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Field procedures in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS)

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Abstract

The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS) is a multi-component epidemiological and neurobiological study of unprecedented size and complexity designed to generate actionable evidence-based recommendations to reduce US Army suicides and increase basic knowledge about determinants of suicidality by carrying out coordinated component studies. A number of major logistical challenges were faced in implementing these studies. The current report presents an overview of the approaches taken to meet these challenges, with a special focus on the field procedures used to implement the component studies. As detailed in the paper, these challenges were addressed at the onset of the initiative by establishing an Executive Committee, a Data Coordination Center (the Survey Research Center [SRC] at the University of Michigan), and study-specific design and analysis teams that worked with staff on instrumentation and field procedures. SRC staff, in turn, worked with the Office of the Deputy Under Secretary of the Army (ODUSA) and local Army Points of Contact (POCs) to address logistical issues and facilitate data collection. These structures, coupled with careful fieldworker training, supervision, and piloting, contributed to the major Army STARRS data collection efforts having higher response rates than previous large-scale studies of comparable military samples.

Introduction

As described in more detail earlier in this issue (Kessler *et al.*, 2013a) and elsewhere (Ursano *et al.*, submitted for publication), the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS; http://www.armystarrs.org) is a multi-component epidemiological and neurobiological study of risk and resilience factors for suicidality and its psychopathological correlates in the US Army. Army STARRS is funded as a Cooperative Agreement between the US National Institute of Mental Health (NIMH) and a consortium of investigators supported jointly by the US Army and NIMH (Insel and McHugh, submitted for publication).

The earlier report by Kessler and colleagues in this issue detailed the fact that Army STARRS includes six coordinated component studies that were designed to interact with each other to facilitate non-experimental hypothesis generation and testing, intervention targeting, and intervention evaluation (Kessler *et al.*, 2013a). Each of these studies is a substantial undertaking in its own right. The unprecedented size, scope, and complexity of these six component studies created a number of logistical and coordination challenges for field implementation. The current report presents an overview of the approaches taken to meet these challenges, with a special focus on the complex field procedures involved in implementing the component studies. Data are also presented on sample sizes and projected response rates of the main Army STARRS surveys.

Organizational structure

The six components of Army STARRS include the following: (i) an Historical Administrative Data Study (HADS) of individual-level time series data from more than 50 million person-months in an integrated administrative database assembled from 38 different Army and Department of Defense (DoD) data systems for the more than 1.6 million soldiers who were on active duty in the US Army at any time between January 1, 2004 and December 31, 2009; (ii) parallel retrospective case–control studies of non-fatal suicides and suicide deaths that include in-depth interviews with soldiers (in the case of non-fatal attempts), Army supervisors, and next of kin (in the case of suicide deaths); (iii–v) three large-scale surveys of active duty Army personnel (the New Soldier Study [NSS] of soldiers at the beginning of Basic Combat Training [BCT]; the All-Army Study [AAS] of soldiers exclusive of those in BCT; and the Pre-Post Deployment Study [PPDS] of three Brigade Combat Teams initially assessed shortly before deploying to Afghanistan and then again three times after returning from deployment) that all included self-administered questionnaires (SAQs). The NSS and the Soldier Health Outcome Studies (SHOS-A) additionally administered neurocognitive tests, while the NSS and PPDS both obtained blood samples from a subset of respondents; (vi) Army STARRS is additionally carrying out a pilot study of the stresses and mental health problems associated with making the transition back to civilian life among soldiers who separate from military service. This pilot study is being implemented in preparation for future long-term follow-up studies of Army STARRS respondents after they separate from military service.

The logistical and coordination challenges of implementing these studies were addressed at the onset of the initiative by establishing an Executive Committee made up of the Co-Principal Investigators (Co-PIs) (Murray Stein, Robert Ursano), the site PIs (Steven Heeringa, Ronald Kessler) along with the Collaborating Scientists from NIMH (Lisa Colpe, Michael Schoenbaum) and US Army consultants (Steven Cervosky, Kenneth Cox) to provide overall supervision and direction. A Data Coordination Center was then established at the Survey Research Center (SRC), the Institute for Social Research, University of Michigan (www.src.isr.umich.edu) to implement the vast majority of Army STARRS data collections and to maintain the centralized Army STARRS data enclave that securely stores all Army STARRS analysis data and supports the computer servers used to carry out all substantive data analyses.

A study-specific design and analysis team was then established for each component Army STARRS study to develop instruments and work with SRC staff on design and field procedures. SRC staff, in turn, worked closely with the Office of the Deputy Under Secretary of the Army (ODUSA), under the auspices of which all Army STARRS data collections were carried out. In cases where data collection required access to local sites, the ODUSA worked with the Army to designate local Points of Contact (POC) who then coordinated with SRC to address logistical issues and facilitate data collection. The Training and Doctrine Command (TRADOC), Forces Command (FORSCOM), and for the Ary STARRS survey carried out in Kuwait the Army Medical Research and Materiel Command (MRMC), the US Central Command (USCENTCOM) and USCENTCOM's Joint Combat Casualty Research Team (JC2RT) were especially important in this regard. Additional coordination was provided by the Army Chaplain Corps, which provided support for the Army STARRS safety plan, and the Medical Command (MEDCOM), which provided Army medics for blood collection.

As noted earlier, all Army STARRS data are securely stored for analysis in the centralized Army STARRS SRC

data enclave. However, two specialized types of raw data are pre-processed elsewhere before being entered into the SRC data enclave for analysis. The first of these two involves the neurocognitive data collected in the NSS and in the case–control study of non-fatal suicide attempters. These data are scored at the University of Pennsylvania under the supervision of Army STARRS collaborator Rubin Gur prior to being transferred to SRC for inclusion in the data enclave for analysis. The second involves the blood samples collected in the NSS and PPDS. These samples are stored and pre-processed at the Rutgers University Cell and DNA Repository (RUCDR; http://www.rucdr.org). Genetic and other analyses performed on the stored blood samples are conducted either at RUCDR or other approved laboratories. All data derived from assays and tests performed on the stored blood are securely transferred to SRC for inclusion in the data enclave for analysis.

