Title: Attitudes regarding the national forensic DNA database: Survey data from the general public, prison inmates and prosecutors' offices in the Republic of Serbia

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Highlights

- The first Eastern European survey of public views on forensic DNA use is conducted
- Professionals linked to forensic genetics show permissive outlook on DNA databasing
- Respondents whose DNA profile has been retained by the state take restrictive stand

ATTITUDES REGARDING THE NATIONAL FORENSIC DNA DATABASE: SURVEY DATA FROM THE GENERAL PUBLIC, PRISON INMATES AND PROSECUTORS' OFFICES IN THE REPUBLIC OF SERBIA

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ABSTRACT

Worldwide, the establishment of national forensic DNA databases has transformed personal identification in the criminal justice system over the past two decades. It has also stimulated much debate centering on ethical issues, human rights, individual privacy, lack of safeguards and other standards. Therefore, a balance between effectiveness and intrusiveness of a national DNA repository is an imperative and needs to be achieved through a suitable legal framework.

On its path to the European Union (EU), the Republic of Serbia is required to harmonize its national policies and legislation with the EU. Specifically, Chapter 24 of the EU *acquis communautaire* (Justice, Freedom and Security) stipulates the compulsory creation of a forensic DNA registry and adoption of corresponding legislation. This process is expected to occur in 2016. Thus, in light of launching the national DNA database, the goal of this work is to instigate a consultation with the Serbian public regarding their views on various aspects of the forensic DNA databank. Importantly, this study specifically assessed the opinions of distinct categories of citizens, including the general public, the prosecutors' offices staff, prisoners, prison guards, and students majoring in criminalistics. Our findings set a baseline for Serbian attitudes towards DNA databank custody, DNA sample and profile inclusion and retention criteria, ethical issues and concerns. Furthermore, results clearly demonstrate a permissive outlook of the respondents who are professional "beneficiaries" of genetic profiling and a restrictive position taken by the respondents whose genetic material has been acquired by the government.

We believe that this opinion poll will be essential in discussions regarding a national DNA database, as well as in motivating further research on the reasons behind the observed views and subsequent development of educational strategies. All of these are, in turn, expected to aid the creation of suitable legislation and to increase societal confidence that the repository will be used in the legal system without interference with individual rights and freedoms.

Keywords: public attitudes, DNA profiling, forensic databases

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1. Introduction

The application of genetic analyses in criminalistics has immensely improved successes in personal identification, in regard to speed, precision, reliability, cost, etc. Since the United Kingdom pioneered its national DNA database, two decades ago, many countries have established their own DNA repositories. The Council for Responsible Genetics (2011) reported that 56 countries maintain operational DNA databases, while 26 are in the planning stage of DNA registers [1]. However, individual countries operate their DNA databases in different manners, in terms of legislation, sample collection, inclusion and removal criteria, profile and sample retention, database access, etc., therefore resulting in a range of approaches, from restrictive to permissive [1-3].

Forensic DNA testing in the Republic of Serbia began in 1997 and it was initially grounded on Polymarker™ system [4]. Today, it is based on up to 21 autosomal STR loci (15 being deposited into the database), including the expanded European Standard Set (ESS) [5], and 17 Y STR loci. The biological sample acquisition for DNA analyses is regulated by the Criminal Procedure Code of the Republic of Serbia, which permits the prosecutor or court to mandate the police to carry out the sampling even without the subject's consent [6]. The Law on Police allows the police to register individuals who have been subjected to DNA profiling [7]. However, neither of the two laws specifically addresses DNA nor defines biological sample retention, destruction, or record keeping methods.

Forensic DNA analyses are performed in one private and six public laboratories (National Criminalistic - Technical Center (NCTC), Ministry of Interior; Faculty of Biology, University of Belgrade; Institute of Forensic Medicine, University of Belgrade; Institute of Forensic Medicine, University of Novi Sad; Institute of Forensic Medicine, University of Niš; and Security Information Agency). At the moment, these individual laboratories operate their own DNA databases, while a national DNA repository and the corresponding legislation are absent. Therefore, during criminalistic investigations, judges coordinate the sending of DNA profiles obtained in one laboratory to the other laboratories for comparison, which is a tedious process. NCTC Laboratory for DNA analysis is a member of the European Network of Forensic Science Institutes (ENFSI) and is currently the only accredited forensic laboratory in compliance with the ISO 17025 standard. Given the lack of legislation requiring compulsory laboratory accreditation, as well as the cost of the process, quality assurance of the six non-accredited laboratories rests solely on GEDNAP proficiency testing [8]. Despite the well-established advantages of ISO 17025 accredited laboratories, particularly considering contamination and secondary transfer, current Serbian legislation allows each of the seven laboratories to present evidence at trial. Therefore, there clearly exists a pressing need to thoroughly regulate the use of forensic DNA analysis, as well as national DNA databases in criminalistics, through a legal framework. As of 2008, every EU member state is required to establish a forensic DNA database, to be searchable by other EU member states [9]. Considering its plans for accession to the European Union and harmonization of the national policies, measures and legislation with EU countries, the Republic of Serbia is in the process of forming a national DNA register. The public hearing on the draft law concerning the establishment and regulation of such database began in November 2016.

