Reducing Risk Behaviors Linked to Noncommunicable Diseases in Mongolia: A Randomized Controlled Trial

Toivgoo Aira, MD, PhD, Wei Wang, MA, Marion Riedel, PhD, and Susan S. Witte, PhD

Objectives. We tested the efficacy of a 6-session, evidence-based health promotion intervention aimed at reducing noncommunicable disease (NCD) risk behaviors.

Methods. Two hundred male and female factory workers in Ulaanbaatar, Mongolia were randomly assigned to groups receiving either the health promotion intervention or a time-matched financial literacy control intervention.

Results. The health promotion intervention increased daily fruit and vegetable intake and physical activity, increased readiness for NCD risk behavior reduction and health promotion knowledge, and reduced the number of daily alcoholic drinks and diabetes symptoms 3 months after the intervention.

Conclusions. The findings support the efficacy of the intervention to reduce risk behaviors associated with NCDs. Dissemination of the intervention may improve productivity, reduce costs of health services, and better the quality of life for Mongolians. (*Am J Public Health.* 2013;103:1666–1674. doi:10.2105/AJPH.2012.301175)

Noncommunicable diseases (NCDs) are the most common causes of premature mortality and morbidity worldwide.[1–4] An estimated 80% of the burden occurs in low- to middle-income countries, and 25% affects people younger than 60 years.[1] The burden of NCDs is expected to increase with the aging of populations, economic development, and the globalization of risk factors.[5] By 2015, cardiovascular disease and diabetes are expected to reduce global gross domestic product by 5%.[1] Approximately half of the total economic burden from NCDs is accounted for by cardiovascular disease, including stroke, ischemic heart disease, and peripheral vascular disease, which together cause more deaths than HIV/AIDS, malaria, and tuberculosis combined.[1] In recognition of the increasing burden and importance of chronic diseases, in 2008 the World Health Assembly endorsed a Global NCD Action Plan for prevention and control.[6] This plan prioritizes 4 NCDs (cardiovascular disease, cancer, diabetes, and chronic respiratory disease) that share major behavioral risk factors amenable to public health action and that together constitute a major portion of the global NCD burden. Developed countries have achieved reductions in NCDs in recent decades through a combination of population-level primary prevention, individual-based primary prevention, and individual-based secondary prevention strategies.[7,8] Because of the likely global economic impact of NCDs in low- to middle-income countries, there is an urgent need to develop and implement national NCD campaigns, particularly at the primary care level, as recommended by the World Health Organization (WHO).[1,2]

NCDs are an increasing public health problem in Mongolia.[8–11] Mongolia's mortality and morbidity rates from cardiovascular disease and cancers greatly exceed those of Western countries; these diseases now represent the major causes of death and disability in Mongolia, particularly in younger age groups (35–55 years).[8] The most recently published Stepwise Approach to Surveillance survey revealed that 9 of every 10 people in Mongolia had at least 1 of the major risk factors and that 1 of every 5 people were at high risk of developing NCDs.[11] To date, there are a few population-level NCD primary prevention efforts, including policies aimed at reducing cigarette smoking and alcohol consumption. The 2005 Mongolian Tobacco Control Law describes limitations on where individuals may or may not smoke in public places, and requirements for labeling, import, and sales.[12] Despite these regulations, smoking is very common in Mongolia and few people are familiar with regulating policies. For example, a recent survey determined that only a third of restaurant owners knew about the policy.[13] Similarly, although there are regulations against the use and abuse of alcohol,[14,15] government spending on implementing the program remains very low. Some suggest that this is because 25% of the state budget comes from tax on alcohol sales.[15] Additional attempts have been made, but accountability is not clear. In December 2011, the president passed the "Together for Alcohol Free Mongolia" campaign, calling for a ban on alcoholic beverages at work-related celebrations and for civil servants to be involved in reducing alcohol consumption and following alcohol-related regulations.[16]

To our knowledge, there are no individual-level primary behavioral interventions targeting NCDs currently implemented in Mongolia. The First Annual Mongolian Public Health Conference, held in December 2011, highlighted efforts to examine prevalence and trends in risk factors for cardiovascular disease, hypertension, and other NCDs. The conference included discussions about responsibility and accountability in health sector management and health promotion (Mongolian Public Health Professionals Association. First annual Mongolian Public Health Conference Program, unpublished data, 2011), but no description or evaluation of individual-level efforts for primary prevention of NCD risk behaviors.

The experiences of other countries show that NCDs are preventable when behavioral interventions are implemented.[7] The INTERHEART[17] and EPIC[18] studies, among others, have demonstrated that coronary heart disease can be reduced by 80%[17] and type 2 diabetes by up to 90%[18] through behaviors such as eating healthy food, maintaining normal body weight, and reducing alcohol and tobacco use.

Since the late 1970s,[19] it has been demonstrated that single interventions addressing multiple risk factors can result in self-reported risk reduction.

Engelgau et al.,[20] in a review of existing evidence, stress that this trend in NCD growth and cost will ultimately reduce or retard overall economic growth in developing countries like Mongolia, as the burdens shift toward the poor. They highlight that lack of prevention and affordable treatment shifts the cost of individual-level NCD unevenly to the poor. Further, short- and long-term disability from NCDs leads to a decrease in the working-age population's participation in the labor force and reduced productivity. This in turn may reduce per capita gross domestic product growth, especially in those economies that are growing and dependent on sources of human capital. Taken together, the evidence suggests that a prerequisite for global development is healthy aging, which in turn requires effectively tackling NCDs.

