

Supplementary materials: alcohol use pregnancy

1. Model calibration and parameter estimation

Table 1 summarizes the payoff report. We used the weighted sum of errors between observed data and simulated variables to define the payoff function. The weights are the inverse of variance for each time series. The table reports the mean absolute percentage error (MAPE), root mean square error (RMSE), and mean absolute error over average (MAE/m). It also reports Theil's statics, such as bias (U_m), unequal variation (U_s), and unequal covariation (U_c). Most of the payoff elements have low errors, bias, and unequal variation, with relatively high unequal covariation, which indicates low chance of having systematic error in the calibration process.

Table 1: Summary of payoff report

	Weight	MAPE (%)	RMSE	MAE/m (%)	Bias (U_m)	Unequal Variation (U_s)	Unequal Covariation (U_c)
ND[Non]	1.99E-05	22.440	449.954	23.049	0.833	0.167	0.000
ND[T1]	1.35E-02	14.784	4.841	13.656	0.001	0.963	0.036
ND[T23]	6.96E-03	19.520	14.144	20.002	0.000	0.870	0.130
NRD[Non]	1.73E-04	0.814	59.964	0.811	0.411	0.063	0.525
NRD[T1]	1.64E-03	16.320	21.904	14.798	0.000	0.394	0.606
NRD[T23]	2.64E-04	57.059	45.226	29.709	0.086	0.904	0.009
RD[Non]	9.48E-05	15.519	598.293	15.265	0.668	0.110	0.222
RD[T1]	1.29E-03	79.463	27.807	54.459	0.436	0.004	0.559
RD[T23]	1.82E+00	NA	0.422	53.484	0.263	0.566	0.171
AUD[Non]	2.70E-04	8.192	84.503	8.464	0.416	0.570	0.014
AUD[T1]	1.16E-02	21.801	9.787	20.327	0.009	0.306	0.685
AUD[T23]	1.64E-02	17.501	8.006	17.428	0.008	0.989	0.003
Sober NRD[Non]	8.22E-05	40.156	136.127	34.556	0.088	0.749	0.164
Sober NRD[T1]	2.28E-03	7.066	10.758	6.105	0.069	0.772	0.159
Sober NRD[T23]	8.01E-04	2.548	13.817	2.509	0.000	0.001	0.999
Sober RD[Non]	2.34E-03	32.406	20.144	21.751	0.186	0.687	0.127
Sober RD[T1]	6.47E-02	3.480	0.995	3.480	0.000	0.023	0.977
Sober RD[T23]	2.28E-02	2.041	1.932	2.010	0.000	0.427	0.573
Sober AUD[Non]	2.11E-02	23.157	4.888	17.978	0.031	0.561	0.408
Sober AUD[T1]	5.82E-01	1.457	0.142	1.489	0.002	0.008	0.991
Sober AUD[T23]	2.05E-01	1.647	0.518	1.623	0.000	0.543	0.457

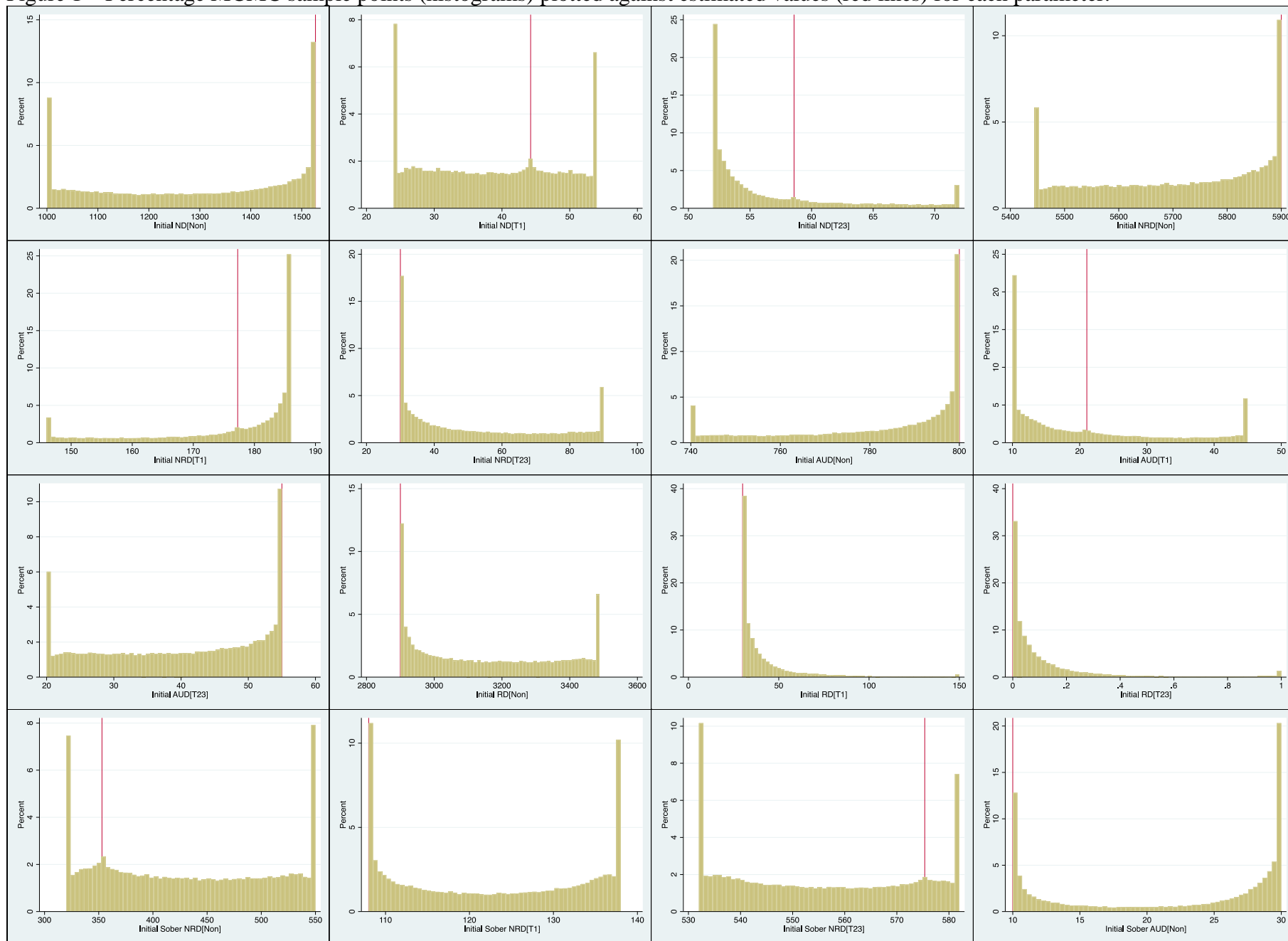
Table 2 reports the 92 estimated parameters through calibration with 95% confidence intervals. We first used Powell optimization to approximate the optimal parameter values, with 500 restarts, to avoid being stuck in local optima. Based on the results of Powell optimization, we used the MCMC method to fine-tune the estimated parameters and collect sample points within the parameter range informed by subject matter experts and defined in the calibration process. We conducted the MCMC sampling without any limit on the number of simulations until the maximum potential scale reduction factor (Max PSRF) reached below 1.2, indicating convergence of MCMC chains. The MCMC method resulted in more than 500,000 sample points for each parameter. We used the sample points to draw the 95% confidence interval for each estimated parameter. Figure 1 shows the distribution of collected samples (histograms shown in percentage) plotted against the estimated values within specified ranges for each parameter.