International experiences have demonstrated that the employment of forensic DNA databases raises numerous concerns, particularly given the severity of consequences, leading to convictions and exonerations of individuals [10, 11]. Opponents point out consequences related to individual privacy and civil rights, potential discrimination issues (such as racial and medical), public distrust in government (such as fraudulent use of DNA in criminalistic investigations), sharing of information with third parties, as well as genetic surveillance [12, 13]. Therefore, responsible genetics is an imperative – achieving a balance between usefulness and convenience of DNA data in law enforcement agencies ensuring a higher level of security, and the protection of human rights and the individual freedoms of all individuals.

Although it has been argued that taking into account the views of the broader public results in superior policy-making decisions [14], national DNA databases are typically launched without prior consultation with the public [15, 16]. Yet, a number of studies have demonstrated the importance of ascertaining public attitudes and knowledge concerning DNA databasing [10, 12, 15, 17-22]. By empirically assessing the views of different categories of respondents, in this work we sought to initiate the first debate and uncover public attitudes with respect to the model of the national DNA register which may be most suitable for Serbia.

2. Materials and Methods

The questionnaire applied in this study was designed by the research team and consisted of 19 questions covering basic perceptions of the benefits, risks and the regulation of the national forensic DNA database, as well as socio-demographic characteristics. The study sample was stratified, convenient and non-representative, consisting of 558 respondents. In order to examine putative differences in viewpoints between specific population groups, we surveyed the following subpopulations of interest: 162 participants from the general public (29% of the sample), 169 staff of the prosecutors' offices from 21 municipalities (30.3%), 156 prisoners (28%), 51 police officer students (9.1%), and 20 prison guards (3.6%). The category of respondents labeled 'general public', indicating a population subgroup without any known prior professional association with forensic DNA databases, was obtained by a snowball sampling method via authors' e-mail contacts. On the other hand, the Ministry of Interior mailed official letters to the prosecutors' offices and prisons, with a request that staff members, as well as inmates in case of the latter, contribute to the study. The questionnaires filled out by individuals who chose to partake in the survey were mailed to the Ministry of Interior. The questionnaire was also directly administered to fourth year students at the Criminalistics Department, Academy of Criminalistic and Police Studies, who consented to participation in the survey.

Out of 558 people surveyed, 197 were women (35.3% of the sample) and 361 were men (64.7%). However, when prisoner category, which consisted exclusively of males, is excluded, the female-to-male ratio of the remaining surveyed population is 197 (49%) to 205 (51%). Different age groups were represented in the dataset, ranging from 19 to 65 years of age. Distribution by age was as follows: 11-20 years 3%, 21-30 years 32.8%, 31-40 years 25.4%, 41-50 years 19.9%, 51-60 15.4%, 61-70 years 2%, while 1.4% of respondents did not disclose their age. In terms of the level of education, 0.2% of respondents reported no education, 10.4% primary

school, 36% secondary school, 5.7% junior college, 39.6% university, 7.5% post-university education, and 0.5% did not answer this question.

Statistical analyses were performed using the Statistical Package for Social Sciences, for Windows, Version 22.0 (IBM Corp., US). The omnibus Chi-square test was applied in the analysis of the responses to individual questions. Additionally, putative differences in responses between pairs of respondent groups were estimated using the Chi-square test of association. Prison guards and trainees were not included in pairwise comparisons, due to the small sample size. Principal component analysis was used with the goal of creating associations between several questions.

3. Results

A majority of the respondents in the current study (67.2% overall, 89.3% of prosecutors and deputy prosecutors, 52.5% of the general public, 58.3% of prisoners, 60% of prison guards, and 70.6% of students) responded that national DNA databases play a significant role in fighting crime (Table 1). However, categories of respondents exhibited differing views on the effectiveness of a DNA register (χ^2=80.919, p<0.01), as prosecutors and deputy prosecutors placed significantly more value on DNA databases as a crime-fighting tool, compared to the general public (χ^2=50.173, p<0.01) and prisoners (χ^2=46.849, p<0.01).

When asked about the institution that should own, manage and govern the national DNA register, the highest number of respondents from all categories chose the Ministry of Interior (46.3% of the general public, 51.5% of the prosecutors' offices staff, 41.7% of prisoners, 55% of prison guards, and 72.5% of students) (Table 1). This answer was followed by an independent public Agency, the Ministry of Health, and the School of Medicine – Forensic Medicine, while respondents who chose the option "other" proposed joint custody by the Ministry of Interior and the Ministry of Health, as well as the Ministry of Justice.

Overall, respondents preferred (41.8%) including in the DNA database either convicted and suspected offenders, or convicted and suspected offenders and volunteers. The same response was given by 34.9% of the general public and 16.1% of the convicted criminals (Table 1). Groups of participants differed in their views regarding the inclusion criteria for the national DNA database (χ^2=107.794, p<0.01). Compared to the general public (χ^2=19.654, p<0.01) and prosecutors' offices staff (χ^2=62.497, p<0.01), prisoners favored the idea that profiles of the entire population (44.2%) or no one's (14.4%) be included in the national register. Inclusion of DNA profiles from crime scene material into the database was supported by 75.3% of the general public, 94.1% of the prosecutors' offices staff, 73.7% of prisoners, 65% of prison guards, and 84.3% of students (Table 1). The highest percentage of respondents (17.3%) to object to storing forensic DNA profiles was in the prisoner category.

