Attendance of Outpatient Clinic Appointments amongst Adults with Congenital Heart Disease: Predictors and Relation to Outcome

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Abstract

Background

Adult Congenital Heart Disease (ACHD) guidelines advise life-long, regular, follow up in predefined intervals in ACHD patients. However, limited data exist to support this position. We aimed to examine whether compliance to regular outpatient clinic appointments vs. non-attendance has an impact on outcome.

Methods and Results

We examined 4461 patients and their records (median age 26 years, 56% with moderate or complex lesion) under follow up at our ACHD center between 1991-2008. Clinic attendance was quantified from electronic hospital records. For survival analysis we included clinic appointments before 2008 with follow up starting at the last attended visit before 2008. Overall 24% of scheduled clinic appointments were not attended. The main predictors of clinic non-attendance (CNA) were non-caucasian ethnicity, low socioeconomic status, younger patient age, number of previous CNAs and the lack of planned additional investigation/s (e.g. echocardiography) scheduled for the same visit. During a cumulative follow-up time of 48,828 patient-years (median 9.6 [IQR 5.6-16.0] years), 366 patients died. Both, the number of CNAs (HR=1.08, 95%CI 1.05-1.12 per CNA, $P<0.001$) and the ratio of CNA to follow up period (HR=1.23, 95%CI 1.04-1.44 per 1 CNA/year, $P=0.013$) emerged as independent predictors of mortality, also after adjustment for patients' age, disease complexity, functional class and socioeconomic status.

Conclusions

Patient adherence to scheduled ACHD outpatient clinic visits is associated with better survival. Identifying patients at increased risk of CNA in a single tertiary centre was feasible. Our novel data provides previously lacking evidence in support of periodic assessment of ACHD patients at tertiary clinics. Furthermore, non-attenders should be specifically targeted and receive counselling to modulate their increased risk of death.

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Introduction

Adult congenital heart disease (ACHD) patients represent an increasing population with high resource utilization.[1, 2] Despite ongoing research and improvements in care, morbidity and mortality remain considerable.[3]

It is now recognized that notwithstanding corrective interventions undergone in childhood, patients with congenital heart disease are not "cured".[4] There are late complications which impact on quality of life and survival.[5-8] Overt symptoms may be late or catastrophic i.e. sudden cardiac death, whereas identification of patients at risk remains challenging. It is, thus, recommended that ACHD patients are assessed regularly at specialized centers. Guidelines go further, providing disease specific intervals for outpatient clinic appointments, ranging from 6 months in complex cyanotic patients to 5 years in patients with simple defects and no residual lesions.[9-11] Such a proactive approach of regular follow-up visits to ACHD clinics, although intuitively safer, is resource- intensive and, surprisingly, lacks strong supportive evidence.

We set to examine predictors of attendance or non-attendance of outpatient clinic visits and its impact on outcome in our large, single centre, tertiary practice.

Patients and Methods

Data on all adult patients with congenital heart disease under follow-up at our tertiary center before 2008 were retrospectively obtained and studied. Patients' clinical data and demographics were retrieved from electronic patients' records. Complete data on all clinic appointments, both attended and non-attended, as well as the number and type of tests performed were retrieved from electronic hospital records. Patients were grouped by ACHD complexity based on the Bethesda Conference classification.[12]

Socioeconomic status was assessed indirectly using the English Index of Multiple Deprivation 2007 (IMD 2007) - a measure of deprivation at the small area level, as previously described.[13] Briefly, it combines 38 indicators distributed across seven domains, including income, health, employment and education, disability, skills and training, barriers to housing and services, crime and living environment. For each domain a score is calculated which is then ranked (the most deprived neighborhood is given a rank of 1). In addition, a total score and rank of deprivation is calculated. The results are provided at lower layer super output area (LSOA) level which was matched to the residential postcode. Travel distance and time were obtained using a custom written script in *R-package* for Windows, which retrieved the data from web-based route planners. Mortality data were retrieved from the national database.