Instrumentation

Pilot work

Before turning to a discussion of field procedures, it is important to note that these procedures were constrained by a number of design requirements dictated by the results of an exhaustive review of the literature on risk and resilience factors for suicide and suicidal behaviors in the general population (Nock *et al.*, 2008) and the military (Gilman *et al.*, 2013). This review made it clear that suicidal behaviors develop through complex, multi-determined processes in which psychosocial and neurobiological factors combine to establish varying levels of risk that overlap for suicide and suicide attempts (Moscicki, 1999; Nock *et al.*, 2008). Rather than summarize the content of these reviews, we merely note for current purposes that the important predictors of suicidality documented in the review were many and varied. This meant that *detailed* assessments were required. In addition, *large samples* were required to achieve adequate statistical power to assess key hypotheses. Because of these requirements, it was necessary to make use of SAQs rather than interviewer-administered instruments.

Even though two-hour blocks of time were made available to Army STARRS to administer surveys (and two such sessions for new soldiers prior to beginning BCT), difficult decisions still had to be made in selecting short, efficient assessment batteries to assess all the constructs of interest to the research team. This problem was addressed by carrying out literature reviews of all instruments available to assess each construct of interest and then implementing extensive pilot studies to evaluate the psychometric properties of the instruments pinpointed in these literature reviews as top candidate measures. A number of methodological reports are either in preparation or, in two cases, completed (Thomas *et al.*, 2013; Kessler *et al.*, 2013c) to describe the results of those pilot studies and the psychometric properties of the final measures included in the Army STARRS component studies.

Another way to shorten assessment was to evaluate instrument skip logic carefully to make sure respondents were skipped out of survey sections as soon as the information needed to classify them on specific dimensions was obtained. This was especially important in the assessment of mental disorders, which took up a substantial part of the SAQs, and where it was possible to skip once it became clear that respondents failed to meet at least subthreshold criteria. Although the use of computer adaptive testing (CAT; Wainer, 2000) was carefully considered in this regard, CAT was rejected in the end due to our inability to carry out sufficiently large pilot studies to obtain stable test parameter estimates needed to guide CAT branching. Nonetheless, as noted next, the use of extensive skip logic in the SAQs had important implications for the preferred modes of data collection.

Data collection modes

The enormous size of the Army STARRS survey data collection effort led to the practical decision that SAQs be group-administered. However, the modes of data collection varied across these surveys. As described in a previous report in this issue (Kessler *et al.*, 2013a), the NSS was administered in three BCT facilities on a weekly basis over a period of two years, allowing SRC to establish a permanent data collection staff on these sites and to set up computer networks that allowed the SAQs to be computer-administered (CAI). Based on the success of this mode in the early NSS replicates, it was also used in administering the AAS at large installations and in the baseline and second follow-up wave of PPDS. However, it did not prove to be cost-effective to use CAI to administer the AAS in the many small installations, where the survey had to be carried out due to the logistical complications of transporting hardware for group survey administration. As a result, a paper-and-pencil-administered (PAPI) version of the AAS questionnaire was also developed.

Other Army STARRS component studies use a mix of data collection modes, including web-based CAI and telephone interviews. These modes are both used in assessing controls in the retrospective case–control study of non-fatal suicide attempts (SHOS-A) as well as in the third follow-up wave of the PPDS (T3), where web-based CAI is used initially and then telephone interviews are used to

assess respondents who fail to complete web-based SAQs. The need for these modes in T3 PPDS is that this survey is carried out approximately nine months after respondents return from deployment, by which time many of them are no longer assigned to the same unit. This means that these respondents have to be traced individually in order to administer the SAQs. This is most easily done with web-based surveys, but additional contact information (cell phones, social security numbers, contact information for next of kin who will know there whereabouts once they separate) was obtained from all baseline PPDS respondents for purposes of tracing them over time and for conducting telephone survey follow-ups of web survey non-respondents.

Multi-component assessment

As noted earlier, the initial literature review showed clearly that suicidal behaviors develop through complex, multi-determined processes. These processes are thought to involve psychosocial and neurobiological factors that combine to establish varying levels of risk (Moscicki, 1999; Nock *et al.*, 2008), with important factors including such diverse things as accumulating stressful life experiences that create risk of suicidality through processes partially mediated by biological pathways (McEwen, 2007) and modified by genetic susceptibilities (Krishnan *et al.*, 2007). The effects of these differential susceptibilities, in turn, are thought to be at least partially mediated by trait-temperament and environmental factors that are themselves jointly influenced by environmental and biological factors (Brent *et al.*, 2002; Caspi *et al.*, 2003; Higley and Linnoila, 1997; Kraemer *et al.*, 1997). There are formidable logistical challenges involved in sorting out these diverse influences that include the need for large longitudinal samples that assess a wide range of both biological and psychosocial variables and that provide opportunities for targeted intervention.

We were especially interested in having as much of this information as possible based on objective assessments due to concern about under-reporting in SAQs. Three approaches were used to do this, all of them having implications for field procedures. First, the Army and DoD administrative data systems provide an important source of independent (of self-report) information on environmental factors. Such information can be obtained at the level of the soldier's unit to define stressors to which the soldier was exposed by virtue of unit membership (e.g. numbers of unit members who recently died in combat, in non-duty-related injuries, or by suicide; numbers of unit members who recently had combat-related injuries, were reported to military authorities as victims of interpersonal or sexual violence, or had charges brought against them for being perpetrators of interpersonal or sexual violence). Individual-level data can also be obtained to characterize certain kinds of stressor exposures (e.g. information on such things as wages of the soldier being garnished due to financial debts, disciplinary actions, job performance ratings). Many other relevant administrative data systems exist as well, such as those providing data from electronic medical records, criminal justice records, and records of the Child and Protective Services system dealing with domestic violence issues. In order to obtain these data, though, it was necessary to obtain written informed consent from Army STARRS participants to access their administrative records. Field procedures for doing this are described later.