We adapted and piloted the feasibility of a theory-based NCD risk reduction intervention combined with motivational interviewing for women and men with primary risk factors (low levels of fruit and vegetable intake, physical inactivity, alcohol and tobacco use) for hypertension, myocardial infarction, stroke, and type 2 diabetes. We hypothesized that, compared with participants randomized to a time-matched financial literacy control condition, participants randomized to a 6-session intervention to reduce NCD behaviors (called "health promotion") would have lower blood pressure; lower cholesterol, triglyceride, and blood glucose levels; lower body mass index (BMI; defined as weight in kilograms divided by height in meters squared); lower self-reported alcohol and tobacco use; higher levels of fruit and vegetable intake; and higher levels of physical activity 3 months after the intervention. We designed this study to address the previously noted weaknesses and gaps, aiming to advance the science of individual-based NCD prevention among the general population of Mongolia.

METHODS

This 2-arm randomized clinical trial (Figure 1) took place between 2010 and 2011 in Ulaanbaatar, Mongolia. Study team staff recruited participants from one of several large power plants in the city during the winter of 2010. Staff enrolled 200 men and women and randomized them into the trial (100 per condition). Participants completed assessments at baseline, immediately posttest, and 3 months after the intervention.

Recruitment

Beginning in the winter of 2010, study team staff used multiple recruitment strategies, including invitation flyers left for or distributed to participants and posted in waiting rooms, personal invitations from factory supervisors and research team members, and word of mouth. Over 2 days, interested participants were invited to stop in at the clinic and complete a 10-minute screening interview, including informed consent to participate, to determine study eligibility. To be eligible, a potential participant had to meet all of the following criteria at the time of screening: (1) aged at least 18 years, (2) met the WHO Stepwise NCD surveillance criteria for being at high risk for multiple NCDs, and (3) not taking hypertensive medication or insulin. Participants must also have reported meeting at least 3 of the following 4 criteria: (1) smoked cigarettes, (2) drank alcohol, (3) did not engage in physical activities each day, and (4) ate fewer than 5 servings of fruit and vegetables each day in the prior 90 days. Another requirement was that participants have no cognitive impairment that would prevent comprehension of study procedures as assessed during the informed consent process; no one was excluded for this reason. All individuals received the equivalent of US $1 compensation for screening. Staff invited eligible participants to complete a baseline interview assessment and then invited them to their first group session.

Randomization

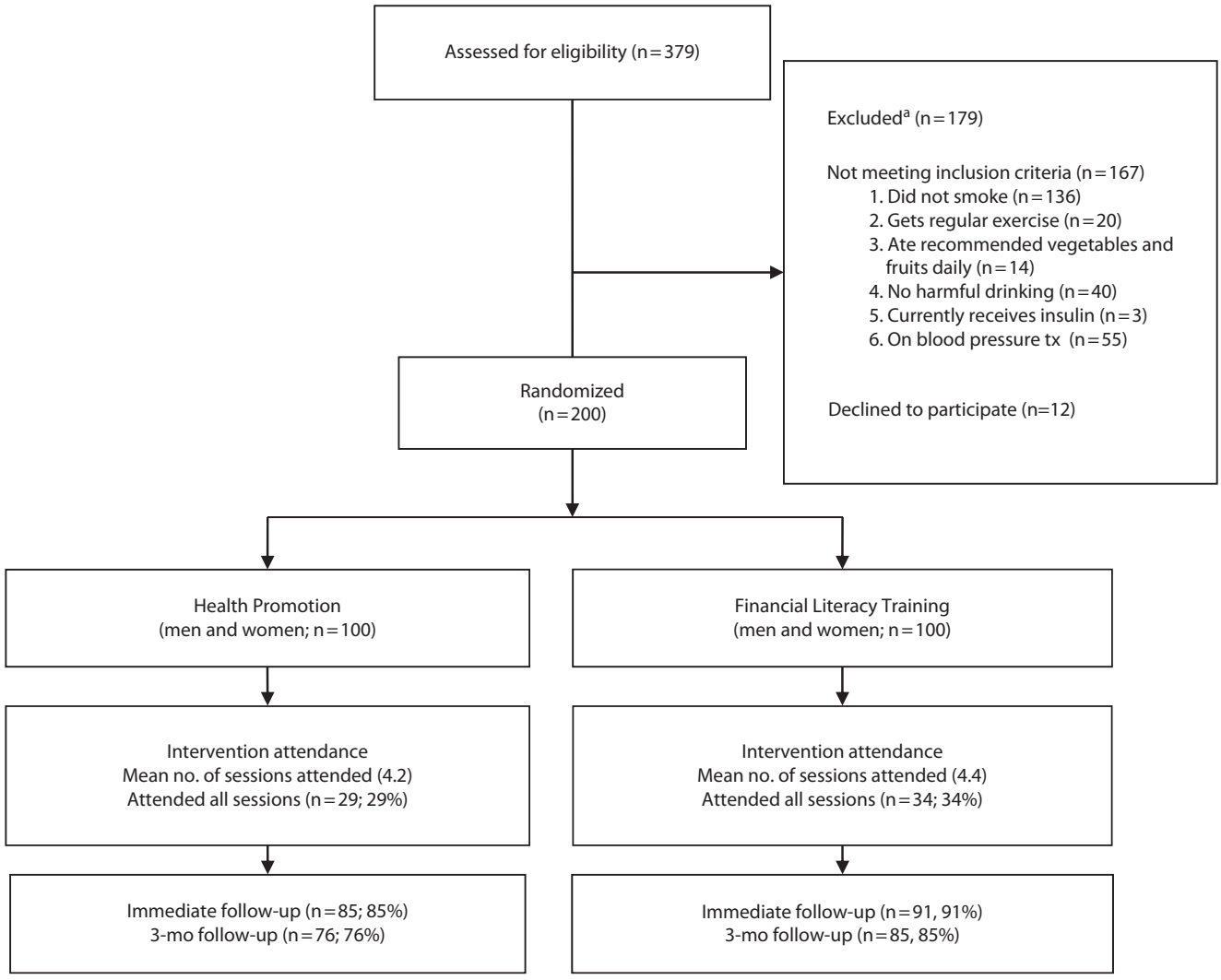
Randomization took place in 2 stages of 100 participants each. For the first stage, the staff scheduled open screening sessions over 2 days, during which time any factory workers could come and complete a screening. The staff screened men and women separately until there were 50 eligible women and 50 eligible men. A random number generator was used to assign men or women to single-gender control (financial literacy) or treatment (health promotion) groups of up to 13 participants. That is, men were randomly assigned to treatment or control condition in groups of 13 until a total of 4 groups was assigned. Staff then conducted the same procedure with women. After these intervention sessions were completed, staff recruited another sample of 100 (50 men and 50 women) and enrolled them by following the same procedures.