Statistical Analysis

Statistical analyses were performed using R-package version 2.15.0.[14] Continuous variables are presented as mean±standard deviation or median and interquartile range (IQR), presented in square brackets, depending on data distribution. Categorical variables are presented as number (percentage). Data distribution was assessed for normality using the Shapiro-Wilk test. Comparison between groups was performed using Wilcoxon rank sum test or Chi-squared test, depending on type of data. Parameters assessing socioeconomic status are used in the statistical analyses as standard score calculated from IMD scores. The relation between likelihood of clinic attendance and various parameters was assessed for each appointment in each patient using a generalized linear mixed model employing the *lme4* package. The relation between clinical and demographic parameters as well as outpatient clinic attendance and mortality was assessed using Cox proportional-hazards regression analysis. For this purpose we have used patients' status on the last attended clinic

appointment before 2008 as the start date (Figure 1). Follow up time was calculated from this appointment till the date of death or the censoring date for survivors (01 Sep 2013). Estimated survival and standardized mortality ratio (SMR) for a gender-matched cohort was based on the Interim Life Tables for England and Wales (2007–2009) published by the Government Actuary's Department.[15]

The number of CNAs and further parameters related to CNAs in the survival analysis relate to appointments before the follow-up start date. A two-sided p-value of <0.05 was considered indicative of statistical significance.

Results

In total, 4,461 patients were included in the analysis. Demographic and clinical characteristics of all patients are presented in Table 1. Median age at the first recorded appointment was 26.4 years, 51% patients were female. According to the Bethesda classification 1,907 (43%) patients had a simple lesion, 1,622 (36%) a moderate, 863 (19%) a complex lesion while 69 (2%) had a lesion not classified in the Bethesda conference document.

The majority of patients were asymptomatic or had only mild symptoms (NYHA functional class I or II in 54% and 37%, respectively) and most patients were of white ethnicity (70.6%). Overall, 36% patients were residents of the Greater London metropolitan area, the median travel distance for all patients was 26.8miles [11.6-55.6miles] corresponding to a median travel time of 51min [32-88min].

Outpatient clinics attendance

There was a significant increase in clinical workload, with the number of outpatient clinic appointments increasing over time from a median of 827 [791-1048] appointments per year in the early era (1991-1995) to 3,184 [3166-3240] per year in

the late era (2006-2010), Figure 2. The overall prevalence of CNAs was 23.4% and it increased over the study period from 15.5% in the early era to 26% in the late era (p<0.0001).

Several parameters emerged as significant predictors of CNA (Figure 3) including non-white ethnicity (OR 1.22, 95% CI 1.13-1.33, P<0.001), previous CNA (OR 1.14, 95% CI 1.08-1.20, P<0.001), and indices of socioeconomic deprivation. Additional investigation/s booked at the day of clinic appointment had a positive effect on adherence to clinic appointments (OR for CNA of 0.49, 95%CI 0.46-0.53, P<0.001). There was also a weak, but statistically significant association of age and risk of CNA (OR 0.97 per 10 years of age, 95%CI 0.95-1.00, p=0.017). Gender, complexity of ACHD and travel distance / time were not predictive of adherence to clinic appointments.

Mortality and predictors of outcome

During a cumulative follow up period of 48,828 years, 366 (8.2%) patients died. The mortality rate - adjusted for age and gender - was significantly higher than in the general population and corresponded to a standardized mortality ratio (SMR) of 2.48, 95% CI 2.20-2.78, Logrank p<0.0001. The SMR was significantly increased for patients with moderate and complex lesions (1.96, 95%CI 1.53-2.50, P<0.0001 and 12.45, 95%CI 10.52-14.73, P<0.0001, respectively) but was close to normal for patients with simple lesions (1.17, 95%CI 0.94-1.46, P=0.11). On survival analysis several parameters emerged as predictors of outcome (Figure 4) including CNA count (HR=1.08, 95%CI 1.05-1.12, P<0.001 and Figure 5) and the ratio of CNA to follow-up time (HR=1.23, 95% 1.04-1.44, P=0.013) as well as age (HR=1.36, 95%CI 1.27-1.45 per 10 years, P<0.001), more than mild complexity of ACHD (HR=2.08, 95%CI 1.64-2.64, P<0.001) and functional status (HR=4.85, 95%CI 3.74-6.30,

P<0.001 for NYHA≥3). In contrast, gender, ethnicity, distance from tertiary centre and indices of socioeconomic status were not predictive of outcome. On multivariate Cox regression analysis all parameters identified as predictors of outcome on univariate analysis remained in the model.