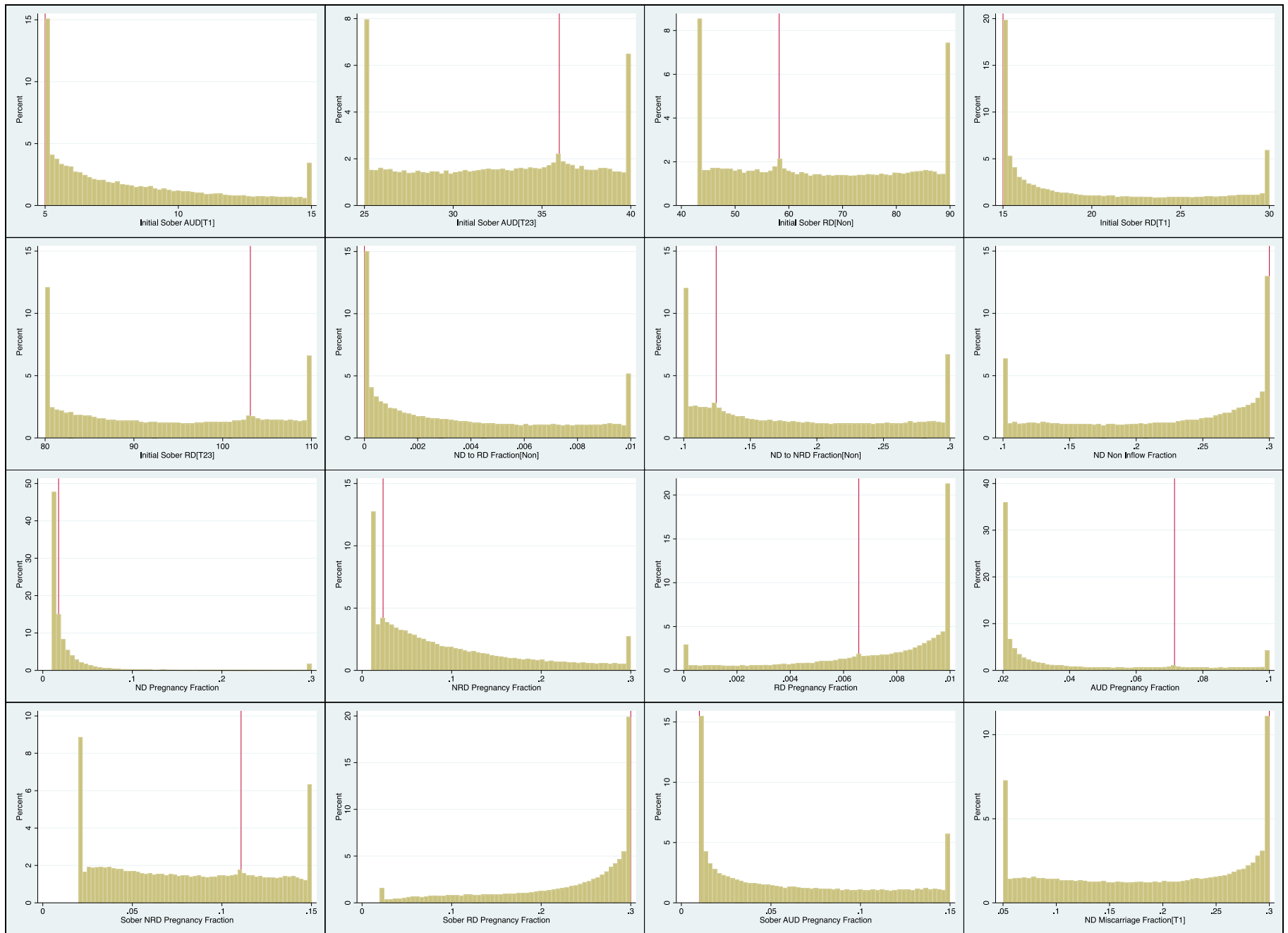
Table 2: Estimated parameters through calibration with 95% confidence intervals