Second, the research team was especially interested in objectively measured neurocognitive factors that have been shown to predict suicidal behavior (Keilp *et al.*, 2008; Keilp *et al.*, 2001; Marzuk *et al.*, 2005). Administrative records provide access to a number of such tests that are administered to all soldiers in the Armed Services Vocational Aptitude Battery (ASVAB) in addition to the Armed Forces Qualification Test (AFQT) and General Technical (GT) Score. However, other neurocognitive factors have been shown to be robust predictors of suicide attempts that are not included in these test batteries, such as tests of poor decision-making, problem-solving, cognitive flexibility, and verbal fluency (Jollant *et al.*, 2005; Sadowski and Kelley, 1993). Recent work by members of the Army STARRS team has also shown that specific aspects of executive functioning associated with cognitive inflexibility or failure to adaptively adjust to changing demands distinguish depressed suicide attempters from non-attempters (Keilp *et al.*, 2001). In order to evaluate the effects of dimensions such as these it was necessary to administer special neuropsychological tests to Army STARRS respondents. However, it was logistically impossible to do this using the one-on-one administration methods traditionally used for such tests (i.e. one test administrator guiding one subject at a time through the test battery). As a result, special group-administered CAI neuropsychological software and test protocols were developed to administer these tests in conjunction with the Army STARRS surveys.

Third, the research team was quite interested in neurobiological predictors of suicidal behaviors. Although some predictors of this sort have been widely studied in clinical samples, much of this work uses protocols that could not realistically be used in broad-based epidemiological screening (e.g. post-mortem brain studies, Arango *et al.*,

1990; Arango *et al.*, 2001; Arango *et al.*, 1995; Boldrini *et al.*, 2004; Hsiung *et al.*, 2003; Mann *et al.*, 2000; Mann *et al.*, 1986; FDG-PET, Boldrini *et al.*, 2004; Parsey *et al.*, 2006). However, it was possible to obtain blood samples to study genetic effects related to suicidal behavior. Suicide appears to be partly heritable, as indicated by concordance being higher in monozygotic (MZ) than dizygotic (DZ) twins (Voracek and Loibl, 2007) and higher in the biological parents of adoptees who died by suicide than of other causes (Mann, 2003). However, the specific genes that contribute to vulnerability for suicide are unknown. This might be true because the numerous association studies on candidate genes have examined only a few candidate genes using a limited number of polymorphisms per gene (Anguelova *et al.*, 2003; Baldessarini and Hennen, 2004; Haghighi *et al.*, 2008; Mann *et al.*, 2001; Rujescu *et al.*, 2007; Uher and McGuffin, 2008; Zill *et al.*, 2004). Another important issue is that genes likely influence elements of the biological vulnerability for suicidal behavior rather than suicide or suicide attempt directly. For example, variants in the monoamine oxidase A gene have been associated with differences in aggression and impulsivity (Manuck *et al.*, 2000), while adverse childhood experiences (Huang *et al.*, 2004) and prenatal exposure to maternal smoking (Wakschlag *et al.*, 2009) have been shown to interact with genes to predict the development of antisocial behavior and greater impulsivity, both of which are risk factors for suicidal behavior in males (Huang *et al.*, 2004). Based on these considerations, it was hypothesized that more consistent results might be found in studies that distinguish suicide-related genes from the genes related to common associated major psychiatric disorders. In order to investigate this possibility, though, it was necessary to obtain blood samples from a large number of respondents. The field procedures used to do this are described later.

Fieldwork organization and procedures

Fieldwork organization

As noted earlier, most Army STARRS fieldwork is carried out by the professional SRC research staff. But there are exceptions. One exception is that AAS fieldwork in Kuwait could not be implemented by SRC staff due to restrictions on civilian travel to Kuwait. As a result, this fieldwork was carried out by Army staff using protocols developed by SRC with training and support provided by SRC. Army staff were also used to collect data from selected units located in Europe and in the Pacific Command (Korea, Hawaii and Alaska). A second exception is that subject recruitment and interviewing for the retrospective case–control study of non-fatal suicide attempts are carried out by research workers employed by the Army STARRS collaborators in the Department of Psychiatry at the Uniformed Services University of the Health Sciences (USUHS). These workers are physically located in psychiatric inpatient units in five participating tertiary care medical facilities (Walter Reed National Military Medical Center, Washington, DC; Fort Bragg, NC; Fort Stewart, GA; Fort Lewis, WA; and Fort Hood, TX), where they attempt to recruit soldiers admitted because of suicide attempts to participate in the case–control study of suicide attempts. Once obtaining written informed consent from these soldiers, the USUHS research workers administer surveys, carry out neuropsychological tests, and obtain blood samples. A third exception is that clinical interviewers employed by the Army STARRS collaborators at Harvard University conduct qualitative telephone interviews with suicide attempters. These interviews use a theoretically-guided form of qualitative interviewing designed to uncover information about critical junctures in the progression to suicide attempts and completions (Strauss, 1987). A final exception is that a clinical reappraisal study of the self-report assessment battery for DSM-IV disorders used in all of the large-scale Army STARRS SAQs (Kessler *et al.*, 2012) was carried out by clinical interviewers employed by the Army STARRS collaborators at USUHS. These interviews involve clinical reappraisal assessments administered by telephone with STARRS SAQ respondents using the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (SCID) (First *et al.*, 2002) as the clinical interview schedule.

Key challenges in fieldwork implementation

Formidable logistical challenges were faced in fielding the large-scale Army STARRS data collections. SRC was required to develop stand-alone, highly-secure, wireless computer networks that could efficiently serve up to 300 laptop computers on NSS and selected AAS Army installations. These networks had to be set up, broken down, and set up again twice each week at each installation where surveys were being carried out. The networks and laptops had to be shipped to new sites with each new quarterly sample replicate. SRC staff transported and set up laptops and network equipment for each data collection session, then packed and returned the equipment to the storage site established at the installation, and recharged laptop batteries between sessions at the storage sites. Where the target AAS sample unit was so small at a given site that it was not feasible or cost effective to set up computer

networks, PAPI was used for group self-administration of the AAS. Whole blood collection in the NSS and PPDS required the development of a special identification protocol involving use of wrist bands with ID numbers and bar codes to ensure respondent confidentiality and permit linking of blood samples with survey responses. Coordination was also required with Army phlebotomists.

Considerable travel and ongoing coordination were needed to establish mobile data collection facilities at the rotating set of data collection sites that were new in each replicate of the AAS. The SRC data collection teams that created this travelling set of facilities worked through the ODUSA to designate a local POC who worked directly with SRC to address logistical issues and facilitate data collection. An SRC Site Coordinator at each site worked with the POC to schedule sessions; obtain contact information for local Chaplains for the safety plan; and ensure access to storage space (for equipment and paper materials), tables and chairs, electrical outlets, etc. for each data collection session. Fitting Army STARRS data collections into the very busy schedules of Army units required a great deal of flexibility and creativity on the part of the SRC staff. Other challenges were faced in implementing the case–control studies of non-fatal suicide attempters and suicide deaths (contacting and recruiting next of kin; selecting, tracing, and recruiting control soldiers and supervisors).