Interventions

Both interventions consisted of 6 biweekly structured 2-hour sessions delivered by a female facilitator who used manuals detailing the implementation protocols. This matching structure allowed us to control for attention and the Hawthorne Effect,[21] allowing inference regarding the efficacy of the health promotion sessions. The financial literacy training (control) sessions provided information and skills building in financial literacy, but they did not address any of the proposed risk content of the health promotion intervention. Sessions took place at the health clinic on the power plant grounds during the work day.

Health promotion sessions included discussion, experiential exercises, games, and skill-building activities to increase self-efficacy, outcome expectancy (attitudes), risk reduction knowledge, and behavioral skills. The intervention was based on social cognitive theory[22] and motivational interviewing.[23] It was originally designed to influence behaviors linked to the risk of cardiovascular disease, diabetes mellitus, chronic respiratory disease, and some cancers, and included physical activity, fruit and vegetable consumption, and strategies for the reduction of alcohol use and smoking. These sessions had been implemented and tested as the control condition in an earlier trial in which the treatment condition received an HIV prevention intervention for sexual risk reduction.[24] Integrating motivational interviewing into the health promotion intervention for this trial was designed to strengthen participants' motivation to make and sustain behavioral change leading to NCD risk reduction.

Motivational interviewing is a brief counseling method designed to evoke intrinsic motivation for change in health behaviors by



Note. tx = treatment.
[a]Because the criteria were not exclusive, they may add to more than 100.

FIGURE 1—Flow chart of intervention aimed at reducing risk of noncommunicable disease: Ulaanbaatar, Mongolia, 2010–2011.

exploring and resolving ambivalence. It has been extensively used for more than a decade to encourage treatment seeking; it has demonstrated efficacy and feasibility for adapting to a variety of risk behaviors and populations across 5 continents.

Intervention activities involved building self-efficacy and moving participants to higher stages of change. To build self-efficacy and skill, participants generated strategies for overcoming barriers to change and, after each session, made goals to reduce a risk behavior.

Objectives of the intervention sessions were to enable participants to do the following:

Session 1: (building motivation to change): (1) understand rationale of motivational interviewing, describing facilitator and participant goals and expectations; (2) identify and express positive and negative consequences of risk behaviors; (3) weigh pros and cons of risky lifestyle (alcohol and tobacco use, physical inactivity, unhealthy diet); (4) identify and discuss reasons for wanting or not wanting to change; (5) discuss perceived consequences of action and inaction; (6) identify discrepancy between where participants are and where they want to be; and (7) hear summary of concerns about changing lifestyle, review pros and cons of changing lifestyle, and repeat self-motivational statements of optimism and hope that have emerged.

Session 2: (1) understand the purpose and expectations of the sessions; (2) understand and sign the commitment pledge; (3) describe 3 areas of wellness: nutrition, exercise, and rest and relaxation; (4) know how to construct goals, barriers, and solutions; (5) learn how to track 3 areas of wellness using a personal journal.

Session 3: (1) assess the current health risks in their lives; (2) identify major health risks of smoking; (3) understand and identify benefits of 3 types of exercise (i.e., aerobic,

strength building, stretching); (4) learn how to do basic strength building, yoga, and stretching exercises; (5) identify an exercise, nutrition, and relaxation goal and identify barriers and solutions to these goals.

Session 4: (1) understand and identify healthy and unhealthy food options; (2) construct a grocery list of healthy foods; (3) plan a healthy meal; (4) identify a weekly goal and identify barriers and solutions to this goal.

Session 5: (1) review nutrition, exercise, and overall health goals, plan for the future, and evaluate barriers and solutions; (2) test one's knowledge through a quiz game; (3) set a goal for future positive life changes.

Session 6: (1) summarize progress since first session; (2) review risks for NCDs and health behaviors necessary to promote reductions in risk; (3) discuss level of change desired (abstinence, moderation, other reduction strategy); (4) discuss plan to sustain gains made in behavior change over time; (5) set goals and commitment to future change.

Study participants were compensated US $3.50 for each intervention session attended.

Data Collection and Assessment

Participants reported their health behaviors prior to the first session (baseline), immediately at the end of the last session (immediately posttest), and at 3 months postintervention. Facilitators were not involved with the data collection, and interviewers were blinded to a participant's intervention assignment. Measures selected for this study focused on sociodemographic and clinical information to determine eligibility, and on biological and self-reported behavioral outcome measures. For participants who indicated agreement, interviews were digitally recorded for quality assurance. Participants were compensated in cash for each assessment.

Sociodemographic variables included the following: gender, age, education, income, marital status, current housing situation, quality of life, and health-related quality of life.

Biological Measures

Primary outcomes were levels of glucose, cholesterol, and triglycerides; blood pressure; BMI. At each assessment point, research staff measured a participant's height and weight and calculated BMI. A trained health professional on the study team took each participant's pulse and read clinical blood pressure using a blood pressure monitor (model BD 8100; Bremed Italy SLR, Palombaro, Italy) twice at each measurement. We used the mean of these 2 measurements, unless they differed by 20 mm Hg or more, in which case a third measure was taken. Participants were referred to a laboratory, where trained laboratory technicians collected blood samples from the antecubital vein after 8 hours of fasting, and then obtained values for plasmatic total cholesterol, triglycerides, and glucose using a Cobas Integra 400 Plus (Roche Diagnostics, Seoul, South Korea).