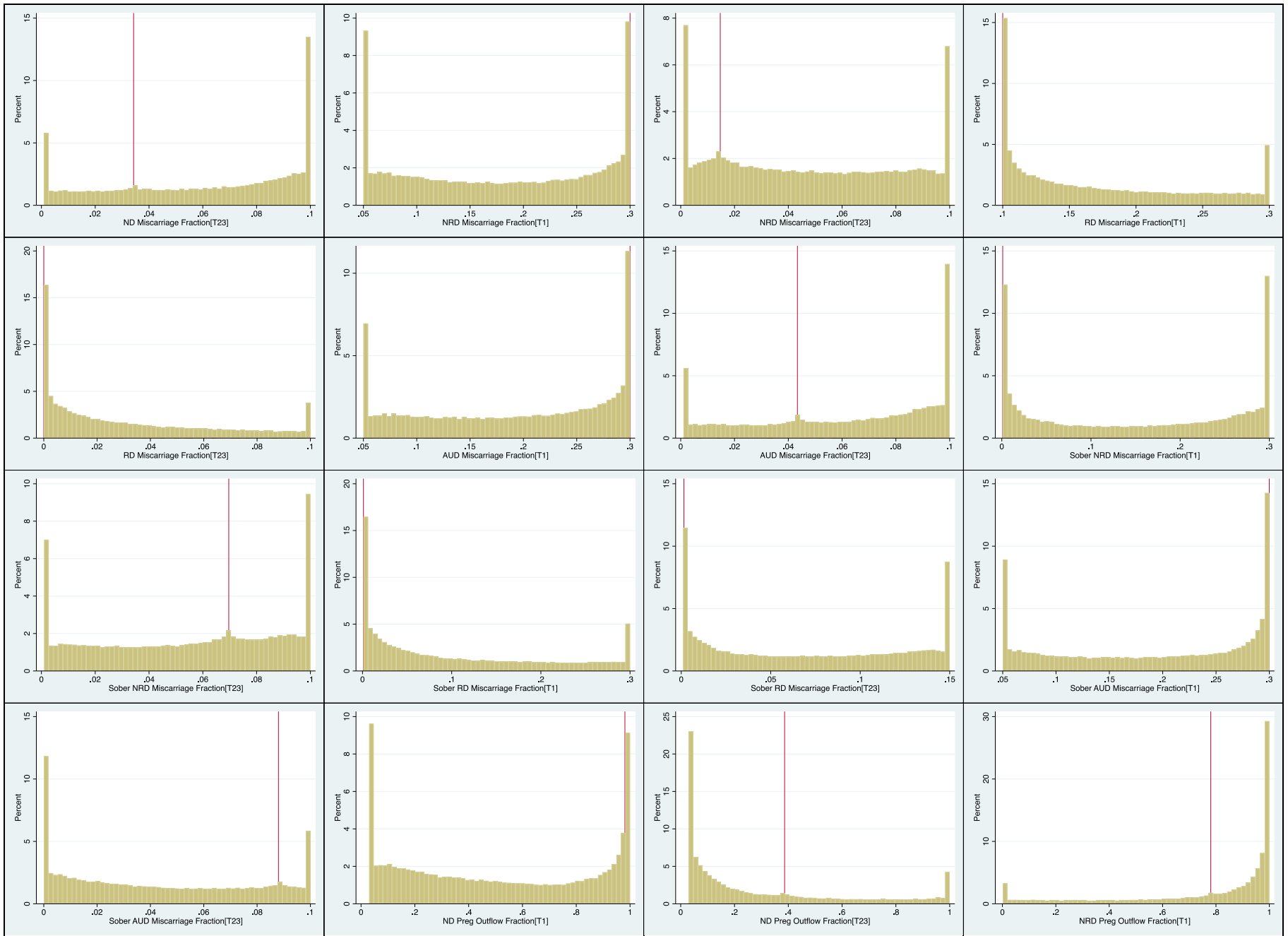
Parameter	Lower bound of 95% CI	Estimated	Upper bound of 95% CI
Initial ND[Non]	1000	1526.97	1527
Initial ND[T1]	24	44.2316	54
Initial ND[T23]	52	58.5784	71.975788
Initial NRD[Non]	5445	5900	5900
Initial NRD[T1]	146	177.269	186
Initial NRD[T23]	30	30	90
Initial AUD[Non]	740	800	800
Initial AUD[T1]	10	21.0616	45
Initial AUD[T23]	20	55	55
Initial RD[Non]	2900	2900	3488
Initial RD[T1]	30	30	107.14044
Initial RD[T23]	0	2.30E-08	0.85771408
Initial Sober NRD[Non]	320	352.953	550
Initial Sober NRD[T1]	108	108	138
Initial Sober NRD[T23]	532	575.356	582
Initial Sober AUD[Non]	10	10	30
Initial Sober AUD[T1]	5	5	15
Initial Sober AUD[T23]	25	35.9728	40
Initial Sober RD[Non]	43	58.1924	90
Initial Sober RD[T1]	15	15	30
Initial Sober RD[T23]	80	103.117	110
ND to RD Fraction[Non]	0	0	0.01
ND to NRD Fraction[Non]	0.1	0.124373	0.3
ND Non Inflow Fraction	0.1	0.3	0.3
ND Pregnancy Fraction	0.01	0.0176286	0.25128648
NRD Pregnancy Fraction	0.01	0.0234029	0.29732724
RD Pregnancy Fraction	5.31E-05	6.57E-03	0.01
AUD Pregnancy Fraction	0.02	0.0715112	0.1
Sober NRD Pregnancy Fraction	0.02	0.110699	0.15
Sober RD Pregnancy Fraction	0.03667045	0.299999	0.3
Sober AUD Pregnancy Fraction	0.01	0.0100208	0.15
ND Miscarriage Fraction[T1]	0.05	0.299975	0.3
ND Miscarriage Fraction[T23]	0.001	0.0342711	0.1
NRD Miscarriage Fraction[T1]	0.05	0.299998	0.3
NRD Miscarriage Fraction[T23]	0.001	0.0146962	0.1
RD Miscarriage Fraction[T1]	0.1	0.1	0.3
RD Miscarriage Fraction[T23]	0	7.56E-07	0.1
AUD Miscarriage Fraction[T1]	0.05	0.3	0.3
AUD Miscarriage Fraction[T23]	0.001	0.0433839	0.1
Sober NRD Miscarriage Fraction[T1]	0.001	0.001	0.3
Sober NRD Miscarriage Fraction[T23]	0.001	0.0696359	0.1
Sober RD Miscarriage Fraction[T1]	0.001	0.0010017	0.3
Sober RD Miscarriage Fraction[T23]	0.001	0.00148454	0.15
Sober AUD Miscarriage Fraction[T1]	0.05	0.299938	0.3
Sober AUD Miscarriage Fraction[T23]	0	0.0880061	0.1
ND Preg Outflow Fraction[T1]	0.03	0.980774	1
ND Preg Outflow Fraction[T23]	0.03	0.386318	1

