

# The Role of Sex and Age in Moderating the Outcome of In-Person and Computer-Based Brief Alcohol Interventions at General Hospitals: Reanalysis of a Brief Intervention Study

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## Keywords

Brief intervention · Feedback · At-risk drinking · Patients · Equity

## Abstract

**Introduction:** The aim of this study was to test whether brief alcohol interventions at general hospitals work equally well for males and females and across age-groups. **Methods:** The current study includes a reanalysis of data reported in the PECO study (testing delivery channels of individualized motivationally tailored alcohol interventions among general hospital patients: in Person vs. COmputer-based) and is therefore of exploratory nature. At-risk drinking general hospital patients aged 18–64 years ( $N = 961$ ) were randomized to in-person counseling, computer-generated individualized feedback letters, or assessment only. Both interventions were delivered on the ward and 1 and 3 months later. Follow-ups were conducted at months 6, 12, 18, and 24. The outcome was grams of alcohol/day. Study group  $\times$  sex and study group  $\times$  age interactions were tested as predictors of

change in grams of alcohol/day over 24 months in latent growth models. If rescaled likelihood ratio tests indicated improved model fit due to the inclusion of interactions, moderator level-specific net changes were calculated. **Results:** Model fit was not significantly improved due to the inclusion of interaction terms between study group and sex ( $\chi^2[6] = 5.9, p = 0.439$ ) or age ( $\chi^2[6] = 5.5, p = 0.485$ ). **Discussion:** Both in-person counseling and computer-generated feedback letters may work equally well among males and females as well as among different age-groups. Therefore, widespread delivery of brief alcohol interventions at general hospitals may be unlikely to widen sex and age inequalities in alcohol-related harm.

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## Introduction

There is good evidence for efficacy of brief alcohol interventions (BAIs) in health care [1]. Their application is justified by the potential to produce reductions in alcohol

use in the population at low cost [2]. Public health impact of BAI however requires that interventions minimize overall alcohol use in the population, while achieving equity across the population, e.g., equity among males and females and across age-groups.

Evidence about sex and age effects on the efficacy of BAIs is inconclusive. A substantial amount of research showed that sex does not influence the outcomes of BAI [3–6]. However, some evidence suggested that females benefit less than males [7], whereas another study among mandated college drinkers showed that males reduced alcohol use less strongly than females [8]. BAIs have been found to be efficacious among adults of different ages [1] whereby effects may be smaller for older adults and less long-lasting for young adults and college-aged students [4, 6]. Other studies found more favorable BAI outcomes for older compared to younger persons [7, 9]. Thus, existing research on the moderating role of sex and age is contradictory.

One explanation for the mixed evidence may be the heterogeneity in delivery mode across studies. In-person versus computer-delivered BAI could lead to variable effects among males and females and across age-groups. In general, studies on the comparative efficacy of in-person and computer-based BAIs are rare and mostly limited to short follow-ups and to college students who are homogeneous in age. Even fewer studies focused on the moderating role of sex and age. Among them, there is some evidence speaking in favor of sex equity in the short-term efficacy of in-person versus computer-based BAIs among college students [10, 11]. For mandated college students, there is some evidence indicating that females respond better to in-person BAI than to computer-based BAI, whereas males did not benefit differently [12]. Similarly, among hispanic primary care patients, females responded more favorably to in-person intervention for illicit drug use, while males responded more favorably to computer-based intervention [13]. However, this difference was not found for non-Hispanic ethnicities. Thus, current evidence on whether sex and age moderate the comparative efficacy of in-person and computer-based BAI in health care and in the long-term is insufficient and inconclusive.

In this study, adult general hospital patients received either in-person counseling, computer-generated individualized feedback letters, or assessment only. Both BAIs have been found to result in drinking reductions at some point over 2 years [14]. While in contrast to assessment only, feedback letters resulted in a 35% greater reduction of gram alcohol per week (primary outcome) up to month 24, in-person counseling reduced the proportion of at-

risk drinkers by 50% 6 months after initial intervention. Also, both BAIs showed beneficial effects on self-reported general health, mental health, and sick days over 2 years [15, 16]. The question now is whether improvements were shared equally across the population. We previously showed that the feedback letters reduced drinking more so in patients with less severe alcohol use or mental health problems, whereas in-person counseling tended to reduce drinking more so in patients with more severe problems [17, 18]. The aim of this study was to test whether in-person counseling and computer-generated feedback letters effects differed by sex and age.