Behavioral Measures

Secondary outcomes were self-reported symptoms of high blood pressure and diabetes, levels of reported tobacco and alcohol use, daily and weekly fruit and vegetable intake, and physical activity over a 3-month follow-up period after the intervention. Participants independently reported their health behaviors at each assessment. We adapted behavioral measures from the WHO Stepwise approach to WHO STEPS Instrument for Chronic Disease Risk Factor Surveillance.[11]

We calculated symptoms of diabetes and of high blood pressure by counting the reported presence of 5 common symptoms (0 = no, 1 = yes; range = 0–5) experienced in the prior 90 days (e.g., for high blood pressure, headache and dizziness; for diabetes, thirst and weight loss).

There was a measure of frequency and intensity for each of the 4 targeted risk behaviors. For assessment (number of days per week) of consumption of fruits and vegetables, physical activity, and smoking frequency, we used a 5-point Likert scale ranging from 1 (less than 1 day) to 5 (every day of the week). Responses for intensity (number of servings) of fruit and vegetable consumption ranged from 1 (1–2 per day) to 3 (≥ 5 per day); intensity of physical activity ranged from 1 (10 minutes) to 4 (≥ 30 minutes). Smoking intensity responses ranged from 1 (< 6 cigarettes per day) to 9 (≥ 41 per day). We measured alcohol frequency on a 4-point scale ranging from 1 (≤ monthly) to 4 (≥ 5 times a week). We measured intensity separately for men and women, asking men if, on a typical day, they had fewer than 5 standard drinks (scored 1) or 5 or more standard drinks (scored 2) and asking women if they had fewer than 4 standard drinks (scored 1) or 4 or more standard drinks (scored 2).

Additional secondary outcomes included readiness to change and knowledge of risk reduction behaviors. Readiness to change scales were composed of 10 items rated on a Likert scale (1 = strongly disagree to 5 = strongly agree), with a range from 0 to 50; each targeted 1 of the 4 main areas of NCD risk reduction: endorsing increases in consumption of fruits and vegetables (Cronbach $\alpha = 0.79$), increases in physical activity (Cronbach $\alpha = 0.77$), and decreases in smoking (Cronbach $\alpha = 0.75$) and alcohol intake (Cronbach $\alpha = 0.88$). Examples of alcohol items included the following: "I am trying to drink less than I used to"; "Sometimes I think I should cut down on my drinking"; and "I am changing my drinking habits right now."

We translated measures into Mongolian from English, and a professional translator then back-translated them for accuracy. Wellspring NGO research staff then pilot tested the baseline assessment and determined that it had adequate face validity. Study participants received US $3 for baseline assessment, $3.50 for immediate posttest assessment, and $8 for 3-month follow-up assessment.

We implemented process measures, including participant satisfaction and feedback ratings, to provide narrative data on the quality of the program.

Quality Assurance

To ensure ethical and scientific integrity during study implementation, we employed quality assurance procedures that focused on (1) adequate training and preparation for study staff and (2) monitoring and correcting potential problems in fidelity of assessment and intervention delivery. We held weekly meetings with all research assistants to reinforce adherence to study protocols. Quality assurance reviews of assessments focused on each interviewer's (1) ability to reliably follow the structured interview script and questions, including appropriate probing for clarification

and nondirective responses to participants' questions about assessment items, and (2) accuracy in recording participants' responses onto the paper-and-pencil questionnaire. Quality assurance reviews of the intervention focused on whether the key elements of the sessions were addressed, the time spent delivering each element, and how well the element was addressed.

We assessed the first 5 recorded interviews overall and then selected a random sample of 10% of recordings. From these, half of the recordings for each interviewer were reviewed. Fidelity of assessment and intervention sessions met quality assurance requirements of 80% or better, indicating that assessments yielded lower than 20% error rates in any single assessment or intervention implementation.

Statistical Analysis

To test the primary hypotheses of the study, we first summarized and compared the major demographic characteristics of both treatment and control groups using *t* tests and χ^2 tests. We then compared the means of outcome variables of interests at baseline, immediately posttest, and 3-month follow-up, including biological, behavioral, and attitude–knowledge scale outcomes. To estimate the effectiveness of the health promotion intervention, we used an ordinary least squares regression to regress 3-month follow-up outcomes on baseline outcomes, treatment group indicators (baseline outcome values), and demographic characteristics (age, education, income, marital status). The intervention effect we were interested in was the estimate of the treatment group indicator. Individual-level randomization did not eliminate potential intraclass correlations within the groups because of their shared experiences during the intervention sessions. To address this concern, we identified 4 demographic variables (age, education, income, marital status) and adjusted for them as covariates as recommended by Murray et al.[25] to reduce the potential adverse impact of any intraclass correlation from group participation.

Because we wanted to test multiple outcomes, we used false discovery rate methodology, which tries to control the proportion of false positive cases when multiple outcomes are tested.[26] We calculated the adjusted *P* values with the R language package fdrtool.[27]

Through use of an intent-to-treat approach, data analysis at each time point included all participants with their randomized treatment assignments regardless of whether they adhered to the treatment protocol. We adopted the Missing Data Imputation framework.[28] Specifically, we assumed that the missing data mechanism was "missing at random" (as missingness was from attrition at immediate posttest and 3-month follow-up) and assumed multivariate normal distribution of the underlying data. We used the R language package Amelia[29] to implement this method.

