	262(59.1)	<0.0001
<=25	222(36.3)	126(28.4)	
26–29	170(27.8)	55(12.4)	
30			
Drinking categories (self-report)	147(25.0)	95(21.5)	<0.0001
Abstainer	207(35.3)	92(20.9)	
Light	131(22.2)	94(21.3)	
Moderate	71(12.1)	53(12.0)	
Heavy	31(5.3)	107(24.3)	
Very heavy			
Current smoker	128(21.1)	202(45.9)	<0.0001
Medical history:	11(1.8)	32(7.2)	<0.0001
Liver disease or Cirrhosis	62 (10.2)	124 (28.0)	<0.001
Diabetes	5 (0.8)	18 (4.1)	0.016
Kidney disease or failure	31 (5.1)	39 (8.8)	0.016
Heart attack or stroke	78 (12.8)	208 (47.0)	<0.001
Gallstones or gallbladder removal			
Physical Quality of life score	52±9.4	38±12	<0.0001
Mental Quality of life score	51±9.2	44±11.5	<0.0001

Proportions are calculated from effective sample size. The complete data (n) for analysis: Race group 609 controls and 442 CP subjects; Drinking categories group 587 control and 441 CP subjects.

Table 2

Multivariable regression model showing significant determinants for Physical Quality of Life in controls and chronic pancreatitis patients in the NAPS2 study

Variable	Reference Category	Parameter Estimate	Standard Error	p-value
Intercept	-	52.81	1.21	<0.001
Chronic Pancreatitis	Controls	-12.02	0.79	<0.001
Age 50 [^]	-	-0.16	0.03	<0.001
Female	Male	-1.60	0.67	0.01
White	Others	0.94	0.92	0.30
Current BMI 25 ^{^^}	-	-0.29	0.07	<0.001
Drinking category Light-Moderate Heavy-Very Heavy	Abstainer	2.57 0.63	0.83 1.00	0.002 0.53
Smoking Past Current	Never smoker	-0.51 -3.03	0.84 0.84	0.55 <0.001
Diabetes	No diabetes	-3.36	0.85	<0.001
Heart Attack or Stroke	-	-2.26	1.27	0.08
Gallstones or gallbladder removal	No gallstones or gallbladder removal	-2.71	0.77	<0.001
Chronic Pancreatitis* Age 50	-	0.18	0.04	<0.001
Chronic Pancreatitis * Current body mass index	-	0.39	0.12	0.001

[^] Age variable centered at 50 years;

^{^^} Current body mass index (BMI) centered at 25

Final sample size – Controls – 570 (93%); chronic pancreatitis – 431 (97%)

Adjusted R-square = 37.7%

For drinking category definitions – refer to methods section

PCS score for a 50 year old male Caucasian control with a BMI of 25, who is an abstainer, never smoker and has no co-morbidities will be 53.75. A CP patient with similar characteristics will have a PCS score of 41.73.

Table 3

Multivariable regression model showing determinants for Mental Quality of Life in controls and chronic pancreatitis patients in the NAPS2 study

Variable	Reference Category	Parameter Estimate	Standard Error	p-value
Intercept	-	52.39	1.19	<0.001
Chronic Pancreatitis	Controls	-4.24	0.90	<0.001
Age 50 [^]	-	0.09	0.02	<0.001
Female	Male	-1.53	0.67	0.02
White	Others	0.51	0.92	0.58
Current BMI 25 ^{^^}	-	-0.03	0.06	0.64
Drinking category Light-Moderate Heavy-Very Heavy	Abstainer	0.73 -1.09	0.83 1.01	0.37 0.28
Smoking Past Current	Never smoker	-0.15 -2.45	0.85 1.08	0.86 0.02
Diabetes	No diabetes	-0.10	0.86	0.90
Heart Attack or Stroke	-	-3.09	1.28	0.02
Gallstones or gallbladder removal	No gallstones or gallbladder removal	-0.91	0.78	0.24
Chronic Pancreatitis* Current smoking	-	-3.85	1.43	0.007

[^] Age variable centered at 50 years;

^{^^} Current body mass index (BMI) centered at 25

Final sample size – Controls – 570 (93%); chronic pancreatitis – 431 (97%)

Adjusted R-square = 18.8%

For drinking category definitions – refer to methods section

MCS score for a 50 year old male Caucasian control with a BMI of 25, who is an abstainer, never smoker and has no co-morbidities will be 52.90.
A CP patient with similar characteristics will have a PSC score of 48.66.