## Material and Methods

The current study presents data from a secondary analysis of the randomized controlled trial entitled “Testing delivery channels of individualized motivationally tailored alcohol interventions among general hospital patients: in person versus computer-based” (PECO). The PECO trial was approved by the local Ethics Committee (BB 07/10, BB 05/13) and registered at ClinicalTrials.gov (NCT01291693). The aim of the trial was to test the efficacy of in-person delivered counseling versus computer-generated individualized feedback letters among general hospital patients with at-risk drinking identified by screening. Primary and secondary outcome data have been published elsewhere [14–16]. Therefore, the current analysis is of exploratory nature, and we report the findings as ancillary data.

### Participants

Sample recruitment took place from February 2011 to July 2012 on 13 wards at the local University Medicine Hospital. Research assistants proactively approached all consecutively admitted patients aged 18–64 years and invited them to participate in an alcohol screening provided by handheld computers. Patients were excluded if they were cognitively or physically incapable, discharged, or transferred within the first 24 h, employed at the conducting research institute, if they had highly infectious diseases or insufficient language skills. Patients screening positive for at-risk alcohol use were eligible for the trial. Females with scores of the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) of 4 or higher and males with scores of 5 or higher were considered at-risk drinkers [19, 20]. Those with AUDIT scores >19 [21, 22] were excluded as evidence showed lack of efficacy of BAIs in persons with more severe alcohol problems [23]. Patients who provided informed written consent were allocated to in-person counseling, computer-generated feedback letters, or assessment only (allocation ratio 2:2:1). Allocation was computerized and depended on week and ward to avoid information exchange between groups. Study assistants who supervised the eligibility screening informed about the trial procedure, invited eligible people to take part in the trial, and observed informed consent were not informed about group allocation. Participants were informed at recruitment that they would receive either in-person conversations, feedback letters, or no additional offer, but group allocation was not revealed to participants until they received an intervention.

### Study Groups

As described elsewhere [14, 24], individualized feedback letters were created by an expert system software at baseline and 1 and 3 months later. The software selected text modules based on assessment data [25]. In accordance with the transtheoretical model (TTM) of behavior change [26], feedback depended on a person's motivational stage. Participants received normative feedback on alcohol use and TTM constructs in comparison to other persons of the same sex and in the same motivational stage, ipsative feedback comparing the person's current with previous data and information on the limits of low-risk drinking [27]. Participants allocated to the in-person intervention condition received counseling face to face on the ward at baseline (median = 20 min) and by telephone 1 and 3 months later (median = 11 min). Across all contacts, participants received median = 35 min of counseling. Counseling was delivered by research staff trained in motivational interviewing [28]. Like the feedback letters, counseling was stage-matched and included normative and ipsative feedback on alcohol use and TTM constructs and information on the limits of low-risk drinking. To ensure comparability, counselors received a one-page manual including the same computer-generated feedback information as the computer-generated feedback letters (see [14] for more details). Participants allocated to assessment only received minimal assessment at baseline and were not contacted at months 1 and 3.

### Follow-Ups

All study groups were followed-up at 6, 12, 18, and 24 months primarily via computer-assisted telephone interviews conducted by trained interviewers. Interviewers were blinded to group allocation. If 10 contact attempts failed, participants received a questionnaire by e-mail or mail, with up to three reminders. Follow-up participants received a voucher of EUR 10 at month 6, a voucher of EUR 15 at month 18, and a voucher of EUR 20 at month 24. All PECO participants received a voucher of EUR 5 prior to 12-month follow-up assessment.

