

**Socio-demographic characteristics, sexual and test-seeking behaviours amongst men who have sex with both men and women: results from a bio-behavioural survey in 13 European cities**

**Address correspondence to:**

Massimo Mirandola

Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy

P.le L.A Scuro, 10 - 37134 Verona (VR) - Italy

E-mail: [massimo.mirandola@gmail.com](mailto:massimo.mirandola@gmail.com)

Phone: +39 045 8121062

Fax: +39 045 8128245

**Financial support**

This manuscript is based on data from the Sialon II project, co-funded under the Second Programme of Community Action in the field of Health (2008-2013) (Work Plan 2010). The sole responsibility lies with the authors of this manuscript and the Commission is not responsible for any use that may be made of the information contained therein.

**Authors and affiliations:**

Massimo Mirandola [1,2], Lorenzo Gios [1], Nigel Sherriff [3], John Pachankis [4], Igor Toskin [5], Laia Ferrer [6], Sónia Dias [7], Inga Velicko [8], Danica Staneková [9], Saulius Caplinskas [10], Emilia Naseva [11], Marta Niedźwiedzka-Stadnik [12] and the Sialon II Network

[1] CReMPE - Regional Coordination Centre for European Project Management

Veneto Region - Department of Health, the Verona University Hospital, Verona, Italy

[2] Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy

[3] Centre for Health Research, University of Brighton, Brighton, UK

[4] Department of Chronic Disease Epidemiology, Social and Behavioral Sciences Division, Yale School of Public Health, Yale University, New Haven, USA

[5] Department of Reproductive Health & Research, World Health Organization, Geneva, Switzerland

[6] Centre Estudis Epidemiològics sobre les Infeccions de Transmissió Sexual i Sida de Catalunya (CEEISCAT), Dept Salut, Generalitat de Catalunya / CIBER Epidemiologia y Salud Pública (CIBERESP), Barcelona, Spain

[7] Global Health and Tropical Medicine, GHTM, Instituto de Higiene e Medicina Tropical, IHMT, Universidade Nova de Lisboa, Lisbon, Portugal

[8] Department of Monitoring and Evaluation, Public Health Agency of Sweden, Solna, Sweden

[9] NRC for HIV/AIDS, Slovak Medical University, Bratislava, Slovak Republic

[10] Centre for Communicable Diseases and AIDS, Mykolas Romeris University,  
Vilnius, Lithuania

[11] Medical University of Sofia, Faculty of Public Health, Sofia, Bulgaria

[12] Department of Epidemiology, National Institute of Public Health-National  
Institute of Hygiene, Warsaw, Poland

## **AUTHORS' CONTRIBUTIONS**

MMI, LGI, NSH, ITO, LFE, SDI, IVE, DST, SCA, ENA participated in the design of the survey questionnaire and the organisation and implementation of the survey in the survey cities.

This analysis was conceived by MMI and LGI. Data were analysed by MMI and LGI.

The first manuscript draft was jointly written by MMI and LGI.

All authors (MMI, LGI, NSH, JPA, ITO, LFE, SDI, IVE, DST, SCA, MNI, ENA) contributed writing to the following drafts.

All authors read and approved the final manuscript.

## **COMPLIANCE WITH ETHICAL STANDARDS**

**Funding:** this manuscript is based on data from the Sialon II project, co-funded under the Second Programme of Community Action in the field of Health (2008-2013) (Work Plan 2010) (Grant Agreement Number: 2010 12 11). The sole responsibility lies with the authors of this manuscript and the Commission is not responsible for any use that may be made of the information contained therein.

**Conflicts of interest:** the authors declare that they have no competing interests.

**Ethical approval:** all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Prior to data collection, research protocols were submitted to, and approved by, an appropriate institutional ethical review board in each participating city, as well as by the WHO Research Project Review Panel (RP2) and the WHO Research Ethics Review Committee (ERC) during 2012-13.

**Informed consent:** according to the study protocol procedures, informed consent was obtained from all individual participants included in the study.