RESULTS

As shown in Figure 1, 100 individuals were assigned to the health promotion condition and 100 to the control condition. Table 1 summarizes participants' demographic characteristics at baseline for each condition. Just over half (51%) were men, and the average age was 36.2 years (SD = 7.4). Most (79%) were married, and 54% had a monthly income of between 50 and 100 000 tugriks (approximately US $38–76). No significant differences were found between groups on sociodemographic characteristics, suggesting that the randomization was successful.

Table 1 also highlights the highest-risk study participants, or those with biological measures at baseline outside of the normal ranges: glucose greater than 125 mg/dL, cholesterol greater than 200 mg/dL, triglycerides greater than 150 mg/dL, BMI greater than 24.9 kg/m^2, and blood pressure (systolic) greater than 140 mm Hg. Although very few (3%) had high glucose levels, a third

TABLE 1—Demographic Characteristics of Treatment and Control Participants: Ulaanbaatar, Mongolia, 2010–2011

Characteristic	Health Promotion (n = 100), No. (%) or Mean ±SE	Financial Literacy Training (Control; n = 100), No. (%) or Mean ± SE	Overall (n = 200), No. (%) or Mean ± SE
Male	51 (51)	51 (51)	102 (51)
Age, y	36.2 ±7.1	36.3 ±7.8	36.2 ±7.4
Education			
< high school graduate	6 (6)	8 (8)	14 (7)
High school graduate	33 (33)	38 (38)	71 (35.5)
Some college	61 (61)	54 (54)	115 (57.5)
Marital status			
Never married	8 (8)	14 (14)	22 (11)
Currently married	84 (84)	74 (74)	158 (79)
Divorced, widowed, or separated	7 (7)	8 (8)	15 (7.5)
Cohabitating	1 (1)	4 (4)	5 (2.5)
Household income, MNT[a]			
< 500 000	31 (31)	38 (38)	69 (34.5)
500 000–1 000 000	56 (56)	52 (52)	108 (54)
> 1 000 000	13 (13)	10 (10)	23 (11.5)
NCD risk			
Glucose > 125 mg/dL	3 (3)	3 (3)	6 (3)
Cholesterol > 200 mg/dL	35 (35)	30 (30)	65 (32.5)
Triglyceride > 150 mg/dL	21 (21)	11 (11)	32 (16)
BMI > 24.9 kg/m^2	57 (57)	59 (59)	116 (58)
BP systolic > 140 mm Hg	24 (24)	28 (28)	52 (26)

Note. BMI = body mass index; BP = blood pressure; NCD = noncommunicable disease. *t* test and χ^2 comparisons of sociodemographics by condition found no significant differences.
[a]US$1 = 1300 Mongolian tugriks (MNT).

of participants (32.5%) had high cholesterol and more than half (58%) had high BMI. Just over a quarter of participants (26%) had high blood pressure.

Table 2 provides the means and standard errors for all study outcomes by intervention condition and assessment point. Increases and reductions can be seen across variables. Some biological outcomes, including levels of cholesterol, triglycerides, and blood pressure, decreased over the follow-up for the health promotion group, compared with the control group, although that change was not significant (Table 3).

Table 3 shows the treatment estimates and 95% confidence intervals of the effect of the health promotion intervention on all study outcomes. In the ordinary least squares model, the outcome variable was the 3-month follow-up measurement, and we controlled the baseline measurement. Thus, the estimates can be interpreted as how much (in the scale of the corresponding outcomes) the participants in the intervention group gained compared with those in the control group. For example, with regard to levels of cholesterol, the 3-month follow-up measurement for participants who

TABLE 2—Outcomes for Treatment and Control Participants at Baseline, Immediately Posttest, and 3-Month Follow-Up: Ulaanbaatar, Mongolia, 2010–2011