### Measures

Outcome data were assessed at months 6, 12, 18, and 24. The primary outcome was gram alcohol/day calculated based on self-reports of the number of drinking-days and drinks/drinking-day in the previous month: The frequency question "In [month], how often did you have an alcoholic drink?" included five response categories: never (frequency multiplier: 0), once (1), 2–4 times (3), 2–3 times per week (10), and 4 times or more per week (22). The quantity question "In [month], how many drinks did you typically have on a drinking day?" separately asked for the numbers of drinks containing beer (0.25 L) and wine/sparkling wine (0.125 L) and spirits (0.04 L). The numbers of drinks were multiplied with their according amount of pure alcohol (9.5 g/10.9 g/10.5 g) and summed up. A quantity-frequency product was determined, divided by 30.5, and rounded.

Sex (male, female) and age (years) assessed at baseline were tested as moderators of the BAI effects on alcohol use. Baseline covariates included school education ( $\leq 9$ , 10–11, and  $\geq 12$  years of school), employment status (employed, unemployed, other), medical department (internal medicine, surgical medicine, trauma surgery, and ear-nose-throat wards), self-rated health assessed by the single-item "Would you say your health in general is: excellent, very good, good, fair, poor?" [29], mental health assessed by

the 5-item Mental Health Inventory [30], partnership, cigarettes/day, alcohol problem severity assessed by the AUDIT [22], and motivational stage assessed by a 4-item staging algorithm [31], adapted from previous measures [31, 32]. The measure allocates persons to four motivational stages according to the TTM. Persons not intending to drink less and not thinking that they drink more than they should were allocated to the precontemplation stage. Persons considering to drink less or thinking that they drink more than they should were allocated to the contemplation stage. Persons planning to drink less were allocated to the preparation stage. Persons having seriously tried to drink less in the past 6 months and with the last attempt lasting were allocated to the action stage.

### Statistical Analysis

Descriptive statistics (mean, standard deviation, absolute number, percent) stratified by sex are given. *t* and  $\chi^2$ -tests were calculated to test for sex differences in baseline variables described above. Outcome data were analyzed using Mplus 7.31 [33]. Latent growth modeling and a maximum likelihood estimator with robust standard errors were used. Models were estimated under a missing at random assumption using all available data (intention-to-treat). Repeated measures of grams of alcohol/day were regressed on growth factors representing the alcohol growth trajectory using a negative binomial model. To handle nonlinearity, the model included three growth factors (intercept, linear slope, and quadratic slope), with the quadratic slope variance being fixed to zero. In step 1, group, sex, and age were regressed on the growth factors. In step 2, their interaction terms were added. If rescaled likelihood ratio tests (LRTs) indicated improved model fit due to the inclusion of interactions ( $p < 0.05$ ), moderator level-specific net changes were calculated. Analyses were adjusted for the baseline covariates reported above.

## Results

### Study Sample

Of the 6,809 patients eligible for screening, 6,251 (92%) completed screening. Of the 1,187 patients eligible for the PECO trial, 975 (82%) participated and 961 (81%) received their allocated treatment. Follow-up participation rates ranged between 77% (month 24) and 83% (month 6). For a flowchart, please see elsewhere [14, 24]. One participant with missing baseline covariate data and one participant reporting an unreasonably high daily amount of alcohol use (i.e., 342 g of pure alcohol per day) were excluded from analysis. The final sample consisted of 959 patients with at-risk alcohol use. It was composed of 719 males (75%) and 240 females (25%) with a mean age of 40.9 years (SD = 14.1). Participants consumed on average 15.2 g alcohol/day (SD = 19.8). Sample characteristics stratified by sex are shown in Table 1.