Unit recruitment and logistical planning (including issuing operational orders) were carried out through the ODUSA, TRADOC, and FORSCOM. Contact with study units began with SRC staff briefing unit leaders on the purposes and importance of Army STARRS and then working with POCs to explain data collection requirements and develop local protocols to address logistical challenges. Additional coordination was needed with the Army Chaplain Corps, which provided support for the safety plan, and the MEDCOM, which provided Army medics for blood collection. The ODUSA maintained a travel team of high-ranking officers who accompanied the SRC data collection team to ensure Army support at each installation. The support and guidance provided by these Commands was essential to the success of Army STARRS data collection.

All soldiers selected for participation in Army STARRS were provided with an information sheet explaining the purposes of the study, providing answers to frequently asked questions, and giving a toll-free number for those who had additional questions. In the cases of the NSS, AAS, and PPDS, pre-designated respondents were additionally ordered to attend a group-administered 30-minute informed consent session that explained study purposes, procedures and confidentiality protections; emphasized the voluntary nature of participation (including the right to withdraw consent at a future date); and answered questions before seeking informed consent. SRC staff made the presentations at these sessions with in-person presentations made by ODUSA staff. Written informed consent was then obtained from volunteers. The Human Subjects Committees of the University of Michigan and USUHS (and for the Kuwait component, the Army Medical Research and Materiel Command) approved all recruitment, consent, and field procedures.

Fieldworker training

SRC hired and trained Site Coordinators and Group Session Proctors for the AAS, NSS, and PPDS data collections. SRC recruitment for the SCID clinical reappraisal study was conducted in person by the SRC field staff. SRC telephone recruitment for the SHOS-A/B case–control studies and telephone interviewing (for the case–control studies and for the third wave of PPDS follow-up interviews), in comparison, are being carried out by interviewers in the SRC Survey Services Laboratory in Ann Arbor, Michigan. Each professional SRC interviewer and fieldworker completes a General Interviewer Training (GIT) course before working on any project. Experienced workers additionally complete GIT refresher courses on a periodic basis. Each Site Coordinator, Group Session Proctor, and Interviewer who worked on Army STARRS also received 4–5 days of study-specific training and completed an Army STARRS certification test before beginning production work.

The USUHS clinical interviewers who administered the SCID interviews were trained by Michael First, a developer of the SCID, and were supervised by an experienced clinical research supervisor. All SCID interviews were digitally recorded with the permission of respondents for quality review purposes. The supervisor reviewed all written interviewer notes and selected recordings. Biweekly in-person clinical interviewer review meetings were held throughout the clinical calibration study field period to prevent interviewer drift. These meetings were chaired by the supervisor and attended remotely by the trainer.

The Harvard clinical interviewers who conduct the qualitative interviews with non-fatal suicide attempters were trained and supervised by Matthew Nock, a clinical psychologist with a long history of research on suicidal behaviors. Nock developed the interview schedule used in these assessments and also conducts some of the interviews. All these clinical interviews are audio-recorded with the permission of respondents and then transcribed and content analyzed using double-coding by independent

raters to establish inter-rater reliability. The coding system evolves in the course of content analysis. Interviewers/coders meet weekly with Nock to review results, address the problem of interviewer/coder drift, and discuss updates and revisions to the coding system.

Fieldwork quality control

As noted earlier, weekly or biweekly interviewer meetings and reviews of tape recorded interviews were used in the clinical reappraisal study (which has now ended) and continue to be used in the ongoing case–control studies to maintain quality control of data collection. In the case of the large-scale survey data collections, quality control procedures began with close monitoring by SRC staff of respondent selection procedures to avoid selectively recruiting respondents. CAI programs were then used in all data collections other than the AAS surveys implemented on small US installations and overseas to control skip logic. Completed CAI SAQs were sent electronically (by mail for PAPI and overseas SAQs) every night to the central Army STARRS Data Coordination Center at University of Michigan, allowing supervisors to monitor data flow and make quality control checks on a daily basis. In cases where problems were detected, rapid remediation efforts were undertaken. Despite these quality control steps, logistical problems occurred in a number of group administration sessions involving units of soldiers arriving late or having to leave early that led to incomplete surveys in a non-trivial proportion of cases. Computer hardware problems were also encountered in a small number of early SAQ sessions that resulted in loss of data. As these were relatively random occurrences, though, we addressed these data losses with the weighting procedures described later.

Sample sizes and response rates

Information on final sample sizes and response rates are available for the NSS and baseline PPDS. Only estimated projections are available, though, for the AAS and PPDS follow-up surveys. In the case of the AAS, while data collection has recently ended, with the late addition of activated Army Reserve (USAR) and National Guard (USANG) units in the continental United States that were either about to deploy to Afghanistan or about to separate from military service after returning from a deployment to Afghanistan, it will take some months to reconcile sample totals with population totals for these replicates. In the case of the PPDS, follow-up surveys are still in progress.

The numbers of respondents with substantially complete SAQ data are 50,765 in the NSS, 9421 in the baseline PPDS, and projected to be 35,372 in the AAS (Table 1). These numbers represent SAQ response rates of 88.8% in the NSS, 90.8% in the baseline PPDS, and 72.0% in the AAS replicates for which results are currently available. The numbers of SAQ respondents that additionally provided written informed consent and accurate identifying information to link their SAQ responses to their administrative data system (ADS) records are 39,132 in the NSS, 7425 in the baseline PPDS, and a projected 24,266 in the AAS. These numbers represent SAQ + ADS response rates of 68.5% in the NSS, 71.5% in the baseline PPDS, and a projected 49.8% in the AAS. Blood samples were also collected in the NSS and baseline PPDS, with some SAQ respondents providing blood samples but not ADS linkage and others providing ADS linkage but not blood samples. The numbers with complete SAQ data and blood samples (with or without ADS linkage) are 33,088 in the NSS and 7923 in the baseline PPDS (80.1–76.2% response rates), while the numbers with complete SAQ data, blood samples, and ADS linkage are 27,807 in the NSS and 6531 in the baseline PPDS (67.3–62.9% response rates).