	Baseline		Immediately Posttest		3 Months	
Outcome	Health Promotion, Mean (SE)	Financial Literacy, Mean (SE)	Health Promotion, Mean (SE)	Financial Literacy, Mean (SE)	Health Promotion, Mean (SE)	Financial Literacy, Mean (SE)
Biological						
Glucose, mg/dL	82.6 (15.2)	86.2 (29.6)	83.5 (16.0)	87.0 (33.5)	82.6 (14.0)	85.4 (23.1)
Cholesterol, mg/dL	191.9 (50.3)	177.2 (48.1)	188.8 (43.4)	176.9 (42.5)	183.3 (46.4)	178.8 (42.0)
Triglyceride, mg/dL	112.6 (83.6)	94.0 (77.0)	116.0 (74.1)	111.3 (77.0)	111.7 (90.8)	111.3 (86.8)
Blood pressure (systolic), mm Hg	129.0 (17.8)	130.6 (20.5)	126.3 (12.2)	126.9 (15.0)	124.1 (14.5)	125.2 (14.7)
Blood pressure (diastolic), mm Hg	82.6 (12.4)	83.0 (13.2)	82.0 (10.5)	82.3 (12.7)	82.2 (11.2)	81.7 (13.1)
Body mass index, kg/m^2	26.6 (4.1)	26.3 (4.0)	26.7 (4.1)	26.4 (4.0)	26.9 (3.9)	26.6 (4.1)
Behavioral						
Days of fruit consumption[a]	1.80 (0.93)	1.73 (0.99)	3.08 (1.39)	2.14 (1.25)	2.96 (1.18)	2.20 (1.02)
Servings of fruit/d[b]	1.09 (0.29)	1.18 (0.44)	1.29 (0.50)	1.06 (0.30)	1.28 (0.46)	1.17 (0.41)
Days of vegetable consumption[a]	4.45 (1.10)	4.42 (1.04)	4.51 (0.89)	4.46 (1.02)	4.40 (0.92)	4.57 (1.08)
Servings of vegetables/d[b]	1.19 (0.39)	1.21 (0.50)	1.47 (0.58)	1.11 (0.34)	1.53 (0.58)	1.35 (0.60)
Days of physical activity[a]	2.52 (1.37)	2.49 (1.22)	3.14 (1.40)	2.44 (1.52)	3.68 (1.24)	3.08 (1.38)
Time spent on physical activity[c]	3.15 (1.01)	3.39 (0.93)	3.05 (1.28)	2.53 (1.30)	3.52 (1.08)	3.35 (1.06)
Days of alcohol consumption[d]	2.00 (0.59)	2.10 (0.56)	1.82 (0.66)	1.86 (0.63)	1.71 (0.69)	1.84 (0.64)
Alcoholic drinks/d (men)[e]	1.92 (0.33)	1.81 (0.33)	1.74 (0.58)	1.85 (0.45)	1.62 (0.49)	1.78 (0.47)
Alcoholic drinks/d (women)[f]	1.75 (0.40)	1.75 (0.44)	1.58 (0.52)	1.81 (0.50)	1.49 (0.48)	1.78 (0.57)
Days/wk smoking[a]	4.32 (1.44)	4.65 (1.06)	4.64 (0.70)	4.77 (0.54)	4.71 (0.64)	4.69 (0.56)
Smoking/d[g]	1.71 (1.27)	2.29 (1.24)	1.38 (1.03)	2.22 (1.25)	1.76 (1.40)	2.26 (1.36)
Blood pressure symptoms	2.36 (1.70)	2.49 (1.65)	1.54 (1.45)	2.04 (1.64)	1.17 (1.31)	1.48 (1.58)
Diabetes symptoms	2.04 (1.36)	2.16 (1.34)	1.22 (1.07)	1.50 (1.21)	0.78 (0.90)	1.20 (1.18)
Attitude[h] and knowledge[i]						
Attitude toward healthy diet	29.4 (6.1)	29.5 (5.6)	34.8 (6.2)	28.3 (7.2)	33.0 (6.1)	30.6 (7.2)
Attitude toward physical activities	29.3 (5.6)	27.7 (6.1)	35.4 (5.0)	28.0 (6.82)	33.3 (5.3)	29.6 (5.5)
Attitude toward smoking	31.5 (5.0)	30.0 (5.0)	38.3 (5.0)	32.6 (5.2)	32.2 (5.6)	32.6 (5.2)
Attitude toward drinking	26.5 (6.3)	27.9 (6.4)	32.7 (5.7)	27.9 (6.4)	31.2 (7.3)	29.0 (7.1)
Health promotion knowledge	3.83 (1.70)	3.60 (1.53)	7.84 (2.18)	3.94 (1.41)	6.10 (2.66)	4.11 (1.77)

[a]Categories for number of days per week as follows: 1 = less than 1 day; 2 = 2–3 days; 3 = 3–4 days; 4 = 5–6 days; 5 = 7 days.
[b]Categories for number of servings of fruits and vegetables as follows: 1 = 1–2 per day; 2 = 3–4 per day; 3 = 5 or more per day.
[c]Categories for number of minutes per day as follows: 1 = 10; 2 = 10–19; 3 = 20–29; 4 = 30 or more.
[d]Alcohol frequency as follows: 1 = monthly or less; 2 = 1–3 times per month; 3 = 1–4 times per week; 5 or more times a week.
[e]Men's alcohol intensity as follows: 1 = fewer than 5 standard drinks; 2 = 5 or more standard drinks per day.
[f]Women's alcohol intensity as follows: 1 = fewer than 4 standard drinks; 2 = 4 or more standard drinks per day.
[g]Categories for smoking intensity as follows: 1 = fewer than 6 cigarettes per day; 2 = 6–10 cigarettes per day; 3 = 11–15 cigarettes per day; 4 = 16–20 cigarettes per day; 5 = 21–25 cigarettes per day; 6 = 26–30 cigarettes per day; 7 = 31–35 cigarettes per day; 8 = 36–40 cigarettes per day; 9 = 41 or more cigarettes per day.
[h]Attitude scales comprised 10 items scored from 1 (strongly disagree) to 5 (strongly agree), for a maximum of 50 points in each.
[i]Knowledge scale comprised 13 items scored 1 (correct) or 0 (incorrect), for a maximum of 13 points.

TABLE 3—Treatment Effect Size Estimates for Biological and Behavioral Outcomes: Ulaanbaatar, Mongolia, 2010–2011

Outcome	b (95% CI)	P^a
Biological		
Glucose, mg/dL	−0.41 (−3.68, 2.85)	.343
Cholesterol, mg/dL	−3.24 (−13.00, 6.48)	.25
Triglyceride, mg/dL	−9.48 (−31.10, 12.2)	.202
Blood pressure (systolic), mm Hg	−0.04 (−3.24, 3.16)	.389
Blood pressure (diastolic), mm Hg	0.84 (−1.98, 3.66)	.266
BMI, kg/m^2	0.06 (−0.28, 0.40)	.319
Behavioral		
Days of fruit consumption	0.72 (0.43, 1.00)	< .001
Servings of fruit/d	0.10 (−0.02, 0.22)	.068
Days of vegetable consumption	−0.18 (−0.45, 0.08)	.103
Servings of vegetables/d	0.17 (−0.01, 0.33)	.031
Days of physical activity	0.64 (0.29, 1.00)	< .001
Time spent on physical activity	0.23 (−0.07, 0.53)	.084
Days of alcohol consumption	−0.13 (−0.31, 0.05)	.1
Alcoholic drinks/d (men)	−0.19 (−0.32, −0.06)	.005
Alcoholic drinks/d (women)	−0.28 (−0.42, −0.15)	< .001
Days/wk smoking	0.06 (−0.09, 0.21)	.214
Smoking/d	−0.27 (−0.63, 0.09)	.09
Diabetes symptoms	−0.38 (−0.66, −0.11)	.006
Blood pressure symptoms	−0.25 (−0.63, 0.12)	.105
Attitude–knowledge scale		
Attitudes toward healthy diet	2.55 (0.83, 4.26)	.004
Attitudes toward physical activity	3.30 (1.88, 4.72)	< .001
Attitudes toward smoking	4.00 (2.75, 5.26)	< .001
Attitudes toward drinking	3.06 (1.34, 4.78)	< .001
Health promotion knowledge scale	1.92 (1.29, 2.55)	< .001