**Table 1.** Baseline sample characteristics by sex

Variables	Males (N = 719)	Females (N = 240)	p value
Age, years, M (SD)	42.5 (13.6)	36.2 (14.4)	<0.001
Living in a partnership, N (%)			
Yes	495 (68.9)	159 (66.3)	0.455
No	224 (31.1)	81 (33.7)	
School education, years, N (%)			
<10	155 (21.6)	35 (14.6)	<0.001
10–11	417 (58.0)	115 (47.9)	
>11	147 (20.4)	90 (37.5)	
Employment status, N (%)			
Employed	470 (65.4)	155 (64.6)	0.024
Unemployed	112 (15.6)	24 (10.0)	
Others	137 (19.0)	61 (25.4)	
Gram alcohol per week, M (SD)	17.7 (21.0)	7.7 (13.0)	<0.001
AUDIT-C, M (SD)	6.4 (1.5)	4.8 (1.2)	<0.001
AUDIT, M (SD)	8.3 (3.0)	6.0 (2.6)	<0.001
Stage of change, N (%)			
PC	282 (39.2)	111 (46.2)	0.064
C	246 (34.2)	60 (25.0)	
P	78 (10.9)	28 (11.7)	
A	113 (15.7)	41 (17.1)	
Medical department, N (%)			
Internal medicine	237 (33.0)	61 (25.4)	0.008
Surgical medicine	72 (10.0)	40 (16.7)	
Trauma surgery	160 (22.2)	63 (26.2)	
Ear-nose-throat	250 (34.8)	76 (31.7)	
Self-rated health,* M (SD)	2.0 (0.8)	2.1 (0.8)	0.441
Mental health,† M (SD)	71.0 (15.7)	62.0 (18.7)	<0.001
Cigarettes per day, M (SD)	7.8 (10.2)	6.2 (7.9)	0.021

Notes: *t* and  $\chi^2$  tests. *N*, number of cases; *M*, mean; *SD*, standard deviation; AUDIT(-C), Alcohol Use Disorders Identification Test(-Consumption); PC, precontemplation; C, contemplation; P, preparation; A, action. \* Range: 0 (poor) – 4 (excellent). † Range: 0–100.

### Moderation Analyses

Rescaled LRTs indicated that model fit was not significantly improved by the inclusion of interaction terms between study group and sex ( $\chi^2[6] = 5.9, p = 0.439$ ) or age ( $\chi^2[6] = 5.5, p = 0.485$ ). That is, drinking reduction following in-person counseling or computer-generated feedback letters was not moderated by sex or by age. Table 2 shows means and regression coefficients of the models including interaction terms.

### Discussion

This study shows that the in-person delivered BAI and the BAI delivered through computer-generated feedback worked equally well both among males and females and among patients at different ages. This finding is in line with previous findings [1, 4–6, 10, 11]. This is

particularly valuable from a public health perspective as not only efficacy but also reach did not differ between males and females and by age [24]. Our finding suggests that neither way of delivery may contribute to the widening of inequalities in alcohol-related harm when delivered to general hospital patients with at-risk alcohol use. From a public health perspective and in the face of finite resources, it is important to identify interventions which minimize overall levels of alcohol use in entire populations, without disadvantaging one or the other population group. Our study provides insight into the sex and age equity, concerning the long-term efficacy of BAI delivered in-person versus through computer-generated feedback in a sample of adult general hospital patients.

Although it is plausible and feasible to integrate proactive in-person BAI into routine care as recommended by the World Health Organization [34], there are several



**Table 2.** Model parameter estimates for latent growth models including interaction terms

	Sex × group interaction model			Age × group interaction model		
	estimate	SE	p value	estimate	SE	p value
<i>Means</i>						
Intercept (i)	2.471	0.113	<0.001	2.134	0.174	<0.001
Linear slope (s)	−0.340	0.137	0.013	−0.333	0.188	0.077
Quadratic slope (q)	0.047	0.033	0.153	0.066	0.047	0.159
<i>Regression coefficients</i>						
<i>i ON</i>						
PE	−0.033	0.094	0.727	−0.053	0.174	0.761
CO	0.080	0.097	0.411	0.256	0.172	0.137
Moderator	−0.584	0.166	<0.001	0.013	0.005	0.005
PE × moderator	−0.038	0.213	0.857	0.001	0.006	0.870
CO × moderator	0.208	0.199	0.297	−0.005	0.006	0.367
<i>s ON</i>						
PE	−0.057	0.118	0.628	−0.142	0.203	0.486
CO	−0.128	0.118	0.278	−0.146	0.185	0.430
Moderator	0.243	0.165	0.140	0.001	0.005	0.794
PE × moderator	−0.027	0.238	0.909	0.003	0.007	0.677
CO × moderator	−0.312	0.207	0.133	−0.003	0.007	0.703
<i>q ON</i>						
PE	0.019	0.027	0.486	0.016	0.050	0.744
CO	0.023	0.027	0.389	0.003	0.046	0.940
Moderator	−0.056	0.038	0.144	−0.001	0.001	0.452
PE × moderator	−0.025	0.056	0.661	0.000	0.002	0.952
CO × moderator	0.053	0.048	0.266	0.001	0.002	0.400