A decomposition of reasons for incomplete response shows that even though all unit members in the AAS and PPDS are ordered to report to the Army STARRS informed consent sessions, 7.3% in the baseline PPDS and 23.5% in the AAS units for which results are currently available were absent due to conflicting duty assignments. However, the vast majority of those attending the informed consent sessions in both surveys (96.0–98.7%) consented to complete the SAQ and 98.0–99.2 of consenters completed the surveys. The situation is quite different in the NSS, where 100% of new soldiers selected for the survey attended the informed consent sessions (i.e. attendance at these sessions was made a part of the new soldier training schedule) and a similar fraction as in the AAS or PPDS consented to participate (97.7% versus 96.0–98.7%) but a smaller proportion of consenters completed the survey (91.0% versus 98.0–99.2%). Consent to link SAQ and administrative data was considerably higher among NSS (83.5%) and PPDS (84.0%) SAQ completers than AAS SAQ completers (72.4%). Based on these differences, the *cooperation* rates for the conjunction of SAQ completion and successful record linkage among soldiers attending informed consent sessions (i.e. response among those who were contacted and participated in the informed consent sessions) are lower in the NSS (68.5%) and AAS (65.1%) than the baseline PPDS.

Discussion

This paper has presented an overview of the field procedures in the Army STARRS, a multi-component initiative

Table 1. Interim sample dispositions in the Army STARRS surveys[1]

	New Soldier Study (Q1 2011–Q4 2012)	All Army Study (Q1–4 2011)	Baseline Pre-Post Deployment Study
I. Components of cooperation rate and response rate calculations			
Attending consent session (ACS)[2]	100.0%	76.5%	92.7%
Consent to complete survey (CCS/ACS)	97.7	96.0	98.7
Completion of survey (CS/CCS)[3]	91.0	98.0	99.2
Consent for linkage of ADS data among survey completers (CRL/CS)	83.5	72.4	84.0
Successful record linkage (ADS/[CS + CRL])[3]	92.3	95.6	93.8
II. Cooperation rates			
Survey	88.8	94.1	97.9
Survey + Consent for record linkage	74.2	68.1	82.2
Survey + ADS	68.5	65.1	77.2
Survey + blood	80.1	—	82.4
Survey + ADS + blood	67.3	—	67.9
III. Response rates			
Survey	88.8	72.0	90.8
Survey + Consent for record linkage	74.2	52.2	76.3
Survey + ADS	68.5	49.8	71.5
Survey + blood	80.1	—	76.2
Survey + ADS + blood	67.3	—	62.9
IV. Sample sizes			
Target sample	(57,152)	(49,128)[5]	(10,380)
Sample with completed surveys	(50,765)	(35,372)[5]	(9421)
Sample with completed surveys and ADS	(39,132)	(24,266)[5]	(7425)
Sample with completed surveys and blood	(33,088)	—	(7923)
Sample with completed surveys, ADS, and blood[4]	(27,807)	—	(6531)

[1]NSS dispositions are reported for calendar years 2011 and 2012. AAS dispositions are reported for replicates in calendar years 2011, as 2012 results are not yet finalized. PPDS dispositions are reported for the full pre-deployment PPDS sample.
[2]The AAS and PPDS target samples were all soldiers in designated units, allowing us to calculate the proportion of target respondents that attended the consent sessions. The NSS target samples, in comparison, were stipulated to be samples of new soldiers recruited on designated survey administration days in Reception Battalion to equal the numbers we could accommodate in the group survey administration settings established on the training bases. All new soldiers designated to be part of these target samples were designated as such by the Army Points of Contact (POCs) and marched to the Army STARRS group administration setting for the informed consent presentation before being asked to provide voluntary informed consent for the survey. Army STARRS data collection staff worked with Army POCs to guarantee that the target samples were not systematically biased. Based on these NSS recruitment procedures, the table stipulates that 100% of pre-designated respondents attended the NSS consent sessions.
[3]Failure to complete the survey was largely due to logistical problems with units arriving late or having to leave early from the group survey sessions, although some new soldiers were unable to complete the survey in the allocated 90-minute data collection period. Record linkage failure occurred when respondents who signed the informed consent form for record linkage either failed to provide linking information or provided information that did not match the information available in Army administrative records.
[4]Collection of blood did not begin until the fourth quarter of 2011 due to delays in IRB approval of this study component.
[5]The final sample sizes for the AAS are projected due to the numbers of respondents in the final replicates, which consist of activated USAR and USANG units, not yet being available at the time this report was prepared.

designed to investigate risk and resilience factors for suicidality and its psychopathological correlates among US Army personnel. We also presented preliminary information on sample sizes and response rates. The unprecedented size, scope, and complexity of Army STARRS created formidable challenges that, as described in the

body of the paper, we addressed by putting in place an organizational structure that provided coordination across component studies while allowing flexibility and creativity within studies and using the expertise of SRC to guide all data collection efforts. The fact that the component Army STARRS studies were carried out as part of a high-profile integrated research initiative helped promote cooperation, as indicated by the fact that the response rates in the AAS and baseline PPDS were a good deal higher than those in a number of other major military surveys (Bray *et al.*, 2006; Ryan *et al.*, 2007).

An issue of special importance in considering the response rates is that the Army STARRS studies, while *de-identified* (i.e. identifying information is kept separate from research data), are not *anonymous* (i.e. identifying information exists that can be linked to the research data of individual respondents) due to the fact that we are linking administrative data to survey responses and following respondents over time. This is in contrast to some other large military surveys, like the Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel (DoD Health Behavior Surveys; Ryan *et al.*, 2007) and the Mental Health Surveillance Surveys in combat environments carried out by US Army Mental Health Advisory Teams (MHATs; Bliese *et al.*, 2011), which were purposefully designed to be anonymous in order to encourage complete and accurate reporting.

The rationale for anonymity in military surveys is compelling, based on the fact that meta-analyses strongly suggest that anonymity can influence survey reports of embarrassing behaviors both in the general population (Turner *et al.*, 1998) and of mental disorders in the military (Gadermann *et al.*, 2012). As a result, a strategic decision was made in fielding the Army STARRS to allow respondents to provide completely anonymous survey reports even though we needed identifying information for ADS linkage. This was done by creating a separate informed consent form for identifying information to link self-report data to other types of data and encouraging respondents to complete the SAQ even if they did not want to consent to ADS linkage.