Table 1. Opinions regarding general aspects of a national DNA database

DATABASE EFFECTIVENESS	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Significant	85	52.5	151	89.3	91	58.3	12	60	36	70.6	375	67.2
Minor	57	35.2	17	10.1	38	24.4	8	40	15	29.4	135	24.2
None	9	5.6	1	0.6	9	5.8	0	0	0	0	19	3.4
Indifferent	3	1.9	0	0	4	2.6	0	0	0	0	7	1.3
Do not know	8	4.9	0	0	14	9	0	0	0	0	22	3.9
	162	100	169	100	156	100	20	100	51	100	558	100

DATABASE CUSTODY	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Ministry of Interior	75	46.3	87	51.5	65	41.7	11	55	37	72.5	275	49.3
Ministry of Health	17	10.5	7	4.1	29	18.6	2	10	2	3.9	57	10.2
Legal Medicine (University)	13	8	9	5.3	9	5.8	0	0	1	2	32	5.7
Autonomous Institution	47	29	60	35.5	33	21.2	7	35	9	17.6	156	28
Other	10	6.2	5	3	18	11.5	0	0	2	3.9	35	6.3
No answer	0	0	1	0.6	2	1.3	0	0	0	0	3	0.5
	162	100	169	100	156	100	20	100	51	100	558	100

INCLUSION CRITERIA	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Convicts	30	18.5	29	17.2	15	9.6	5	25	11	21.6	90	16.1
Convicts and suspects	36	18.5	57	33.7	24	15.4	3	15	15	29.4	135	24.2
Convicts, suspects and volunteers	28	17.3	39	23.1	16	10.3	0	0	15	29.4	98	17.6
Entire RS population	62	38.3	43	25.4	69	44.2	12	60	9	17.6	195	34.9
No one	4	2.5	0	0	22	14.1	0	0	0	0	26	4.7
Other	2	1.2	1	0.6	10	6.4	0	0	1	2	14	2.5
	162	100	169	100	156	100	20	100	51	100	558	100

INCLUSION OF PROFILES FROM CRIME SCENES	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Yes	122	75.3	159	94.1	115	73.7	13	65	43	84.3	452	81
No	18	11.1	6	3.6	27	17.3	2	10	4	7.8	57	10.2
Indifferent	10	6.2	2	1.2	1	0.6	1	5	2	3.9	16	2.9
Do not know	12	7.4	2	1.2	13	8.3	4	20	2	3.9	33	5.9
	162	100	169	100	156	100	20	100	51	100	558	100

Table 2 presents attitudes related to convicted offenders. Overall, respondents favored including in the database individuals convicted of any felony (41.9%), rather than serious felonies only (29.1%), or all felonies and misdemeanors (25.3%), although categories of respondents differed in their attitudes on this issue (χ^2=73.949, p<0.01). Prisoners favored storing DNA profiles of individuals convicted for serious crimes only, compared to the general public (χ^2=32.366, p<0.01) and prosecutors (χ^2=40.760, p<0.01). The same trend was observed when the prison sentence duration was considered as an inclusion factor. A vast majority of respondents thought that DNA profiles should be kept in the database either indefinitely (38.9% of the general public, 61.5% of the

prosecutors' offices staff, 56.4% of prisoners, 60% of prison guards, and 41.2% of students) or until the death of the convicted offender (53.1% of the general public, 33.1% of the prosecutors' offices staff, 17.9% of prisoners, 40% of prison guards, and 56.9% of students), although more prisoners favored the idea of the DNA profile being expunged at the end of the prison sentence, compared to the general public (χ^2=52.391, p<0.01) or the prosecutors' offices staff (χ^2=34.979, p<0.01). Additionally, prosecutors and deputy prosecutors preferred indefinite storing of convicted offenders' DNA profiles, compared to the general public (χ^2=22.383, p<0.01).

Table 2. Opinions concerning criteria for convicted individuals

OFFENCE TYPE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Serious crimes only	39	24.1	34	20.1	65	41.7	7	35	18	35.3	163	29.1
All crimes	82	50.6	91	53.6	35	22.4	5	25	22	43.1	235	41.9
All crimes and misdemeanors	38	23.5	41	24.3	44	28.2	8	40	11	21.6	142	25.3
Other	1	0.6	3	1.8	12	7.7	1	5	0	0	17	3
No answer	3	1.9	0	0	1	0.6	0	0	0	0	4	0.7
	163	100	169	100	157	100	21	100	51	100	561	100

PRISON SENTENCE DURATION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Any	143	88.3	164	97	104	66.7	19	95	40	78.4	470	84.2
Fixed	16	9.9	2	1.2	41	26.3	0	0	11	21.6	70	12.5
Other	0	0	0	0	1	0.6	0	0	0	0	1	0.2
No answer	3	1.9	3	1.8	10	6.4	1	5	0	0	17	3
	162	100	169	100	156	100	20	100	51	100	558	100

DNA PROFILE RETENTION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Indefinite	63	38.9	104	61.5	88	56.4	12	60	21	41.2	288	51.6
Until convict's death	86	53.1	56	33.1	28	17.9	8	40	29	56.9	207	37.1
Until the end of the prison sentence	7	4.3	2	1.2	29	18.6	0	0	0	0	38	6.8
Other	3	1.9	6	3.6	10	6.4	0	0	1	2	20	3.6
No answer	2	1.2	1	0.6	0	0	0	0	0	0	3	0.5
	161	100	169	100	155	100	20	100	51	100	556	100

Principal component analysis revealed that attitudes of the public toward suspects were congruent with the ones for convicted individuals, considering both the offense type and retention of the DNA profile in the database (data not shown). Again, interviewed categories differed in their views on suspects' DNA profiles (χ^2=67.106, p<0.01), since prisoners preferred (44.9%) storing DNA profiles of individuals suspected of having committed serious crimes only, compared to the general public (χ^2=27.232, p<0.01) and prosecutors' offices staff (χ^2=46.571, p<0.01) (Table 3).