Models adjusted for gender (men = 0) or age, school education, employment status, partnership, AUDIT score, self-reported health, mental health, medical department, and motivational stage. SE, standard error; PE, in-person; CO, computer-based.

implementation barriers such as lack of financial resources and high workload in health care [34]. The public health impact and therefore the likelihood for uptake and sustainability in real-world may be at least as high than that of the in-person BAI. It has to be considered that the computer-generated feedback letters used in our study may overcome some of these barriers, has proven efficacious in the long-term and after intervention activities have ended [14], and seems not to widen inequalities.

Our study provides three strengths. First, a high reach of the target population and high intervention adherence rates have been achieved by the proactive recruitment approach. For each intervention, contact participants were proactively contacted by research assistants. Second, both BAIs were theory-based and adequately delivered. Third, the follow-up period of 2 years allowed a long-term view on the efficacy of computer-based and in-person BAIs as a function of sociodemographic pa-

tient characteristics. Some limitations of this study should be noted. First, the current study was of exploratory nature. The PECO trial was powered to detect treatment effects in the whole sample rather than differential treatment effects across the population, and results should therefore be regarded as preliminary. Definite conclusions about the presence or absence of equity in BAI effects can only be drawn from larger studies powered to detect interaction effects. Second, analyses were based on self-report data, and reporting bias cannot be ruled out. However, self-reports offer a noninvasive and low-cost way of obtaining data on alcohol use with acceptable validity [35], particularly among persons who have no severe alcohol problems [36]. Furthermore, any counseling typically relies on self-report, and this is what counselors work with. Third, the generalizability of our findings may be limited to systematically recruited populations and may not apply to populations approached through recruitment approaches with lower levels of

proactivity. In addition to that, persons with acute alcohol intoxication may be underrepresented in our sample as patients being discharged or transferred within 24 h were excluded from the study. Patients who had been admitted to emergency department due to alcohol were found to be younger, more often male, and more likely suffer from alcohol-related health problems than patients who had not been admitted due to alcohol [37]. This participant selection also limits the generalizability of our findings. In general, an important point to note is that our results indicating sex equity in the efficacy of BAI do not tell us anything about gender equity. Understanding gender differences in intervention effects and the effects among gender minorities is an important component for the (further) development fair and equitable interventions to reduce alcohol use and related harm in the population at large. Another issue to consider refers to the technology development since the start of the PECO trial. Considering the high degree of digitalization in the population, the question arises if individualized feedback letters are more or less acceptable and effective than, e.g., individualized feedback provided on smartphones.

To conclude, the efficacy of BAI delivered in-person or through computer-generated feedback letters over 2 years may not depend on sex and age. Our findings suggest that both ways of proactive BAI delivery may be unlikely to widen inequalities in alcohol-related harm.

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## Statement of Ethics

The study protocol was reviewed and approved by the local Ethics Committee (BB 07/10, BB 05/13). Written informed consent was observed from all trial participants.

## Conflict of Interest Statement

Gallus Bischof and Jennis Freyer-Adam are members of the Motivational Interviewing Network of Trainers. The authors have no conflicts of interest to disclose.

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## Author Contributions

Sophie Baumann: conceptualization, methodology, formal analysis, writing – original draft, and visualization. Beate Gaertner and Ulrich John: writing – review and editing and funding acquisition. Gallus Bischof and Filipa Krolo: writing – review and editing. Jennis Freyer-Adam: writing – review and editing, supervision, and funding acquisition. All the authors read and approved the final manuscript.

## Data Availability Statement

The data that support the findings of this study are not publicly available due to terms of written informed consent to which participants agreed but are available from the corresponding author upon reasonable request.

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