It is noteworthy in this regard that the proportions of soldiers attending AAS and PPDS consent sessions who completed these surveys (94.1–98.0%) are similar to the proportions who participated in previous Army surveys that used completely anonymous surveys. For example, the cooperation rate in the most recently reported DoD Health Behavior Survey among soldiers attending consent-survey sessions was 95.8% (Bray *et al.*, 2009). The cooperation rate among soldiers attending consent-survey sessions in an earlier survey of pre-post deployment mental health of US Army soldiers and Marines deployed in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) in Afghanistan was 98% (Hoge *et al.*, 2004). Importantly, though, the proportions of eligible respondents who attended the consent-survey sessions in these earlier studies (80% of those described as "accessible for study," but only 64.7% of all unit members, in the DoD Health Behavior Survey; 58% in the OIF/OEF surveys) were considerably lower than in the Army STARRS PPDS (92.7%) and AAS (76.5%). This suggests that there was more self-selection of cooperative soldiers in these earlier surveys than in the AAS or PPDS, making it all the more striking that the SAQ cooperation rates in the AAS and PPDS were comparable to those in these earlier surveys.

An advantage of having access to SAQ data for soldiers who did not consent to ADS linkage is that comparisons can be made with the SAQ reports of soldiers that agreed to ADS linkage. With regard to objective variables reported in the SAQs (e.g. age, sex, education, rank, marital status), these comparisons allow us to examine the extent to which consent for ADS linkage was non-random. Data are also available in the SAQ on more subjective data, such as reports of being anxious, depressed, and suicidal. These reports might be biased by the knowledge that responses are not completely anonymous, making the comparison of results in the completely anonymous SAQs and the de-identified (but not completely anonymous) SAQS of considerable interest. This kind of comparison is the focus of a companion paper in this issue (Kessler *et al.*, 2013b).

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Additional Information: A complete list of Army STARRS publications can be found at http://www.ARMYSTARRS.org.

Declaration of interest statement

In the past five years Kessler has been a consultant for Eli Lilly & Company, Glaxo, Inc., Integrated Benefits Institute, Ortho-McNeil Janssen Scientific Affairs, Pfizer Inc., Sanofi-Aventis Groupe, Shire US Inc., and Transcept Pharmaceuticals Inc. and has served on advisory boards for Johnson & Johnson. Kessler has had research support for his epidemiological studies over this time period from Eli Lilly & Company, EPI-Q, GlaxoSmithKline, Ortho-McNeil Janssen Scientific Affairs, Sanofi-Aventis Groupe, Shire US, Inc., and Walgreens Co. Kessler owns a 25% share in DataStat, Inc. Stein has in the last three years been a consultant for Healthcare Management Technologies and had research support for pharmacological imaging studies from Janssen. The remaining authors report no competing interests.

References

Anguelova M., Benkelfat C., Turecki G. (2003) A systematic review of association studies investigating genes coding for serotonin receptors and the serotonin transporter: II. Suicidal behavior. *Molecular Psychiatry*, **8**(7), 646–653, DOI: 10.1038/sj.mp.4001336.

Arango V., Ernsberger P., Marzuk P.M., Chen J.S., Tierney H., Stanley M., Reis D.J., Mann J.J. (1990) Autoradiographic demonstration of increased serotonin 5-HT2 and beta-adrenergic receptor binding sites in the brain of suicide victims. *Archives of General Psychiatry*, **47**(11), 1038–1047, DOI: 10.1001/archpsyc.1990.01810230054009.

Arango V., Underwood M.D., Boldrini M., Tamir H., Kassir S.A., Hsiung S., Chen J.J., Mann J.J. (2001) Serotonin 1A receptors, serotonin transporter binding and serotonin transporter mRNA expression in the brainstem of depressed suicide victims. *Neuropsychopharmacology*, **25**(6), 892–903, DOI: 10.1016/S0893-133X(01)00310-4.

Arango V., Underwood M.D., Gubbi A.V., Mann J.J. (1995) Localized alterations in pre- and postsynaptic serotonin binding sites in the ventrolateral prefrontal cortex of suicide victims. *Brain Research*, **688**(1–2), 121–133, DOI: 10.1016/0006-8993(95)00523-S.

Baldessarini R.J., Hennen J. (2004) Genetics of suicide: an overview. *Harvard Review of Psychiatry*, **12**(1), 1–13.

Bliese P.D., Thomas J.L., McGurk D., McBride S., Castro C.A. (2011) Mental health advisory teams: a proactive examination of mental health during combat deployments. *International Review of Psychiatry*, **23**(2), 127–134, DOI: 10.3109/09540261.2011.558834.

Boldrini M., Underwood M.D., Martini A., Kassir S. A., Mann J.J., Arango V. (2004) Distribution of serotonin-1A autoreceptors in the dorsal raphe nucleus of depressed suicide victims. ACNP 43rd Annual Meeting. San Juan, Puerto Rico.

Bray R.M., Hourani L.L., Olmsted K.L.R., Witt M., Brown J.M., Pemberton M.R., Marsden M.E., Marriott B., Scheffler S., Vandermaas-Peeler R., Weimer B., Calvin S., Bradshaw M., Close K., Hayden D. (2006) 2005 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel: A Component of the Defense Lifestyle Assessment Program (DLAP), Research Triangle Park, NC, Research Triangle Institute.

Bray R.M., Pemberton M.R., Hourani L.L., Witt M., Rae Olmsted K.L., Brown J.M., Weimer B.J., Lane M.E., Marsden M.E., Scheffler S.A.,

Vandermaas-Peeler R., Aspinwall K.R., Anderson E.M., Spagnola K., Close K.L., Gratton J.L., Calvin S.L., Bradshaw M.R. (2009) 2008 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel: A Component of the Defense Lifestyle Assessment Program (DLAP), Research Triangle Park, NC, Research Triangle Institute.

Brent D.A., Oquendo M., Birmaher B., Greenhill L., Kolko D., Stanley B., Zelazny J., Brodsky B., Bridge J., Ellis S., Salazar J.O., Mann J.J. (2002) Familial pathways to early-onset suicide attempt: risk for suicidal behavior in offspring of mood-disordered suicide attempters. *Archives of General Psychiatry*, **59**(9), 801–807, DOI: 10.1001/archpsyc.59.9.801.