Discussion

Adult patients with congenital heart disease are at increased risk of mortality.[16] Previous studies have identified several predictors of death in this population including, among others, functional class, pulmonary function, cardiothoracic ratio and cardiopulmonary exercise performance.[17-19] Most of these parameters, although helpful for risk stratification, cannot be easily modified. Our study demonstrates for the first time that adherence to outpatient clinic appointments in ACHD patients is a strong and independent predictor of better survival. Furthermore, our data may help identify patients at increased risk of non-attendance to clinics and increase their adherence to specialized ACHD clinic follow-ups.

Risk factors for non-adherence to follow-up

We have identified several risk factors for non-adherence to follow-up clinic schedules namely non-white ethnicity, previously missed clinic appointments and lower socioeconomic status. In contrast to recent studies by Mackie et al and Gurvitz et al, severity of lesion was not related to the adherence to clinic appointments in our population.[20, 21] Patients with these risk factors may benefit from additional counselling and specific measures to improve clinic attendance and, thus, outcome. Several methods have been proposed for reducing missed appointments including text-messaging and telephone reminders.[22, 23] In the current study additional

planned investigations (about which the patient was informed in the invitation letter) on the day of appointment, including echocardiography, pacemaker interrogation or cardiopulmonary exercise testing reduced the risk of missed appointment by approx. 50%. Most ACHD patients require periodic tests which may be arranged both on the day of the outpatient clinic appointment or on a different day. Our study suggests that booking additional investigation/s ideal on the day of the outpatient clinic appointment may significantly reduce the risk of CNA.

Apart from patients' characteristics, different ACHD healthcare systems may have an impact on adherence to clinic appointments. It has been previously demonstrated that patients may get lost to follow-up during transition from pediatric to adult congenital heart care, whether in a vertical or horizontal model of care for congenital heart disease.[5, 20, 21, 24, 25] Furthermore, education of the patient and his/her family on the merits of periodic assessment before clinical decompensation needs to continue.[26] The rate of non-attendance to tertiary ACHD clinic varied over the period of study. While there may have been structural changes in the unit during the period of the study to partially explain this, the trend for increasing rate of non-attendance with time would suggest that more efforts need to be made to communicate with the patients the need to entirely engage with life-long ACHD care. This should include sharing the data from this report with the patients themselves and their supporting groups.

Potential reasons for improved mortality with regular follow-up

The reasons for the adverse prognostic impact of missed outpatient clinic appointments are likely to be multifactorial. We submit that patients not adhering to their appointments are, obviously, less likely to receive timely and appropriate therapy. It has been previously shown that ACHD patients tend to overestimate their

functional capacity.[27] For example, patients claiming to be asymptomatic have significantly reduced maximum oxygen uptake on cardiorespiratory exercise testing compared to healthy controls.[28] Subtle changes in objective exercise capacity reflective of disease progression may be, therefore, missed by patients, who in turn, fail to seek professional advice.

This contrasts to patients who are regular attenders to ACHD outpatient clinics, where the decision making for interventions is often based on changes on periodic tests performed such as ECG, CXR, biomarkers, echocardiography, cardiac MRI and exercise testing.[29-34] Furthermore, it contrasts to other cardiac clinics, such as coronary artery disease heart failure, where symptoms may drive clinic attendance.

Limitations

This is a retrospective study performed at a single, tertiary ACHD center with patients representative of such a setting but not necessarily of the ACHD population in the community.

It cannot be, furthermore, excluded that missing clinic appointment is a marker of increased mortality rather than a direct and modifiable risk factor. For example, patients not adhering to their clinic appointments are also more likely not to take their medication regularly.[35, 36] Therefore, increasing the adherence to clinic appointments shouldn't be the sole target. Patients with previous missed appointments should, thus, be offered new appointments and counselling discussing modifiable behavioral risk factors and their potential to improve outcome.

Although non-white ethnicity and socioeconomic deprivation were predictive of CNA, they were not predictive of mortality. Number of CNAs, however, and ratio of CNAs to follow-up time were clear predictive of worse outcome, making a strong case for targeting aggressively ACHD clinics non-attenders.

Future, prospective studies extended to ACHD patients outside tertiary care will validate our data and may examine the potential benefit of proactively bringing non-clinic attenders back to tertiary ACHD care and targeted counseling on outcome.