## **ACKNOWLEDGEMENTS**

### **Financial Support**

This manuscript is based on data from the Sialon II project, co-funded under the Second Programme of Community Action in the field of Health (2008-2013) (Work Plan 2010). The sole responsibility lies with the authors of this manuscript and the Commission is not responsible for any use that may be made of the information contained therein

### **The Sialon II Network (extended list)**

Massimo Mirandola, Lorenzo Gios, Stefano Benvenuti, Ruth Joanna Davis, Massimo Lunardi, Silvana Menichelli, Michele Breveglieri, Martina Furegato (Coordinamento Regionale per il Management e la Progettazione Europea, Azienda Ospedaliera Universitaria Integrata, Verona, Italy); Wim Vanden Berghe, Peter de Groot, Christiana Nöstlinger, Veronica van Wijk, Katrien Fransen, Tine Vermoesen, Michiel Vanackere (Institute of Tropical Medicine, Antwerp, Belgium); Fourat Benchikha, Sandra Van den Eynde, Boris Cruyssaert, Mark Sergeant, Karel Blondeel, Pieter Damen (Sensoa, Antwerp, Belgium); François Massoz, Erwin Carlier (Rainbowhouse Brussels, Belgium); Michael François, Stephen Karon (Ex Aequo, Belgium); Safia Soltani, Thierry Martin (Belgium); Alan De Bruyne (The Belgian Pride, Belgium); Françoise Bocken (Alias, Belgium); Myriam Dieleman (Observatoire du sida et des sexualités, Belgium); Ivailo Alexiev, Reneta Dimitrova, Anna Gancheva, Dobromira Bogeva, Maria Nikolova, Mariya Muhtarova, Todor Kantarjiev (National Center of Infectious and Parasitic Diseases, Sofia, Bulgaria); Viara Georgieva (National Center of Infectious and Parasitic Diseases, Sofia, Bulgaria); Ministry of Health, Sofia,

Bulgaria); Emilia Naseva, Petar Tsintsarski, Hristo Taskov, Tonka Varleva (Program “Prevention and Control of HIV/AIDS”, Ministry of Health, Sofia, Bulgaria); Elena Birindjieva, Aneliya Angelova, Manol Antonov (Association “Health without borders”, Bulgaria); Ulrich Marcus, Susanne Barbara Schink, Sandra Dudareva-Vizule, Matthias an der Heiden, Sami Marzougui, Viviane Bremer, Andrea Kühne, Kerstin Schönerstedt-Zastrau, Ruth Zimmermann (Robert Koch Institute, Berlin, Germany); Andreas Wille (Institut für Hygiene und Umwelt, Hamburg, Germany); Kai Eckstein, Norman Buch, Philipp Moskophidis, Marc Grenz, Danilo Schmogro (Hein & Fiete, Hamburg, Germany); Giuseppe Cornaglia, Antonella Zorzi, Elisabetta Tonolli, Giuliana Lo Cascio, Teresa Todeschini, Manuela Recchia, Lorella Pattini, Maria Rocca, Alessandra Bighignoli, Anita Galardi, Loredana Martini, Sandro Caffi, Pier Paolo Benetollo, Francesco Cobello, Chiara Bovom, Umberta Benvenuti (Azienda Ospedaliera Universitaria Integrata, Verona, Italy); Giulia Bisoffi, Oscar Bortolami, Laura Crestani (Unità Supporto alla Ricerca e Biostatistica, Azienda Ospedaliera Universitaria Integrata, Verona, Italy); Fabiano Comperini (Italy); Ercole Concia, Emanuela Lattuada, Massimiliano Lanzafame, Stefania Leonardi, Paola Del Bravo (Infectious Diseases Section, Department of Pathology, Verona University Hospital, Veneto Region, Verona, Italy); Maddalena Cordioli, Fabio Rigo, Emanuele Guardalben, Ivan Marchesoni (Università degli studi di Verona, Verona, Italy); Barbara Suligoj, Vincenza Regine, Lucia Pugliese (Centro Operativo AIDS, Istituto Superiore di Sanità, Rome, Italy); Saulius Caplinskas, Irma Caplinskiene, Rima Krupenkaite (Centre for Communicable Diseases and AIDS, Vilnius, Lithuania); Gediminas Sargelis, Arturas Rudomanskis (“Tolerant Youth Association”, Vilnius, Lithuania); Sónia Dias, Ana Gama, Oriana Brás (Global Health and Tropical Medicine, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa,