Caspi A., Sugden K., Moffitt T.E., Taylor A., Craig I.W., Harrington H., McClay J., Mill J., Martin J., Braithwaite A., Poulton R. (2003) Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science*, **301**(5631), 386–389, DOI: 10.1126/science.1083968.

First M.B., Spitzer R.L., Gibbon M., Williams J. B.W. (2002) Structured Clinical Interview for DSM-IV Axis I Disorders, Research Version, Non-patient Edition (SCID-I/NP), New York, Biometrics Research, New York State Psychiatric Institute.

Gadermann A.M., Engel C.C., Naifeh J.A., Nock M.K., Petukhova M., Santiago P.N., Wu B., Zaslavsky A. M., Kessler R.C. (2012) Prevalence of DSM-IV major depression among U.S. military personnel: meta-analysis and simulation. *Military Medicine*, **177**(8 Suppl), 47–59.

Gilman S.E., Goldenberg M., Kessler R.C., McCarroll J.E., McLaughlin K.A., Peterson C., Schoenbaum M., Stanley B., Ursano R.J. (2013) Suicide among Soldiers: a review of psychological risk and protective factors. *Psychiatry*, **76**(2), 97–125.

Haghighi F., Bach-Mizrachi H., Huang Y.Y., Arango V., Shi S., Dwork A.J., Rosoklija G., Sheng H.T., Morozova I., Ju J., Russo J.J., Mann J.J. (2008) Genetic architecture of the human tryptophan hydroxylase 2 Gene: existence of neural isoforms and relevance for major depression. *Molecular Psychiatry*, **13**(8), 813–820, DOI: 10.1038/sj.mp.4002127.

Higley J.D., Linnoila M. (1997) Low central nervous system serotonergic activity is traitlike and correlates with impulsive behavior. A nonhuman primate model investigating genetic and environmental influences on neurotransmission. *Annals of the New York Academy of Sciences*, **836**, 39–56, DOI: 10.1111/j.1749-6632.1997.tb52354.x.

Hoge C.W., Castro C.A., Messer S.C., McGurk D., Cotting D.I., Koffman R.L. (2004) Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *New England Journal of Medicine*, **351**(1), 13–22, DOI: 10.1056/NEJMoa040603.

Hsiung S., Adlersberg M., Arango V., Mann J.J., Tamir H., Liu K. (2003) Reduced 5-HT1A receptor signaling in brains of suicide victims: involvement of adenylyl cyclase, phosphatidylinositol 3-kinase, Akt and MAP kinase. *Journal of Neurochemistry*, **87**(1), 182–194, DOI: 10.1046/j.1471-4159.2003.01987.x.

Huang Y.Y., Cate S.P., Battistuzzi C., Oquendo M.A., Brent D., Mann J.J. (2004) An association between a functional polymorphism in the monoamine oxidase a gene promoter, impulsive traits and early abuse experiences. *Neuropsychopharmacology*, **29**(8), 1498–1505, DOI: 10.1038/sj.npp.1300455.

Insel T., McHugh J.M. (submitted for publication) The U.S. Army-National Institute of Mental Health Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS): rapidly translating interventions to reduce suicide.

Jollant F., Bellivier F., Leboyer M., Astruc B., Torres S., Verdier R., Castelnau D., Malafosse A., Courtet P. (2005) Impaired decision making in suicide attempters. *American Journal of Psychiatry*, **162**(2), 304–310, DOI: 10.1176/appi.ajp.162.2.304.

Keilp J.G., Gorlyn M., Oquendo M.A., Burke A.K., Mann J.J. (2008) Attention deficit in depressed suicide attempters. *Psychiatry Research*, **159**(1–2), 7–17, DOI: 10.1016/j.psychres.2007.08.020.

Keilp J.G., Sackeim H.A., Brodsky B.S., Oquendo M.A., Malone K.M., Mann J.J. (2001) Neuropsychological dysfunction in depressed suicide attempters. *American Journal of Psychiatry*, **158**(5), 735–741, DOI: 10.1176/appi.ajp.158.5.735.

Kessler R.C., Calabrese J.R., Farley P.A., Gruber M.J., Jewell M.A., Katon W., Keck P.E., Nierenberg A.A., Sampson N.A., Shear M.K., Shillington A.C., Stein M.B., Thase M.E., Wittchen H.U. (2012) Composite International Diagnostic Interview screening scales for DSM-IV anxiety and mood disorders. *Psychological Medicine*, 1–13, DOI: 10.1017/S0033291712002334.

Kessler R.C., Colpe L.J., Fullerton C.S., Gebler N., Naifeh J.A., Nock M.K., Sampson N.A., Schoenbaum M., Zaslavsky A.M., Stein M.B., Ursano R.J., Heeringa S.G. (2013a) Design of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods and Psychiatric Research*, **22**(4), 267–275.

Kessler R.C., Heeringa S.G., Colpe L.J., Fullerton C.S., Gebler N., Naifeh J.A., Nock M.K., Sampson N. A., Schoenbaum M., Zaslavsky A.M., Stein M.B., Ursano R.J. (2013b) Response bias, weighting adjustments, and design effects in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research*, **22**(4), 288–302.

Kessler R.C., Santiago P., Colpe L.J., Dempsey C.L., First M.H., Heeringa S. G., Stein M.B., Fullerton C.S., Gruber M.J., Naifeh J.A., Nock M.K., Sampson N.A., Schoenbaum M., Zaslavsky A.M., Ursano R.J. (2013c) Clinical reappraisal of the Composite International Diagnostic Interview Screening Scales (CIDI-SC) in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods and Psychiatric Research*, **22**(4), 303–321.

Kraemer G.W., Schmidt D.E., Ebert M.H. (1997) The behavioral neurobiology of self-injurious behavior in rhesus monkeys. Current concepts and relations to impulsive behavior in humans. *Annals of the New York Academy of Sciences*, **836**, 12–38, DOI: 10.1111/j.1749-6632.1997.tb52353.x.

Krishnan V., Han M.H., Graham D.L., Berton O., Renthal W., Russo S.J., Laplant Q., Graham A., Lutter M., Lagace D.C., Ghose S., Reister R., Tannous P., Green T.A., Neve R.L., Chakravarty S., Kumar A., Eisch A.J., Self D. W., Lee F.S., Tamminga C.A., Cooper D.C., Gershenfeld H.K., Nestler E.J. (2007) Molecular adaptations underlying susceptibility and resistance to social defeat in brain reward regions. *Cell*, **131**(2), 391–404, DOI: 10.1016/j.cell.2007.09.018.