Conclusions

Patient adherence to scheduled ACHD outpatient clinic visits is associated with better survival. Identifying patients at increased risk of CNA in a single tertiary centre was feasible. Our novel data provides previously lacking evidence in support of periodic assessment of ACHD patients at tertiary clinics. Furthermore, non-attenders should be specifically targeted and receive counselling to modulate their increased risk of death.

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Tables

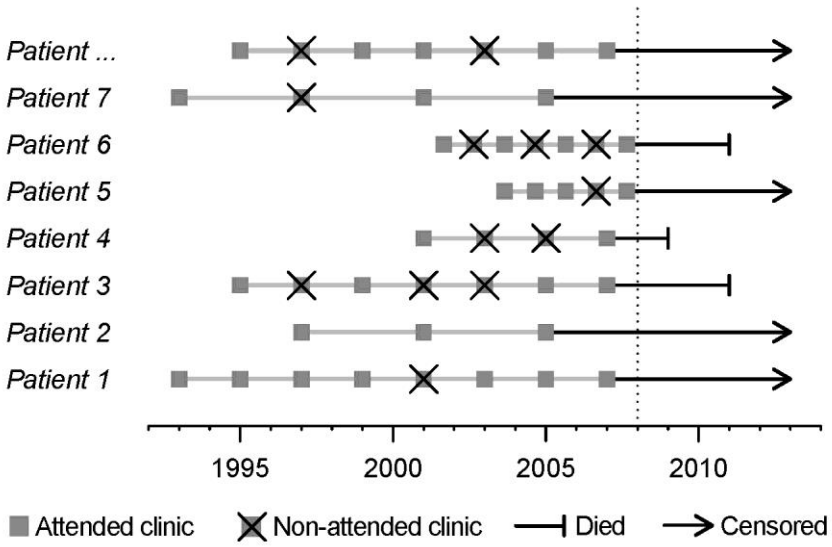
Table 1. *Baseline characteristics*.

	All pts.	Lesion type		
		Mild	Moderate or complex	Non-classified
	n=4461	n=1907	n=2485	n=69
Female, n (%)	2295 (51.4%)	998 (52.3%)	1262 (50.8%)	35 (50.7%)
Age, y	26.4 [19.1-37.2]	28.3 [19.9-40.4]	25.1 [18.8-34.6]	25.2 [17.4-37.4]
White ethnicity	70.6%	65.7%	73.9%	76.5%
Follow-up time, y	9.6 [5.6-16.0]	9.5 [5.7-16.9]	9.7 [5.5-15.2]	8.5 [5.4-16.0]
Death, n (%)	366 (8.2%)	104 (5.5%)	259 (10.4%)	3 (4.3%)
Age at death, y	42.4 [31.7-56.8]	51.2 [35.5-65.7]	41.0 [31.0-51.2]	54.6 [41.0-57.8]
NYHA class (I/II/III/IV, %)	54/37/9/0%	23/63/13/1%	61/31/8/0%	94/6/0/0%
CNA before 2008	1.0 [0.0-3.0]	1.0 [0.0-3.0]	1.0 [0.0-3.0]	1.0 [0.0-2.5]
CNA before 2008 ≥2	1153 (25.8%)	447 (23.4%)	695 (28.0%)	11 (15.9%)
CNA before 2008 / FU-time	1.6 [0.0-4.4]	1.3 [0.0-4.1]	1.9 [0.0-4.6]	1.3 [0.0-3.4]
Travel distance (miles)	26.8 [11.6-55.6]	21.5 [10.8-47.6]	31.2 [13.1-62.1]	15.7 [8.3-45.2]
Travel time (min)	51.0 [32.0-88.0]	47.0 [30.0-80.0]	57.0 [34.0-93.0]	35.0 [25.0-78.5]
IMD score	15.17 [8.72-24.76]	15.38 [8.83-24.73]	15.01 [8.61-24.73]	14.93 [9.18-25.59]
IMD income score	0.10 [0.06-0.18]	0.10 [0.06-0.18]	0.10 [0.06-0.18]	0.10 [0.05-0.18]
IMD employment score	0.07 [0.04-0.10]	0.07 [0.04-0.10]	0.07 [0.04-0.10]	0.07 [0.04-0.10]
IMD health score	-0.39 [-0.92-0.18]	-0.39 [-0.93-0.17]	-0.38 [-0.92-0.19]	-0.21 [-1.02-0.30]
IMD education score	12.25 [5.66-21.56]	11.23 [5.38-20.55]	12.88 [5.92-22.56]	9.62 [3.23-16.97]

CNA, clinic not attended; FU-time, follow-up time since the first attended, recorded appointment till death or censoring; IMD, indices of multiple deprivation as a measure of socioeconomic background. For each score the lower the value the higher the socioeconomic status.