Table 3. Opinions concerning criteria for suspected individuals

OFFENCE TYPE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Serious crimes only	49	30.2	37	21.9	70	44.9	6	30	24	47.1	186	33.3
All crimes	71	43.8	85	50.3	27	17.3	5	25	18	35.3	206	36.9
All crimes and misdemeanors	38	23.5	39	23.1	49	31.4	8	40	9	17.6	143	25.6
Other	0	0	3	1.8	9	5.8	1	5	0	0	13	2.3
No answer	4	2.5	5	3	1	0.6	0	0	0	0	10	1.8
	162	100	169	100	156	100	20	100	51	100	558	100

DNA PROFILE RETENTION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Indefinite	89	54.9	103	60.9	95	60.9	14	70	26	51	327	58.8
Until acquital	60	37	46	27.2	55	35.3	6	30	22	43.1	189	33.9
Other	7	4.3	13	7.7	6	3.8	0	0	3	5.9	29	5.2
No answer	6	3.7	7	4.1	0	0	0	0	0	0	13	2.3
	162	100	169	100	156	100	20	100	51	100	558	100

Opinions on two peculiar aspects of DNA databasing, familial searches and the exchange of information across national borders, which have been a subject of concern regarding genetic surveillance and requirements for specific policy decisions based on ethical, legal, social, and logistical considerations [23, 24], are presented in Table 4. Approximately half of the subjects in each category (51.2% of the general public, 52.7% of the prosecutors' offices staff, 42.9% of prisoners, 50% of prison guards, and 49% of students) supported the usage of DNA profiles stored in the national database for taking legal actions against relatives. Also, a majority of subjects in all the categories (63.3% of the general public, 68.6% of the prosecutors' office staff, 54.5% of prisoners, 60% of prison guards, and 49% of students) agreed with forwarding DNA profiles from the register to Interpol, with the aim of international cooperation in fighting crime, although optional forwarding (i.e. in case of serious crimes only, such as terrorism and organised crime, per Interpol's request and following to a predefined protocol) was also an option.

Table 4. Opinions concerning aspects of the DNA database pertinent to genetic surveillance

FAMILIAL SEARCHES	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agree	83	51.2	89	52.7	67	42.9	10	50	25	49	274	49.1
Disagree	36	22.2	30	17.8	52	33.3	4	20	14	27.5	136	24.4
Agree under certain circumstances	15	9.3	35	20.7	4	2.6	3	15	5	9.8	62	11.1
Do not know	28	17.3	12	7.1	32	20.5	3	15	7	13.7	82	14.7
No answer	0	0	3	1.8	1	0.6	0	0	0	0	4	0.7
	162	100	169	100	156	100	20	100	51	100	558	100

COOPERATION WITH THE INTERPOL	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agree	103	63.6	116	68.6	85	54.5	12	60	25	49	341	61.1
Disagree	29	17.9	10	5.9	34	21.8	4	20	11	21.6	88	15.8
Agree under certain circumstances	15	9.3	30	17.8	7	4.5	3	15	7	13.7	62	11.1
Do not know	15	9.3	13	7.7	29	18.6	1	5	8	15.7	66	11.8
No answer	0	0	0	0	1	0.6	0	0	0	0	1	0.2
	162	100	169	100	156	100	20	100	51	100	558	100

The principal component analysis also showed that responses regarding privacy issues and potential misuses uniformly reflected respondents' concerns regarding the DNA database. When asked about the extent to which a national DNA register could violate one's privacy (without further defining the term privacy), the categories of examinees differed in their responses (χ^2=108.670, p<0.01). While 94.7% of prosecutors and deputy prosecutors believed that a DNA database would not intrude on individual's privacy, or at least not to a great extent, only 57.1% of prisoners agreed with this (Table 5). Similarly, 31.4% of prisoners, compared to 25.9% of the general public, 7.7% of the prosecutors' office staff, 15% of prison guards, and 19.6% of students, had serious concerns regarding potential misuses of a DNA database.