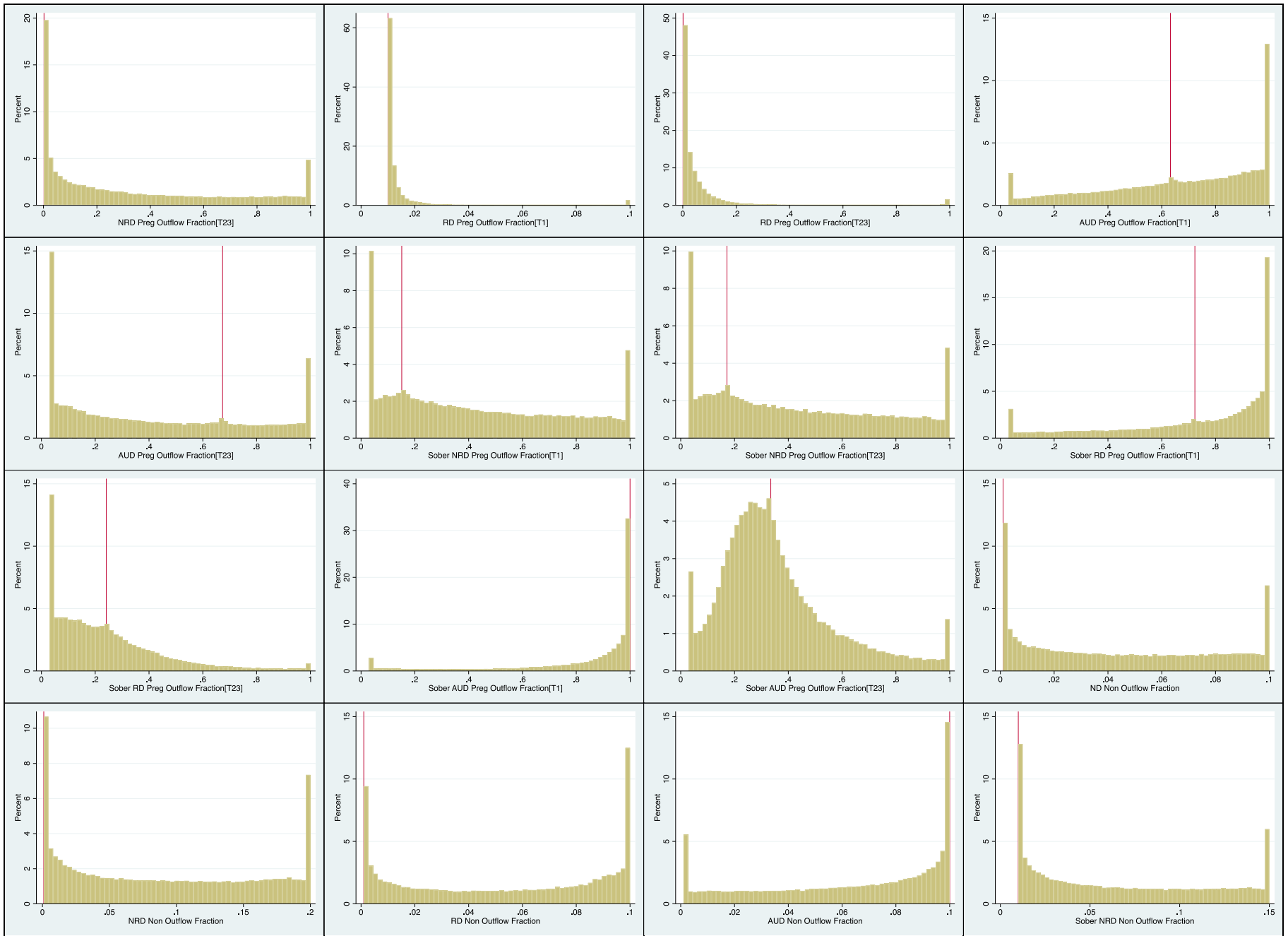
NRD Preg Outflow Fraction[T1]	0.00259719	0.780433	1
NRD Preg Outflow Fraction[T23]	0.001	0.00192645	1
RD Preg Outflow Fraction[T1]	0.01	0.01	0.06395416
RD Preg Outflow Fraction[T23]	0.001	0.00100001	0.66182486
AUD Preg Outflow Fraction[T1]	0.04551521	0.632203	1
AUD Preg Outflow Fraction[T23]	0.03	0.673538	1
Sober NRD Preg Outflow Fraction[T1]	0.03	0.15127	1
Sober NRD Preg Outflow Fraction[T23]	0.03	0.171941	1
Sober RD Preg Outflow Fraction[T1]	0.03	0.723083	1
Sober RD Preg Outflow Fraction[T23]	0.03	0.241336	0.81297316
Sober AUD Preg Outflow Fraction[T1]	0.03882599	0.999931	1
Sober AUD Preg Outflow Fraction[T23]	0.04415023	0.334987	0.92013761
ND Non Outflow Fraction	0.001	0.001	0.1
NRD Non Outflow Fraction	0.001	0.001	0.2
RD Non Outflow Fraction	0.001	0.00100016	0.1
AUD Non Outflow Fraction	0.001	0.1	0.1
Sober NRD Non Outflow Fraction	0.01	0.0100004	0.15
Sober RD Non Outflow Fraction	0.01	0.0497923	0.05
Sober AUD Non Outflow Fraction	0.01	0.0105136	0.05
AUD to NRD Fraction[Non]	0	0.25	0.25
RD to NRD Fraction[Non]	0	0.022874	0.1
Sober AUD to NRD Fraction[Non]	0	0.409067	0.5
Sober NRD to NRD Fraction[Non]	0	0.559295	0.6
Sober RD to NRD Fraction[Non]	0	0.5	0.5
Fraction Completing Tx to NRD	0	0.85	0.85
NRD to Sober NRD Fraction[Non]	0	0.0208551	0.5
NRD to Sober NRD Fraction[T1]	0	1.64E-06	0.6
NRD to Sober NRD Fraction[T23]	0	0.5	0.5
NRD to RD Fraction[Non]	0	0.132937	0.15
AUD to RD Fraction[Non]	0	0.15	0.15
Sober AUD to RD Fraction[Non]	0	0.00105981	0.1
Sober RD to RD Fraction[Non]	0	0.0999874	0.1
RD to Sober RD Fraction[Non]	0	0.0174965	0.0995824
RD to Sober RD Fraction[T1]	0	0	0.99178493
RD to Sober RD Fraction[T23]	0	0	0.95970353
RD to AUD Fraction[Non]	0.1	0.1	0.3
AUD to Sober AUD Fraction[Non]	0	0.00087471	0.08657991
AUD to Sober AUD Fraction[T1]	0	0.290767	0.5
AUD to Sober AUD Fraction[T23]	0	0.072415	0.49042704
Fraction Completing Tx to RD	0	0.0999999	0.1
Sober AUD to AUD Fraction[Non]	0	3.13E-07	0.5
Initial AUD in Treatment[Non]	50	299.96	300
AUD Tx Fractional Inflow Rate	0.05	0.05	0.3
Fraction Completing Tx	0	0.227346	0.95
Fraction Completing Tx to Sober AUD	0	0	0.5