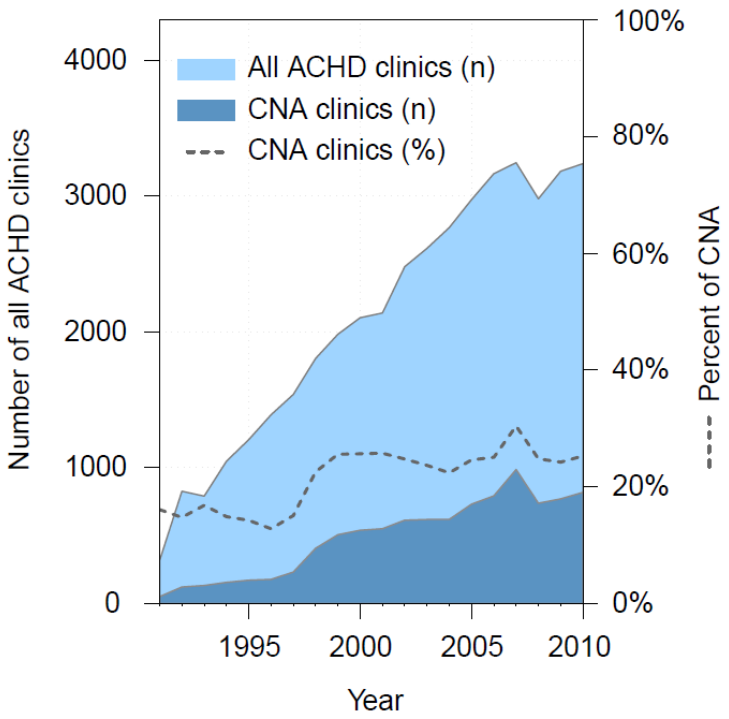
Figure Titles and Legends

Figure 1.