Note. BMI = body mass index; CI = confidence interval.
[a]*P* values are false discovery rate-adjusted significance probabilities.

received the treatment was on average 3.24 mg/dL lower than for those in the control group. For biological outcomes, results were promising but not significant. Glucose and blood pressure appear to have changed for both conditions, but cholesterol and triglyceride levels appear to be lower overall among the health promotion participants compared with the financial literacy training (control) participants. Decreases were not significantly greater but trended toward significance.

There were a number of significant improvements in behavioral outcomes, as well as all of the readiness for change and knowledge outcomes, among the health promotion intervention participants compared with the control participants. Days of fruit consumption and servings of vegetables per day increased significantly, as did the overall reported days of physical activity. Both men and women reported drinking significantly fewer alcoholic drinks per day, and overall symptoms for diabetes were reduced from baseline to 3-month follow-up. For the health promotion group only, all readiness-for-change scales showed improved readiness for reducing alcohol use and smoking (i.e., a commitment to action) and increasing fruit and vegetable consumption and physical activity. Overall health knowledge also increased significantly for the health promotion group only.

DISCUSSION

To our knowledge, this is the first randomized clinical trial to evaluate NCD risk reduction in Mongolia. The study targeted a sample of factory workers, among whom rates of NCD risks were variable and in some cases quite high (e.g., 32.5% had baseline levels of cholesterol above the normal range). Study results demonstrate that a 6-session health promotion intervention had significant effects on multiple health behaviors and beliefs among Mongolian male and female workers.

The study demonstrated the feasibility of implementing a randomized clinical trial among factory workers in Mongolia. The research team was able to recruit, screen, assess, and implement the 6 biweekly intervention sessions, immediately and 3 months posttest, among 200 participants over the course of only 12 months. Participant feedback from satisfaction surveys was overwhelmingly positive. This demonstration of feasibility and the preliminary effects sizes indicate the value of mounting a clinical trial with a larger sample size and a follow-up long enough to detect significant biological effects. Even without such a trial, the findings suggest the potential value of implementing and disseminating such an intervention in the general population.

In this study, readiness-for-change and knowledge scales, which represent levels of commitment to changing behavior, all increased significantly for the health promotion participants at follow-up. Although immediate posttest levels dropped off slightly at 3-month follow-up, all gains remained significant over time. This, combined with the promising directions of biological outcome for the health promotion group, is strong evidence of the relative efficacy of the intervention in reducing risks for NCDs. Further, on the basis of motivational interviewing theory, if readiness for change can increase and be positively directed, it may further mediate and support risk reduction outcomes over time.

Limitations

Study findings must be considered in light of study limitations. The study had a relatively small sample size for a clinical trial and limited funds, and the project timeline did not allow for longer-term follow-up. It may be that the relatively small sample size and short follow-up

time did not allow detection of changes in blood levels, which could account for the lack of more significant biological and behavioral findings in the study.

Some outcomes may have been influenced by the cost of obtaining goods; for example, it might have been harder to purchase and consume more fruits and vegetables because of the rising costs of groceries caused by the fluctuating economy and political conditions. On the other hand, we may have seen reductions in alcohol use or smoking among participants in the control condition because the focus of the intervention was on financial management and savings. Those participants who determined that saving money was preferable to purchasing alcohol or cigarettes may have reported lowering their risk behaviors for this reason.

Implications

The significance of this project is that it tested a low-cost, evidence-based NCD prevention intervention with male and female workers in the capital city of Mongolia, where more than half of the country's population resides. The project offered—and demonstrated the efficacy of—a safe tool for health care providers at all levels to use to increase NCD knowledge and awareness among the general population, and thus to promote and support healthier lifestyles for Mongolians.

Study findings and the enthusiasm of participants (based on anecdotal reports from the study team members) suggest that an additional sustainable impact of the intervention is that participants may continue to work at their behavioral change. In addition, women and men who successfully completed the course of intervention spoke about their intention to serve as role models to others at risk, including family and friends. Therefore, we expect the project will benefit not only those who participated, but also others in the community who have indirect involvement through peer modeling and diffusion.

The findings from this study indicate the efficacy of this brief intervention not only to increase readiness to change risk behaviors, but also to reduce behavioral risks of NCDs. This program fills a significant gap in public health policy in Mongolia for behaviorally based, individual-level NCD risk reduction. Implementation of such an intervention may show considerable return on investment through improved productivity, reduced costs of other health services, and better lives for those in need of care.[20] A longer-term trial with a sample drawn from the general population and additional measures for cost-effectiveness and relative productivity is needed to examine whether a long-term follow-up will yield biological outcomes of significance, as well as the potential reductions in cost and increases in productivity to the overall economy that such an intervention might achieve over time. Programs like this hold the potential for large-scale disease prevention, but policies and actions to change NCD risk factors in Mongolia will require private and public interest, political support, and policy and administrative institutions that can initiate, implement, sustain, and evaluate such programs for the long-term health of the population.[7] ■

About the Authors

Toivgoo Aira is with Wellspring, NGO, Ulaanbaatar, Mongolia, and the Global Health Research Center of Central Asia, Columbia University, New York, NY. Wei Wang is with the Department of Statistics and Marion Riedel is with the School of Social Work, Columbia University. Susan S. Witte is with the School of Social Work and the Global Health Research Center of Central Asia, Columbia University.