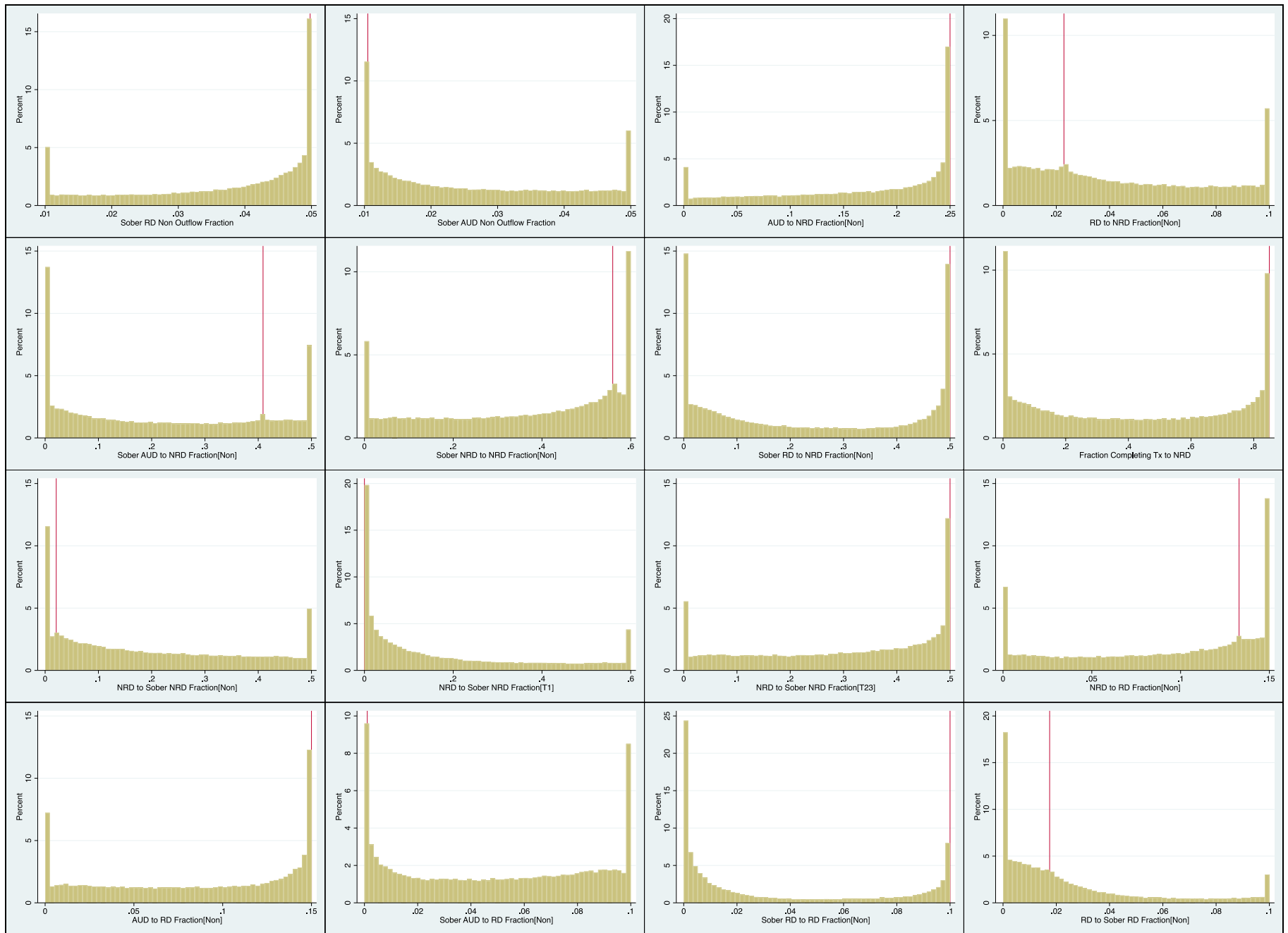
Figure 1 – Percentage MCMC sample points (histograms) plotted against estimated values (red lines) for each parameter.