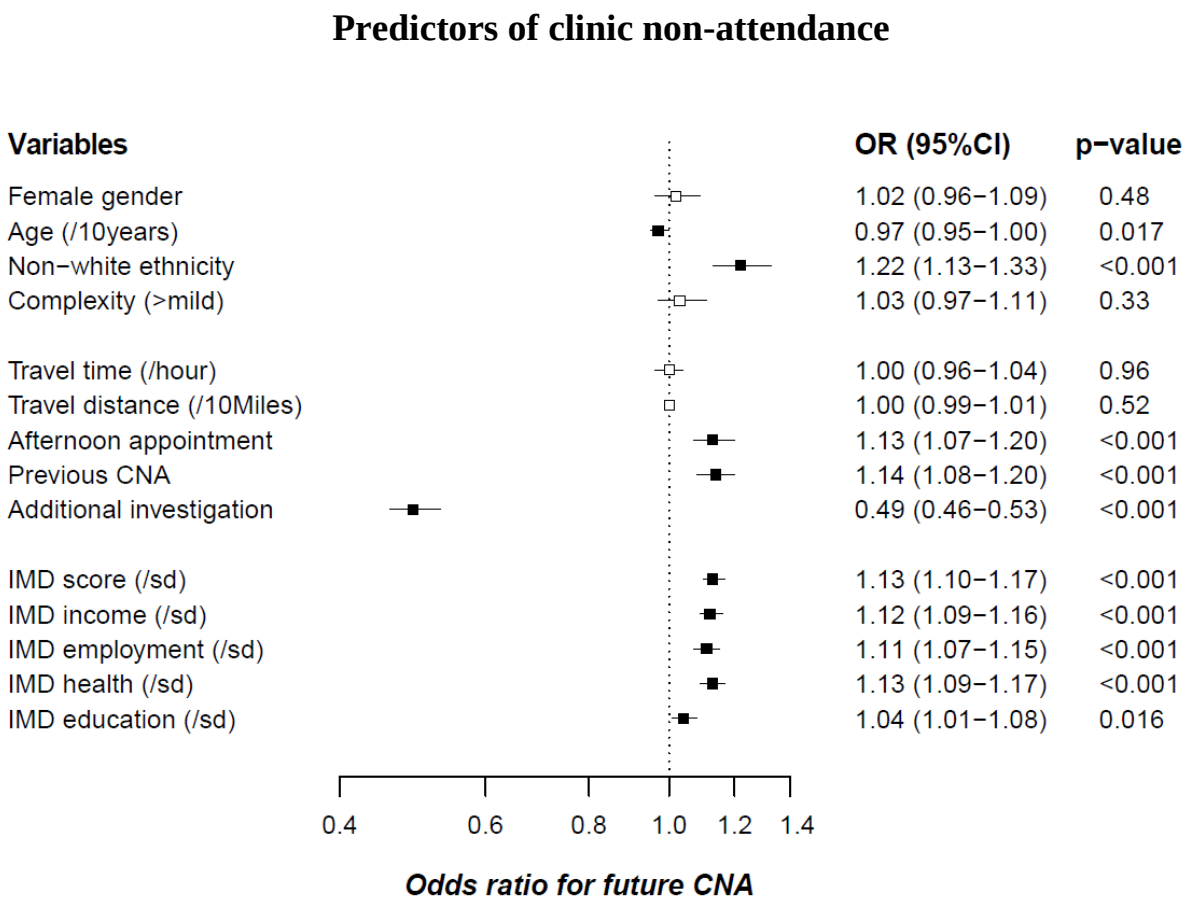
Schematic representation of the survival analysis. All patients under follow up prior to 2008 were included. All outpatient clinic appointments before 2008 were classified as "attended" or "non-attended". Clinical status and other parameters were assessed on the last appointment before 2009, which was also the start for the follow-up time in survival analysis.

Figure 2.



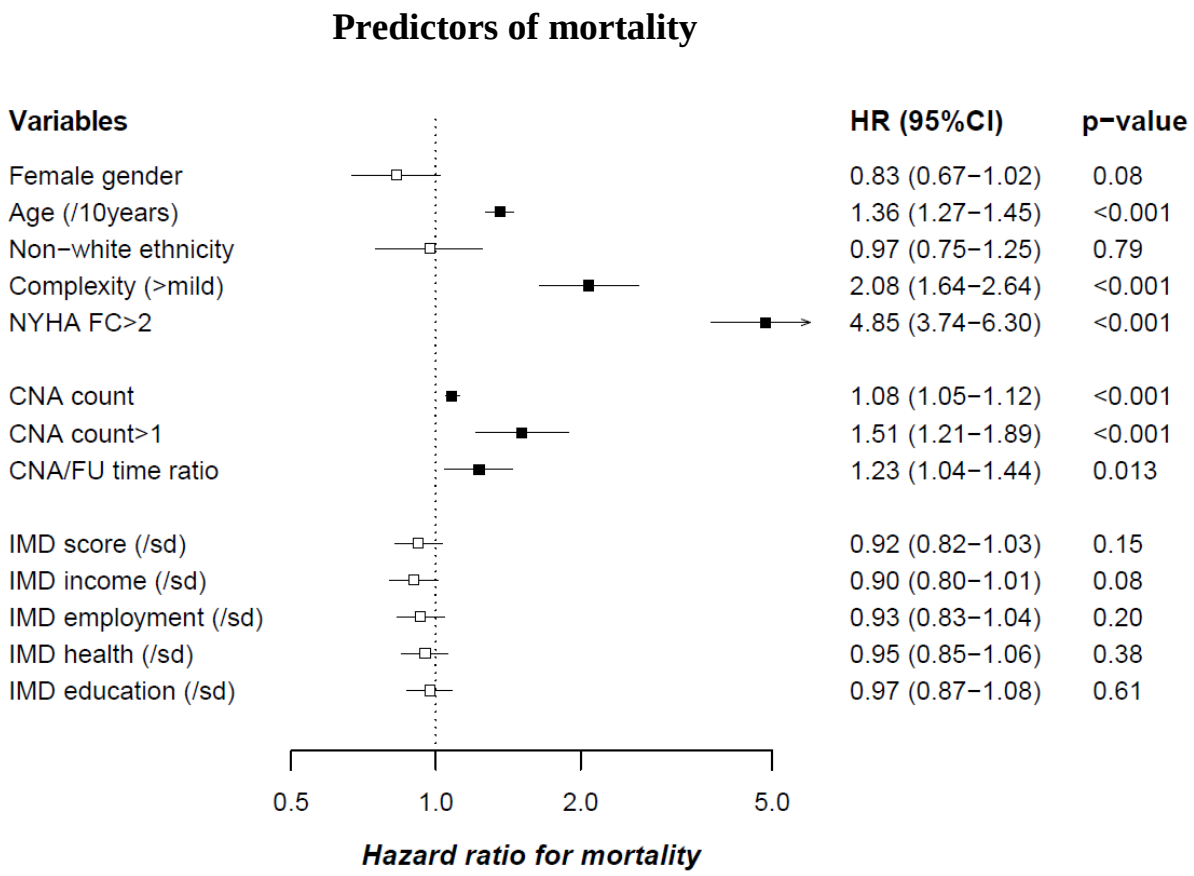
Number of all outpatient clinic appointments and missed outpatient clinic appointments (CNA) by year.