Table 5. Opinions regarding violation of privacy

PRIVACY INVASION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Signficant	22	13.6	1	0.6	42	26.9	2	10	7	13.7	74	13.3
Minor	51	31.5	73	43.2	31	19.9	6	30	27	52.9	188	33.7
No invasion	69	42.6	87	51.5	58	37.2	8	40	13	25.5	235	42.1
Indifferent	5	3.1	4	2.4	1	0.6	1	5	1	2	12	2.2
Other	5	3.1	2	1.2	1	0.6	1	5	1	2	10	1.8
Do not know	8	4.9	2	1.2	23	14.7	2	10	1	2	36	6.5
No answer	2	1.2	0	0	0	0	0	0	1	2	3	0.5
	162	100	169	100	156	100	20	100	51	100	558	100

MISUSE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Significant concerns	42	25.9	13	7.7	49	31.4	3	15	10	19.6	117	21
Minor concerns	58	35.8	65	38.5	40	25.6	10	50	24	47.1	197	35.3
No concerns	47	29	76	45	38	24.4	5	25	13	25.5	179	32.1
Indifferent	8	4.9	3	1.8	2	1.3	0	0	2	3.9	15	2.7
Other	0	0	3	1.8	0	0	1	5	0	0	4	0.7
Do not know	6	3.7	6	3.6	27	17.3	1	5	2	3.9	42	7.5
No answer	1	0.6	3	1.8	0	0	0	0	0	0	4	0.7
	162	100	169	100	156	100	20	100	51	100	558	100

Considering socio-demographic factors, the older the participants in this study, the more they favored entrusting the national database to an independent entity (p<0.01) and the more optimistic their perception of the importance of a forensic DNA repository (p<0.05). More educated respondents disfavored the Ministry of Interior as the database custodian (p<0.01), but the confidence in the impact of a forensic DNA register in crime fighting strengthened with the increase in the education level (p<0.01). In regard to profession, tests of associations between pairs of population categories have demonstrated disagreeing opinions regarding the DNA database (p<0.01). Prosecutors and deputy prosecutors placed significantly more value on a DNA database as a crime-fighting tool, compared to the general public (χ^2=50.173, p<0.01) and prisoners (χ^2=46.849, p<0.01). They further favored indefinite DNA profile

retention, unlike the general public ($p<0.01$), which sides with the Spanish sample [12], as well as legislations implemented by Greece and Northern Ireland [3]. The same trend was observed for biological sample retention ($p<0.01$).

4. Discussion

The results obtained in this survey illustrate that Serbian publics perceive a forensic national DNA register as an important and valuable contribution to fighting crime more efficiently, which is in agreement with previous research [12, 17, 18, 22]. Furthermore, similar to previous findings from the US [18], the surveyed Serbians favor the inclusion of individuals convicted of felonies, while expressing more restrictive views regarding individuals convicted of misdemeanors, as well as suspects. This illustrates the importance of public debates in shaping adequate national policies, given that the majority of European countries have chosen to also incorporate suspects in their national DNA databases, with only a few exceptions (Belgium, Norway) [9]. However, given that respondents preferred the inclusion of individuals convicted of any crime (not only serious crimes), the severity of offense appears to play a much lesser role in the beliefs of Serbian publics, compared to participants from New Zealand [17] and the US [18]. These findings are in agreement with a previous study on alternative sanctions and restorative justice measures, in which one third of the surveyed Serbian respondents preferred prison sentences as the sanction for various punishable behaviors [25].

Additionally, as seen in South Wales and New Zealand [15, 17], approximately a third of assessed population of Serbia appears to support the inclusion of the entire population in the DNA bank. Given that all Serbian people are accustomed to providing biometric data for mandatory identity cards (see below), this attitude could be a consequence of peoples' obedience regarding any request that state may make for the collection of personal data for identification purposes [26]. Supporters of profiling the entire Serbian population, tend to also support indefinite retention of biological profiles and samples, familial searches, and cooperation with the Interpol and tend not to be concerned about invasion of privacy and potential misuse of the database (Table S1), consistently demonstrating a more permissive attitude. On the contrary, in one Spanish study, 57.4% of examinees disagreed with, while 42.6% agreed with the nonconsensual sampling of all citizens [19]; in another study conducted in the US, the option of including all newborns in the database was the least favored (45%), with 28% of the respondents strongly opposed to the idea [18]. An additional discrepancy between these and results of others [10, 12] is reflected in the finding that approximately one half of the Serbian respondents would entrust custody of the database to the Ministry of Interior, including police and security agencies.

The observed dissimilarities in attitudes regarding custody and inclusion criteria could stem from different levels of exposure to the subject matter in specific countries, as well as from different levels of awareness and knowledge about the effectiveness and intrusiveness of DNA databases. Indeed, the first public hearing on this topic, which included officials and experts, began in November 2016, only one television discussion addressed biometric data in general and, unlike GMOs and vaccines, forensic genetics is not a popular debate topic on forums and social networks in Serbia. Given that the only exposure to the topic is through CSI fiction, as well as occasional newspaper articles, the overall more permissive views of the surveyed Serbian population may be a consequence

of a CSI effect, although this would have to be tested directly, in future research. Additionally, considering the fact that Serbia is a developing country [27] with purchasing power four times lower than the European average [28], it is not surprising that the average Serbian person might not place much value on contemplating forensic genetics. Supporting this argument is the fact that in 2008 the Serbian Government implemented mandatory biometric identity cards, without prior public discussion or real opposition. In fact, one report revealed that the implementation of biometric identity cards failed in many developed countries, but was accepted in the poorest countries in the world [29]. On the other hand, it cannot be ruled out that more permissive views may result from the widespread belief that innocent people have nothing to fear and that surrendering DNA in return for personal and collective security is a worthy cause [21, 26].