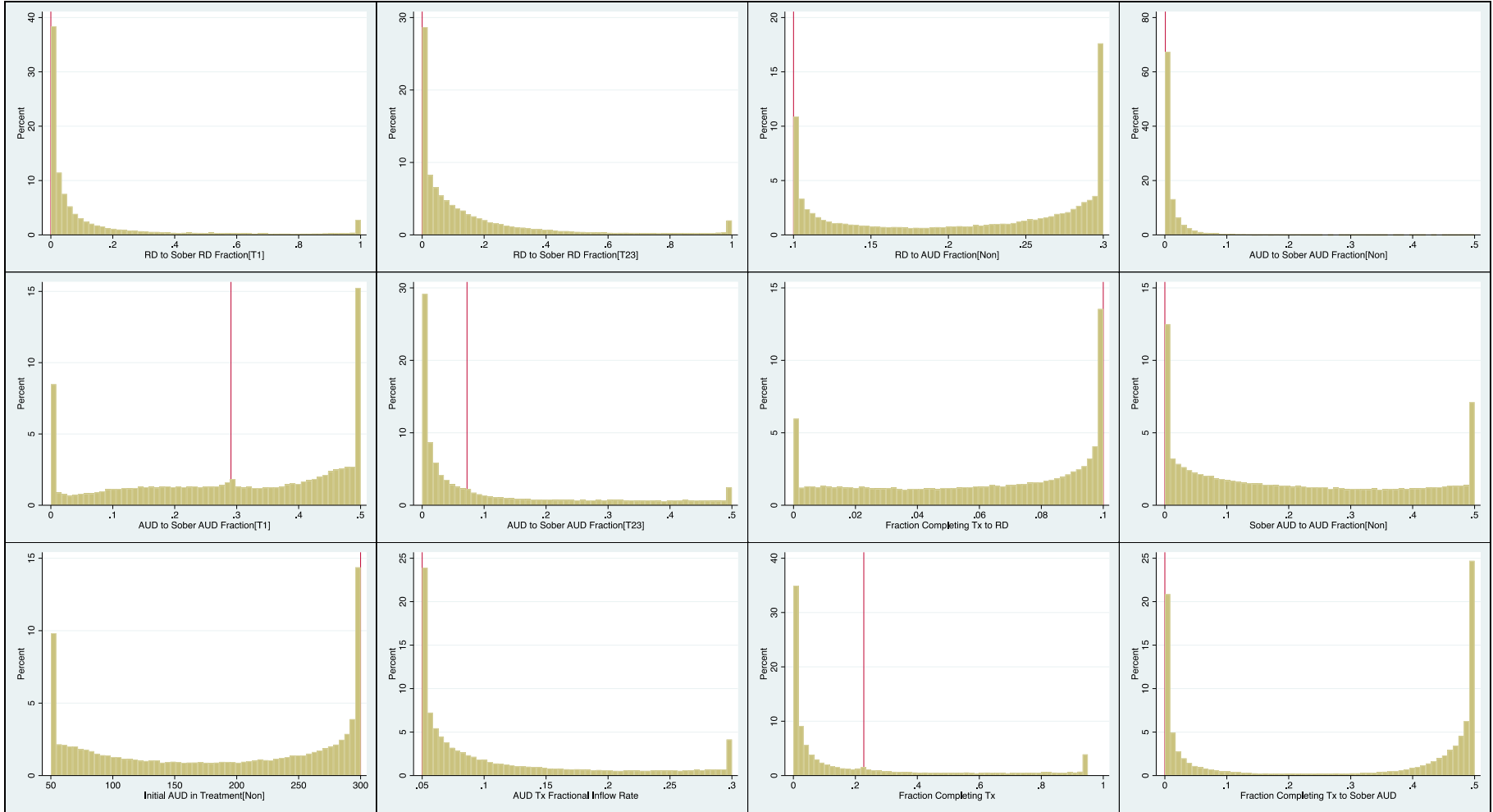












2. Simulated vs. data

Figure 2 – Simulated variables (blue lines) plotted against the historical data (red dots) for Sober NRD, Sober RD, and Sober AUD, shown in each column. First row represents the number of non-pregnant women, second row reports the number of pregnant women in first trimester (T1), and the third row shows the number of pregnant women in second and third trimesters (T23).