Portugal); João Piedade (Medical Microbiology Unit, Instituto de Higiene e Medicina Tropical, Lisbon, Portugal); Ricardo Fuertes, Nuno Pinto, João Brito, Júlio Esteves, Jesus Rojas, Fernando Ferreira, Miguel Rocha, Hugo Machado, Maria José Campos (CheckpointLX, Portugal); Luís Mendão (Grupo Português de Ativistas sobre Tratamentos de VIH/SIDA – Pedro Santos, Portugal); Magdalena Rosińska, Bożena Kucharczyk, Marta Niedźwiedzka-Stadnik, Łukasz Henszel, Andrzej Zieliński, Michał Czerwiński (National Institute of Public Health – National Institute of Hygiene, NIPH-NIH, Warsaw, Poland); Michał Pawłęga, Ewelina Burdon, Małgorzata Gajdemska, Agnieszka Guściora, Nikodem Klasik, Katarzyna Rżanek, Michał Sawicki, Michał Tęcza (Lambda Warszawa, Warsaw, Poland); Mateusz Dębski, Anna Maciejewska, Izabela Pazdan (SKA Warsaw, Poland); Alexandru Răfila, Daniela Pitigoi, Adrian Abagiu (National Institute for Infectious Diseases Prof. Dr. Matei Bals, Bucharest, Romania); Carolina Marin, Ioana Panzariu, Alexandru Miroiu (ACCEPT Association, Bucharest, Romania); Madalina Popa, Monica Likker (National Institute for Infectious Diseases Prof. Dr. Matei Bals, Bucharest, Romania); Maria Georgescu, Galina Musat, Dan Cojocar, Mihai Lixandru, Raluca Teodorescu (Romanian Anti-AIDS Association – ARAS, Bucharest, Romania); Danica Staneková, Monika Hábková, Tatiana Drobková, Zuzana Chabadová, Soňa Wimmerová, Maria Mojzesová (Slovak Medical University, NRC for HIV/AIDS Prevention, Bratislava, Slovakia); Filip Kunč, Michal Skurák, Peter Bodnar, Katarína Horniaková, Mária Krahulcová, Jarmila Präsensová (Slovakia); Martin Smoleň, Peter Záhradník, Pavol Tibaj (NGO Dúhové srdce, Bratislava, Slovakia); Irena Klavs, Tanja Kustec, Claudia Adamič (National Institute of Public Health, Ljubljana, Slovenia); Mario Poljak, Robert Krošelj, Jana Mlakar (Institute of Microbiology and Immunology, Medical Faculty, University of



Ljubljana, Ljubljana, Slovenia); Miran Šolinc (Association SKUC, Ljubljana, Slovenia); Cinta Folch, Laia Ferrer, Alexandra Montoliu, Jordi Casabona, Anna Esteve, Montserrat Galdon (Centre for Epidemiological Studies on HIV/STI in Catalonia CEEISCAT, Dept Salut, Generalitat de Catalunya, Barcelona, Spain); Victoria Gonzalez (Microbiology Service, Hospital Universitari Germans Trias i Pujol, Barcelona, Spain); Rafael Muñoz (StopSida, Barcelona, Spain); Maria Axelsson, Torsten Berglund, Sharon Kuhlmann-Berenzon, Achilleas Tsoumanis, Inga Velicko, Christer Janson, Bartek Lindh, Kajsa Aperia (Public Health Agency of Sweden, Stockholm, Sweden); Buddha Babulanam, Hans Carlberg, Malte Davidsson, Nedo Entenza Gutierrez, Viktor Hildingsson, Henrik Klasson, Moises Peña Ramos, Cristian Quintero Rojas, Sven-Olof Sandberg, Andreas Samuelson, Eric Sjöberg, Tommy Sjölund, Simon Svensson, Iván Valencia (Sweden); Filip Garcia, Olov Lindblad (RFSL Stockholm, Sweden); Jon Voss (Stockholm Gay Life, Sweden); Ronnie Ask, Anders Blaxhult, Maarit Maliniemi (Venhälsan, Stockholm South General Hospital, Stockholm, Sweden); Monica Idestrom, Nils Blom (Public Health Agency of Sweden, Stockholm, Sweden); Nigel Sherriff, Christina Panton, Glynis Flood (Centre for Health Research, University of Brighton, Brighton, UK); Katrien Fransen, Tine Vermoesen (Aids Reference Laboratory, Institute of Tropical Medicine, Antwerp, Belgium); Ross Boseley, Marc Tweed (Terrence Higgins Trust, South, UK); Jonathon Roberts (Claude Nicol Centre, Royal Sussex County Hospital, Brighton, UK); Cinthia Menel Lemos (Executive Agency for Health and Consumers); Paolo Guglielmetti, Wolfgang Philipp, Matthias Schuppe (DG SANTE); Andrew Amato, Irina Dinca, Karin Haar, Anastasia Pharris, Teymur Noori (European Centre for Disease Prevention and Control ECDC); Igor Toskin, Armando Seuc, Natalie Maurer (Department of Reproductive Health & Research of the World Health Organization,