When asked to specify their concerns regarding the DNA databank, 63.4% of respondents specified potential misuses, mostly citing corruption and invasion of privacy. The most prevalent answers included lack of procedures for preventing fraudulent use of DNA samples and data, noncompliance with the law, planting evidence at crime scenes, unauthorized database access, sharing information with third parties, using data for other purposes (e.g. leading to medical discrimination), DNA database safety, accuracy of the methodology, human error, and economic concerns. Although these fears are shared among geographies and nationalities, as proposed by Machado and Silva (2014) [21], they may be enhanced by public's distrust of Serbian government institutions. In fact, almost one third of respondents in the current study would prefer entrusting the national DNA database to an independent institution (Table 1). Additionally, a 2014 survey of 1,572 men and women reported that 52% of examinees did not have confidence in the Serbian judiciary system, and 32% in the law enforcement and security agencies [30]. This is contradictory to the overall favorable views discussed above, but as Curtis (2014) noted, initial positive opinions on forensic DNA use can turn out contradictory when investigated in greater detail [17], illustrating the need for further in-depth examination. However, it is important to note that the obtained results are not random and there is a dependence between different questions – respondents who believe in the benefits of forensic DNA database consistently provided more permissive responses, while the ones who oppose consistently gave restrictive answers regarding virtually all tested aspects of forensic DNA databasing (Table S2).

In an attempt to identify the factors which influence the observed attitudes we examined the socio-demographic data that had previously been indicated [10, 12, 13, 17, 22]. The finding that the older the participants, the more optimistic their opinion of the importance of a forensic DNA repository appears to contradict the results of a study conducted in Portugal [22], although the Portuguese sample had a skewed age distribution. Also, in the current dataset, the education level appeared to shape opinions on virtually all tested aspects of forensic DNA database use. More educated respondents disfavored the Ministry of Interior as the database custodian, mirroring attitudes previously reported for a nationally representative sample of the population of Spain [12]. The finding that confidence in the potential of forensic DNA register increased with the education level contradicts results from a recent study conducted in Portugal [22]. However, one should bear in mind that the prisoner population in the current sample features an

extremely low level of education, and the prosecutor category – a higher education level. This leads to the influence of profession on opinions regarding the forensic DNA database, also addressed in previous studies [12, 13, 22].

Prosecutors and deputy prosecutors placed considerably more significance in the DNA database as a means of fighting crime and supported much more permissive inclusion and retention criteria, compared to the other two groups. Although test of association could not be performed for students and the other categories (given the police officer student sample size), it is evident that their views on the custody of DNA database, its potential as a crime-fighting means, inclusion criteria, privacy invasion and potential misuses closely mirror those recorded for prosecutors and deputy prosecutors (Tables 1 and 5). This resembles the earlier recorded attitudes of health and life science professionals [22] and public bodies (activist groups, professional associations, advisory bodies, and rights groups), which are expected to professionally engage with forensic genetics [24]. Thus, while some form of professional link to genetics tends to result in optimistic views about the benefits of a forensic DNA register in the criminal justice system, it is important to note that underlying reasons shaping such opinions may be quite different in diverse publics. The expert public might favor national DNA databases due to their comprehension of the topic (informed views) and also due to their general belief in the benefits of science and technology [22]. On the other hand, the prosecutors, deputy prosecutors and future law enforcement officers who participated in this survey possess a higher level of education, but receive virtually no education in science and technology (including DNA). Since these categories of respondents lack technical knowledge, they are more likely to be guided by the convenience and assistance that DNA-based identification provides in their daily work. We propose that the detected perceptions may be the result of a more pronounced CSI-effect in this subpopulation, however, as stated earlier, further research is needed to elucidate this hypothesis. The results obtained in this study support the notion that the influence of profession should be further explored [22], and especially taking into account attitudes of heterogeneous stakeholders [24].

Prisoners generally favored a more restrictive set of criteria, such as inclusion of persons convicted of serious crimes only, and expulsion of DNA profiles at acquittal, perhaps due to the fact that their DNA sample and profile are retained by the state. Interestingly, the majority of interviewed prisoners (56.4%) also think that DNA profiles should be retained indefinitely in the database, which was previously documented among prisoners in Portugal [20] and Austria [33]. This might be due to the fact that DNA profile retention would allow profiled individuals to prove their innocence, instead of being treated as the “usual suspects” by the police simply by the virtue of being ex-convicts, as has been argued previously [20]. Additionally, 44.2% of prisoners believe that the entire Serbian population should be profiled. This view is the most favored answer among prisoners and it is more prevalent than in the general public and among prosecutors. Portuguese prisoners also supported a universal database, pointing out that it would serve not only for conviction, but also in cases of exonerations, abductions, disappearances, etc. [20]. Furthermore, a study conducted in Serbia reported that one third of the participants supported retributive justice for various punishable behaviors [25], suggesting the public’s need to condemn offenders. Thus, DNA profiling of all citizens appears to represent inmates’ departure from the “usual suspect” stigma and has been noted globally.

Cases such as Dobbiaco in Italy [34] and Kappen in the UK [13] exemplified how database searching geared to identify relatives of unknown offenders can lead to great successes in the identification of serious felons, such as rapists and murderers, thus the current study also addressed the concept of familial searches in police investigations in instances when the crime scene DNA profile yields no database matches. Familial searching is currently not performed in Serbia, yet overall 49.1% of respondents in the current dataset endorse it, with this response being the top answer in all categories, including prisoners (Table 4). Such support is interesting, given that several investigative and ethical concerns might be raised on this topic, including large volume of putative relatives without matching intelligence information, police interviews with individuals purely due to their genetic relatedness to a databased individual, with the underlying assumption that relatedness may imply criminality, privacy intrusion through the revelation of previously unknown genetic links or the lack of previously presumed genetic relationships, etc. [13]. Given the lack of a national database or previous public debates in Serbia, as well as the complexity of the specific topic, we argue that the obtained results largely reflect a lack of awareness and knowledge regarding the benefits and costs of familial searching. In fact, recent studies addressing the understanding of various aspects of national DNA databases suggest that knowledge of the subject matter is very limited [17, 26].