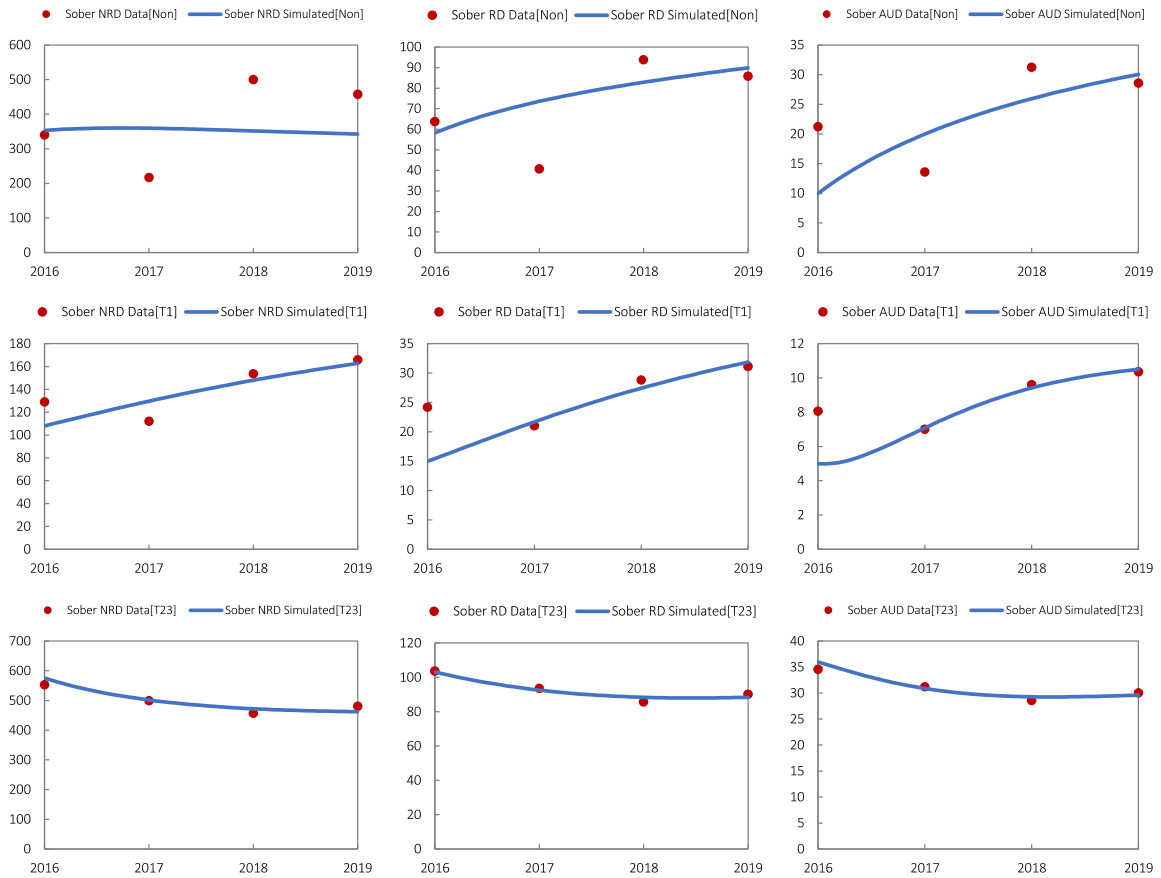


Table 3: Preconceptual AEP-Prevention Program Study Results

Title	Behavior Change	Control Group(s)	Behavior Change Proportions
	Intervention	Control Group(s)	
Ingersoll et al., 2013	<u>Alcohol: (drinks per drinking day)</u> Baseline = 4.6, 3M= 4.0, 6M = 3.7 <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 74.6%, 3M = 54.2%, 6M = 44.7%	2 Control Groups: <u>Alcohol (drinks per drinking day):</u> Baseline= 4.5 and 4.6, 3M = 3.9 and 4.2, 6M= 3.6 and 3.7 <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 72.3% and 68%, 3M = 65.8% and 54.2%, 6M = 55% and 50.7%	NA
Farrell-Carnahan et al., 2013	<u>Alcohol : (% reporting "risk drinking")</u> Baseline = 100%, 3M = 85.7%, 6M = 85.7% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline: 84.5%, 3M = 63.7%, 6M = 64.3%	NA	NA
Floyd et al., 2007	<u>Alcohol : (% reporting "risk drinking")</u> Baseline 100%, 3M = 54% , 6M = 54% , 9M = 46% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline: 100%. 3M = 55%, 6M = 52%, 9M = 31%	<u>Alcohol : (% reporting "risk drinking")</u> : Baseline = 100%, 3M = 64%, 6M = 62%, 9M = 56% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 100%, 3M = 72%, 6M = 67%, 9M = 61%	At 3 Months 28% Alc only, 34% BC only, 39% both
Hanson et al., 2017	<u>Alcohol : (% reporting "risk drinking")</u> Baseline: 100% 3M = 66%, 6M = 61% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline: 100%, 3M = 8%, 6M = 19%	NA	At 3 Months: 10% Alc only; 68% BC only 23% both At 6 Months 20% Alc only; 62% BC only 19% Both
Velasquez et al., 2017	<u>Alcohol : (% reporting "risk drinking")</u> Baseline = 100% 3M = 66%, 6M = 61%, 9M = 61% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 100% 3M = 65%, 6M = 58%, 9M = 53%	<u>Alcohol : (% reporting "risk drinking")</u> Baseline = 100% 3M = 83%, 6M = 83%, 9M = 75% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 100% 3M = 88%, 6M = 81%, 9M = 77%	NA
Hutton et al., 2014	Two Sites (Baltimore and Denver) <u>Alcohol : (% reporting "risk drinking")</u> (Bmore) Baseline = 100% 3M = 55%, 6M = 56% (Den) Baseline = 100% 3M = 59%, 6M = 57% <u>Birth Control (% reporting inconsistent or no use):</u> (Bmore) Baseline = 100% 3M = 33%, 6M = 38%, (Den) Baseline = 100% 3M = 52%, 6M = 66%	NA	At 3 Months: Baltimore: 18% Alc only, 44% BC only, 37% both Denver: 35% Alc only 44% = BC only 21% both; At 6 Months: Baltimore: 21% Alc only, 45% BC only, 30% both Denver: 30% Alc only; 30% BC only 39% both
Ingersoll et al., 2018	Note: accounting for change from screening to pretreatment which indicated reductions in behaviors <u>Alcohol : (% reporting "risk drinking")</u> 6M = 82% <u>Birth Control (% reporting inconsistent or no use):</u> 6M = 60%	<u>Alcohol : (% reporting "risk drinking")</u> 6M =80% <u>Birth Control (% reporting inconsistent or no use):</u> 6M = 84%	NA