Mann J.J. (2003) Neurobiology of suicidal behaviour. *Nature Reviews Neuroscience*, **4**(10), 819–828, DOI: 10.1038/nrn1220.

Mann J.J., Brent D.A., Arango V. (2001) The neurobiology and genetics of suicide and attempted suicide: a focus on the serotonergic system. *Neuropsychopharmacology*, **24**(5), 467–477, DOI: 10.1016/S0893-133X(00)00228-1.

Mann J.J., Huang Y.Y., Underwood M.D., Kassir S.A., Oppenheim S., Kelly T.M., Dwork A.J., Arango V. (2000) A serotonin transporter gene promoter polymorphism (5-HTTLPR) and prefrontal cortical binding in major depression

and suicide. *Archives of General Psychiatry*, **57**(8), 729–738, DOI: 10.1001/archpsyc.57.8.729.

Mann J.J., Stanley M., McBride P.A., McEwen B.S. (1986) Increased serotonin2 and beta-adrenergic receptor binding in the frontal cortices of suicide victims. *Archives of General Psychiatry*, **43**(10), 954–959, DOI: 10.1001/archpsyc.1986.01800100048007.

Manuck S.B., Flory J.D., Ferrell R.E., Mann J.J., Muldoon M.F. (2000) A regulatory polymorphism of the monoamine oxidase-A gene may be associated with variability in aggression, impulsivity, and central nervous system serotonergic responsivity. *Psychiatry Research*, **95**(1), 9–23, DOI: 10.1016/S0165-1781(00)00162-1.

Marzuk P.M., Hartwell N., Leon A.C., Portera L. (2005) Executive functioning in depressed patients with suicidal ideation. *Acta Psychiatrica Scandinavica*, **112**(4), 294–301, DOI: 10.1111/j.1600-0447.2005.00585.x.

McEwen B.S. (2007) Physiology and neurobiology of stress and adaptation: central role of the brain. *Physiological Reviews*, **87**(3), 873–904, DOI: 10.1152/physrev.00041.2006.

Moscicki E.K. (1999) Epidemiology of suicide. In Jacobs D.G. (ed.) *The Harvard Medical School Guide to Suicide Assessment and Intervention*, pp 40–51, San Francisco, CA: Jossey-Bass.

Nock M.K., Borges G., Bromet E.J., Cha C.B., Kessler R.C., Lee S. (2008) Suicide and suicidal behavior. *Epidemiologic Reviews*, **30**(1), 133–154, DOI: 10.1093/epirev/mxn002.

Parsey R.V., Hastings R.S., Oquendo M.A., Huang Y.Y., Simpson N., Arcement J., Huang Y., Ogden R.T., Van Heertum R.L., Arango V., Mann J.J. (2006) Lower serotonin transporter binding potential in the human brain during major depressive episodes. *American Journal of Psychiatry*, **163**(1), 52–58, DOI: 10.1176/appi.ajp.163.1.52.

Rujescu D., Thalmeier A., Moller H.J., Bronisch T., Giegling I. (2007) Molecular genetic findings in suicidal behavior: what is beyond the serotonergic system? *Archives of Suicide Research*, **11**(1), 17–40, DOI: 10.1080/13811110600897317.

Ryan M.A., Smith T.C., Smith B., Amoroso P., Boyko E.J., Gray G.C., Gackstetter G.D., Riddle J. R., Wells T.S., Gumbs G., Corbeil T.E., Hooper T.I. (2007) Millennium Cohort: enrollment begins a 21-year contribution to understanding the impact of military service. *Journal of Clinical Epidemiology*, **60**(2), 181–191, DOI: 10.1016/j.jclinepi.2006.05.009.

Sadowski C., Kelley M.L. (1993) Social problem solving in suicidal adolescents. *Journal of Consulting and Clinical Psychology*, **61**(1), 121–127, DOI: 10.1037/0022-006X.61.1.121.

Strauss A.L. (1987) *Qualitative Analysis for Social Scientists*, Cambridge: Cambridge University Press.

Thomas M.L., Brown G.G., Gur R.C., Hansen J.A., Nock M.K., Heeringa S., Ursano R.J., Stein M.B. (2013) Parallel psychometric and cognitive modeling analyses of the Penn Face Memory Test in the Army Study to Assess Risk and Resilience in Servicemembers. *Journal of Clinical and Experimental Neuropsychology*, **35**(3), 225–245, DOI: 10.1080/13803395.2012.762974.

Turner C.F., Ku L., Rogers S.M., Lindberg L.D., Pleck J.H., Sonenstein F.L. (1998) Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. *Science*, **280**(5365), 867–873, DOI: 10.1126/science.280.5365.867.

Uher R., McGuffin P. (2008) The moderation by the serotonin transporter gene of environmental adversity in the aetiology of mental illness: review and methodological analysis. *Molecular Psychiatry*, **13**(2), 131–146, DOI: 10.1038/sj.mp.4002067.

Ursano R.J., Heeringa S., Stein M.B., Kessler R.C. (submitted for publication) The Army Study to Assess Risk and Resilience in Servicemembers (STARRS).

Voracek M., Loibl L.M. (2007) Genetics of suicide: a systematic review of twin studies. *Wiener Klinische Wochenschrift*, **119**(15–16), 463–475,

Wainer H. (2000) *Computerized Adaptive Testing: A Primer*, Second Edition, Mahwah, NJ: Erlbaum.

Wakschlag L.S., Kistner E.O., Pine D.S., Biesecker G., Pickett K.E., Skol A.D., Dukic V., Blair R.J., Leventhal B.L., Cox N.J., Burns J.L., Kasza K.E., Wright R.J., Cook E.H., Jr. (2009) Interaction of prenatal exposure to cigarettes and MAOA genotype in pathways to youth antisocial behavior. *Molecular Psychiatry*, **15**(9), 928–937, DOI: 10.1038/mp.2009.22.

Zill P., Buttner A., Eisenmenger W., Moller H.J., Bondy B., Ackenheil M. (2004) Single nucleotide polymorphism and haplotype analysis of a novel tryptophan hydroxylase isoform (TPH2) gene in suicide victims. *Biological Psychiatry*, **56**(8), 581–586, DOI: 10.1016/j.biopsych.2004.07.015.