Conclusion

To our knowledge, this represents the first study of its kind not only in Serbia, but in all of Eastern Europe. It also represents the first reserach from a developing country. The goal of this work was to acquire baseline information on Serbian attitudes regarding a broad set of questions pertaining forensic DNA databasing. The obtained data suggests that the professional beneficiaries of forensic DNA technologies are distinguished by more permissive views, in contrast to a more restrictive attitude of prisoners, whose genetic material has been sampled by the government. Apart from underlying factors that may be applicable globally (such as socio-demographic parameters and the CSI effect), this work also discussed specific factors that may play a role in shaping Serbian public opinion, such as lack of exposure, economic predicament, and distrust in public institutions, which may be a result of the development level and other national and cultural idiosyncrasies.

As the first public opinion assessment, this study cannot be comprehensive and further research needs to include a more generalized random sample, as well as to address issues such as population awareness and knowledge of forensic DNA databasing, sources of information, opinions on DNA repositories in the context of juvenile delinquency, ownership of DNA profile between government and the individual, consequences of refusing to provide a DNA sample, and others. More detailed research will also help elucidate often ambiguous public attitudes. Additionally, while the draft version of the Serbian law on national DNA register follows legislation of most European countries, in that it is restricted to the analysis of noncoding DNA regions, emerging technologies, such as Next Generation Sequencing (NGS), will bring in a new set of challenges to an already complex issue. These include decisions regarding the number and choice of loci to be sequenced, as well as parameters for their analysis, phenotypic information, choice of cases for which this approach would be used, rules on data sharing, etc. [35, 36]. Therefore, as the new technologies promptly advance,

it is essential that the same occurs with in-depth explorations of public knowledge, interpretations, misconceptions and beliefs regarding the advantages and disadvantages of technology. These will aid not only in providing collective opinions on forensic genetics, but also in developing strategies for raising awareness and education levels, and building operational and legal models that would utilize up-to-date technologies to fight crime, on the one hand, and conform to the fundamental privacy and human rights on the other.

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Tables

Table 1. Opinions regarding general aspects of a national DNA database

DATABASE EFFECTIVENESS	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Significant	85	52.5	151	89.3	91	58.3	12	60	36	70.6	375	67.2
Minor	57	35.2	17	10.1	38	24.4	8	40	15	29.4	135	24.2
None	9	5.6	1	0.6	9	5.8	0	0	0	0	19	3.4
Indifferent	3	1.9	0	0	4	2.6	0	0	0	0	7	1.3
Do not know	8	4.9	0	0	14	9	0	0	0	0	22	3.9
	162	100	169	100	156	100	20	100	51	100	558	100

DATABASE CUSTODY	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Ministry of Interior	75	46.3	87	51.5	65	41.7	11	55	37	72.5	275	49.3
Ministry of Health	17	10.5	7	4.1	29	18.6	2	10	2	3.9	57	10.2
Legal Medicine (University)	13	8	9	5.3	9	5.8	0	0	1	2	32	5.7
Autonomous Institution	47	29	60	35.5	33	21.2	7	35	9	17.6	156	28
Other	10	6.2	5	3	18	11.5	0	0	2	3.9	35	6.3
No answer	0	0	1	0.6	2	1.3	0	0	0	0	3	0.5
	162	100	169	100	156	100	20	100	51	100	558	100

INCLUSION CRITERIA	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Convicts	30	18.5	29	17.2	15	9.6	5	25	11	21.6	90	16.1
Convicts and suspects	36	18.5	57	33.7	24	15.4	3	15	15	29.4	135	24.2
Convicts, suspects and volunteers	28	17.3	39	23.1	16	10.3	0	0	15	29.4	98	17.6
Entire RS population	62	38.3	43	25.4	69	44.2	12	60	9	17.6	195	34.9
No one	4	2.5	0	0	22	14.1	0	0	0	0	26	4.7
Other	2	1.2	1	0.6	10	6.4	0	0	1	2	14	2.5
	162	100	169	100	156	100	20	100	51	100	558	100

INCLUSION OF PROFILES FROM CRIME SCENES	General public		Prosecutor's office		Prisoners		Prison guards		Students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Yes	122	75.3	159	94.1	115	73.7	13	65	43	84.3	452	81
No	18	11.1	6	3.6	27	17.3	2	10	4	7.8	57	10.2
Indifferent	10	6.2	2	1.2	1	0.6	1	5	2	3.9	16	2.9
Do not know	12	7.4	2	1.2	13	8.3	4	20	2	3.9	33	5.9
	162	100	169	100	156	100	20	100	51	100	558	100