Figure 3.



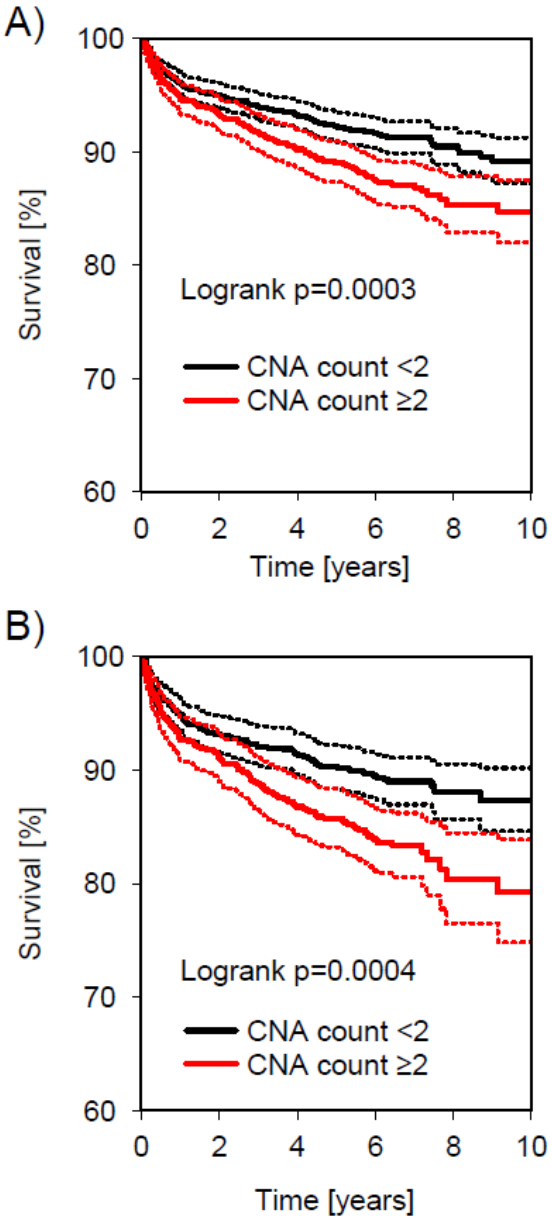
Predictors of future clinic non-attendance (CNA) on univariate generalized linear mixed model analysis. IMD=indices of multiple deprivation, expressed as z-score; OR=odds ratio; sd=standard deviation.

Figure 4.



Predictors of mortality on univariate Cox regression analysis. CNA=missed clinic appointment. CNA/FU ratio=ratio of CNA to total follow-up in years. IMD=indices of multiple deprivation, expressed as z-score; sd=standard deviation.

Figure 5.



Survival in relation to the number of not attended clinics (CNA) in all patients (A) and in patients with moderate or severe cardiac lesions (B). Clinic appointments were classified as CNA if patient did not come do the clinic appointment or cancelled the clinic on the day of appointment. Patients who contacted the coordinator beforehand and re-booked the clinic were not classified as CNA.

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