Correspondence should be sent to Toivgoo Aira, Executive Director, Wellspring, NGO, Peace Avenue, SB District, Zorig Building, Ulaanbaatar, Mongolia 210648 (e-mail: tg_aira@yahoo.com). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This article was accepted December 1, 2012.

Contributors

T. Aira supervised all aspects of the study, including the original study proposal, data collection, and supervision. T. Aira and S. S. Witte conceptualized the study, developed the study protocols, and collaborated on the writing. W. Wang conducted the data analysis. M. Riedel provided study intervention refinement and supervision and collaborated on the writing.

Acknowledgments

This study was made possible through funding from the Millennium Challenges Corporation (grant 1-10/433-1 to T. A., PI) and Wellspring, NGO.

We acknowledge the contributions of the participants without whom this study would not have been possible.

Human Participant Protection

The Mongolian National Ministry of Health's Medical Ethical Committee approved this study.

References

1. Couser WG, Remuzzi G, Mendis S, Tonelli M. The contribution of chronic kidney disease to the global burden of noncommunicable diseases. *Kidney Int.* 2011;80(12):1258–1270.

2. *Preventing Chronic Diseases: A Vital Investment.* Geneva, Switzerland: World Health Organization; 2005.

3. El Nahas M. The global challenge of chronic kidney disease. *Kidney Int.* 2005;68(6):2918–2929.

4. Zhang QL, Rothenbacher D. Prevalence of chronic kidney disease in population-based studies: systematic review. *BMC Public Health.* 2008;8:117.

5. Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet.* 2008;372 (9642):940–949.

6. *2008–2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases: Prevent and Control Cardiovascular Diseases, Cancers, Chronic Respiratory Diseases and Diabetes.* Geneva, Switzerland: World Health Organization; 2008.

7. Ezzati M, Riboli E. Can noncommunicable diseases be prevented? Lessons from studies of populations and individuals. *Science.* 2012;337 (6101):1482–1487.

8. Otgontuya D, Oum S, Palam E, Rani M, Buckley BS. Individual-based primary prevention of cardiovascular disease in Cambodia and Mongolia: early identification and management of hypertension and diabetes mellitus. *BMC Public Health.* 2012; 12:254.

9. Komatsu F, Hasegawa K, Watanabe SK, et al. Comparison of electrocardiogram findings and lifestyles between urbanized people and ger-living people in Ulaanbaatar, Mongolia. *Atherosclerosis.* 2004;175 (1):101–108.

10. Rudatsikira E, Dondog J, Siziya S, Muula AS. Prevalence and determinants of adolescent cigarette smoking in Mongolia. *Singapore Med J.* 2008;49 (1):57–62.

11. *Mongolian STEPS Survey on the Prevalence of Noncommunicable Disease and Injury Risk Factors—2009.* Ulaanbaatar, Mongolia: World Health Organization; 2012.

12. Mongolian Tobacco Control Law. Ulaanbaatar, Mongolia: Parliament of Mongolia; 2005.

13. Chang SH, Delgermaa V, Mungun-Ulzii K, Erdenekhuu N. Support for smoke-free policy among restaurant owners and managers in Ulaanbaatar, Mongolia. *Tob Control.* 2009;18(6):479–484.

14. Mongolian Special Parliamentary Commission on the Prevention of Criminal Activity. *National Program on Alcohol Prevention and Control.* Ulaanbaatar, Mongolia: State Great Khural; 2003.

15. Armstrong S, Byamba T. The dual nature of alcohol use and abuse in Mongolia: reflections through policy. *Asia Pac J Public Health.* 2010;22(3 suppl): 209S–215S.

16. Together for Alcohol Free Mongolia. 2011. Available at: http://infoMongolia.com. Accessed November 1, 2012.

17. Yusuf S, Hawken S, Ounpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case–control study. *Lancet.* 2004;364 (9438):937–952.

18. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med.* 2002;346(6):393–403.

19. Multiple Risk Factor Intervention Trial Research Group. Multiple risk factor intervention trial: risk factor changes and mortality results. *JAMA.* 1982;248 (12):1465–1477.

20. Engelgau M, Rosenhouse S, El-Saharty S, Mahal A. The economic effect of noncommunicable diseases on households and nations: a review of existing evidence. *J Health Commun.* 2011;16(suppl 2): 75–81.

21. Franke RH, Kaul JD. The Hawthorne experiments: first statistical interpretation. *Am Sociol Rev.* 1978;43:623–643.

22. Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ: Prentice Hall; 1986.

23. Miller WR, Rollnick S. *Motivational Interviewing: Preparing People to Change Addictive Behavior.* New York, NY: Guilford Press; 1991.

24. Witte SS, Altantsetseg B, Aira T, et al. Reducing sexual HIV/STI risk and harmful alcohol use among sex workers in Mongolia: a randomized clinical trial. *AIDS Behav.* 2011;15(8):1785–1794.

25. Murray DM, Varnell SP, Blitstein JL. Design and analysis of group-randomized trials: a review of recent methodological developments. *Am J Public Health.* 2004;94(3):423–432.

26. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Statis Soc B.* 1995;57(1): 289–300.

27. Klaus B, Strimmer K. *fdrtool: Estimation of (Local) False Discovery Rates and Higher Criticism, R Package Version 1.2.10.* 2012. Available at: http://CRAN.R-project.org/package=fdrtool. Accessed June 11, 2013.

28. Little RJA, Rubin DB. *Statistical Analysis With Missing Data.* New York, NY: Wiley; 1987.

29. Honaker J, King G, Blackwell M. *Amelia II: Multiple Imputation, Version 1.7.1.* 2013. Available at: http://gking.harvard.edu/amelia. Accessed June 11, 2013.