Sobell et al., 2017	Two Groups: Students and non-Students <u>Alcohol : (% reporting "risk drinking")</u> : (students) Baseline = 100% 6M = 81%, (nonstudents) Baseline = 100% 6M = 86% <u>Birth Control (% reporting inconsistent or no use):</u> (students) Baseline = 100% 6M = 32%, (nonstudents) Baseline = 100% 6M = 62%	<u>Alcohol : (% reporting "risk drinking")</u> : (students) Baseline = 100% 6M = 80%, (nonstudents) Baseline = 100% , 6M =85% <u>Birth Control (% reporting inconsistent or no use):</u> (students) Baseline = 100% 6M = 48%, (nonstudents) Baseline = 100% 6M = 59%	NA
Wilton et al., 2013	<u>Alcohol : (% reporting "risk drinking")</u> Baseline = 100% 6M = 56% <u>Birth Control (% reporting inconsistent or no use):</u> Baseline = 100% 6M = 89%	NA	NA

- Farrell-Carnahan, L., Hetteema, J., Jackson, J., Kamalanathan, S., Ritterband, L. M. & Ingersoll, K. S. 2013. Feasibility and promise of a remote-delivered preconception motivational interviewing intervention to reduce risk for alcohol-exposed pregnancy. *Telemed J E Health*, 19, 597-604.
- Floyd, R. L., Sobell, M., Velasquez, M. M., Ingersoll, K., Nettleman, M., Sobell, L., Mullen, P. D., Ceperich, S., Von Sternberg, K., Bolton, B., Johnson, K., Skarpness, B. & Nagaraja, J. 2007. Preventing alcohol-exposed pregnancies: a randomized controlled trial. *Am J Prev Med*, 32, 1-10.
- Hanson, J. D., Nelson, M. E., Jensen, J. L., Willman, A., Jacobs-Knight, J. & Ingersoll, K. 2017. Impact of the CHOICES Intervention in Preventing Alcohol-Exposed Pregnancies in American Indian Women. *Alcohol Clin Exp Res*, 41, 828-835.
- Hutton, H. E., Chander, G., Green, P. P., Hutsell, C. A., Weingarten, K. & Peterson, K. L. 2014. A novel integration effort to reduce the risk for alcohol-exposed pregnancy among women attending urban STD clinics. *PuBaselineic Health Rep*, 129 Suppl 1, 56-62.
- Ingersoll, K., Frederick, C., Macdonnell, K., Ritterband, L., Lord, H., Jones, B. & Truwit, L. 2018. A pilot RCT of an Internet intervention to reduce the risk of alcohol-exposed pregnancy. *Alcoholism: Clinical and Experimental Research*, 42, 1132-1144.
- Ingersoll, K. S., Ceperich, S. D., Hetteema, J. E., Farrell-Carnahan, L. & Penberthy, J. K. 2013. Preconceptional motivational interviewing interventions to reduce alcohol-exposed pregnancy risk. *J Subst Abuse Treat*, 44, 407-16.
- Sobell, L. C., Sobell, M. B., Johnson, K., Heinecke, N., Agrawal, S. & Bolton, B. 2017. Preventing Alcohol-Exposed Pregnancies: A Randomized Controlled Trial of a Self-Administered Version of Project CHOICES with College Students and Nonstudents. *Alcohol Clin Exp Res*, 41, 1182-1190.
- Velasquez, M. M., Von Sternberg, K. L., Floyd, R. L., Parrish, D., Kowalchuk, A., Stephens, N. S., Ostermeyer, B., Green, C., Seale, J. P. & Mullen, P. D. 2017. Preventing Alcohol and Tobacco Exposed Pregnancies: CHOICES Plus in Primary Care. *Am J Prev Med*, 53, 85-95.
- Wilton, G., Moberg, D. P., Van Stelle, K. R., Dold, L. L., Obmascher, K. & Goodrich, J. 2013. A randomized trial comparing telephone versus in-person brief intervention to reduce the risk of an alcohol-exposed pregnancy. *J Subst Abuse Treat*, 45, 389-94.