Table 2. Opinions concerning criteria for convicted individuals

OFFENCE TYPE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Serious crimes only	39	24.1	34	20.1	65	41.7	7	35	18	35.3	163	29.1
All crimes	82	50.6	91	53.6	35	22.4	5	25	22	43.1	235	41.9
All crimes and offences	38	23.5	41	24.3	44	28.2	8	40	11	21.6	142	25.3
Other	1	0.6	3	1.8	12	7.7	1	5	0	0	17	3
No answer	3	1.9	0	0	1	0.6	0	0	0	0	4	0.7
	163	100	169	100	157	100	21	100	51	100	561	100

PRISON SENTENCE DURATION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Any	143	88.3	164	97	104	66.7	19	95	40	78.4	470	84.2
Fixed	16	9.9	2	1.2	41	26.3	0	0	11	21.6	70	12.5
Other	0	0	0	0	1	0.6	0	0	0	0	1	0.2
No answer	3	1.9	3	1.8	10	6.4	1	5	0	0	17	3

	162	100	169	100	156	100	20	100	51	100	558	100

DNA PROFILE RETENTION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Indefinite	63	38.9	104	61.5	88	56.4	12	60	21	41.2	288	51.6
Until convict's death	86	53.1	56	33.1	28	17.9	8	40	29	56.9	207	37.1
Until the end of the prison sentence	7	4.3	2	1.2	29	18.6	0	0	0	0	38	6.8
Other	3	1.9	6	3.6	10	6.4	0	0	1	2	20	3.6
No answer	2	1.2	1	0.6	0	0	0	0	0	0	3	0.5
	161	100	169	100	155	100	20	100	51	100	556	100

Table 3. Opinions concerning criteria for suspected individuals

OFFENCE TYPE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Serious crimes only	49	30.2	37	21.9	70	44.9	6	30	24	47.1	186	33.3
All crimes	71	43.8	85	50.3	27	17.3	5	25	18	35.3	206	36.9
All crimes and offences	38	23.5	39	23.1	49	31.4	8	40	9	17.6	143	25.6
Other	0	0	3	1.8	9	5.8	1	5	0	0	13	2.3
No answer	4	2.5	5	3	1	0.6	0	0	0	0	10	1.8
	162	100	169	100	156	100	20	100	51	100	558	100

DNA PROFILE RETENTION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Indefinite	89	54.9	103	60.9	95	60.9	14	70	26	51	327	58.8
Until acquital	60	37	46	27.2	55	35.3	6	30	22	43.1	189	33.9
Other	7	4.3	13	7.7	6	3.8	0	0	3	5.9	29	5.2
No answer	6	3.7	7	4.1	0	0	0	0	0	0	13	2.3
	162	100	169	100	156	100	20	100	51	100	558	100

Table 4. Opinions concerning aspects of the DNA database pertinent to genetic surveillance

FAMILIAL SEARCHES	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agree	83	51.2	89	52.7	67	42.9	10	50	25	49	274	49.1
Disagree	36	22.2	30	17.8	52	33.3	4	20	14	27.5	136	24.4
Agree under certain circumstances	15	9.3	35	20.7	4	2.6	3	15	5	9.8	62	11.1
Do not know	28	17.3	12	7.1	32	20.5	3	15	7	13.7	82	14.7
No answer	0	0	3	1.8	1	0.6	0	0	0	0	4	0.7
	162	100	169	100	156	100	20	100	51	100	558	100

COOPERATION WITH THE INTERPOL	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agree	103	63.6	116	68.6	85	54.5	12	60	25	49	341	61.1
Disagree	29	17.9	10	5.9	34	21.8	4	20	11	21.6	88	15.8
Agree under certain circumstances	15	9.3	30	17.8	7	4.5	3	15	7	13.7	62	11.1
Do not know	15	9.3	13	7.7	29	18.6	1	5	8	15.7	66	11.8
No answer	0	0	0	0	1	0.6	0	0	0	0	1	0.2
	162	100	169	100	156	100	20	100	51	100	558	100

Table 5. Opinions regarding violation of privacy

PRIVACY INVASION	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Significant concerns	22	13.6	1	0.6	42	26.9	2	10	7	13.7	74	13.3
Minor concerns	51	31.5	73	43.2	31	19.9	6	30	27	52.9	188	33.7
No concerns	69	42.6	87	51.5	58	37.2	8	40	13	25.5	235	42.1
Indifferent	5	3.1	4	2.4	1	0.6	1	5	1	2	12	2.2
Other	5	3.1	2	1.2	1	0.6	1	5	1	2	10	1.8
Do not know	8	4.9	2	1.2	23	14.7	2	10	1	2	36	6.5
No answer	2	1.2	0	0	0	0	0	0	1	2	3	0.5
	162	100	169	100	156	100	20	100	51	100	558	100

MISUSE	General public		Prosecutor's office		Prisoners		Prison guards		Police students		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Significant concerns	42	25.9	13	7.7	49	31.4	3	15	10	19.6	117	21
Minor concerns	58	35.8	65	38.5	40	25.6	10	50	24	47.1	197	35.3
No concerns	47	29	76	45	38	24.4	5	25	13	25.5	179	32.1
Indifferent	8	4.9	3	1.8	2	1.3	0	0	2	3.9	15	2.7
Other	0	0	3	1.8	0	0	1	5	0	0	4	0.7
Do not know	6	3.7	6	3.6	27	17.3	1	5	2	3.9	42	7.5
No answer	1	0.6	3	1.8	0	0	0	0	0	0	4	0.7
	162	100	169	100	156	100	20	100	51	100	558	100