WHO); Lev Zohrabyan, Alexandrina Iovita, Maddalena Campioni, Patrick Noack  
(Joint United Nations Programme on HIV/AIDS UNAIDS); Rosanna Peeling  
(London School of Hygiene and Tropical Medicine); Lisa Johnston (USA).

**Socio-demographic characteristics, sexual and test-seeking behaviours amongst men who have sex with both men and women: results from a bio-behavioural survey in 13 European cities**

## **ABSTRACT**

Within the MSM population, Men who have Sex with both Men and Women (MSMW) are identified as a high-risk group both worldwide and in Europe.

Objectives: In a multi-centred bio-behavioural cross-sectional study, we aimed to assess the relationship(s) between socio-demographic factors, stigma, sexual behavioural patterns, test seeking behaviour and sero-status amongst MSMW. A multi-level analysis was conducted to identify factors associated with being MSMW versus Men who have Sex with Men Only (MSMO). A total of 4,901 MSM were enrolled across the 13 study sites. Participants were categorised as MSMW in the 12.64% of the cases. Factors such as educational status, perceived homonegativity, testing facilities knowledge and HIV testing lifetime seem to be relevant factors when characterising the MSMW group. The results highlight the vulnerability of MSMW and the wide spectrum of risky behavioural and psycho-social patterns, particularly in terms of HIV testing, 'outness', and perceived stigma.

## **RESUMEN**

Los Hombres que tienen Sexo con Hombres y Mujeres (HSHM) son un grupo de población de alto riesgo dentro de los HSH. Evaluar la relación entre factores socio-demográficos, estigma, patrones de conducta sexual y de búsqueda de la prueba y el estado serológico de los HSHM. Estudio bio-conductual multicéntrico transversal. Análisis multinivel para identificar factores asociados con ser HSHM respecto a los Hombres que Sólo tienen Sexo con Hombres. Se reclutaron 4.901 HSH en 13 ciudades, siendo un 12,64% HSHM. El nivel educativo, la homonegatividad percibida, el conocimiento de los lugares de realización de la prueba y la prueba del VIH alguna vez son factores relevantes para caracterizar los HSHM. Los resultados subrayan la vulnerabilidad de los HSHM y la diversidad de conductas y patrones psicosociales de riesgo, particularmente en términos de la prueba del VIH, visibilidad de la identidad sexual y estigma percibido.

**Keywords:** MSMW, risk behaviours, HIV, Time-Location Sampling, Respondent-Driven Sampling

## **BACKGROUND**

Despite concerted public health efforts, the HIV epidemic is still expanding in many countries especially amongst MSM communities (1). Although there are many factors both individual and structural that are likely to impact on this dynamic, one of the most relevant facilitating factors is the high number of UAI partners amongst the MSM population (2) (3).

Within the MSM population, bisexual males or Men who have Sex with both Men and Women (MSMW, also referred to as behaviourally bisexual men) are identified as a high-risk group both worldwide and in Europe (4) (5) (6). This is because MSMW represent a sub-group with both behavioural and psycho-social vulnerabilities (7) (8) compared to Men who have Sex with Men Only (MSMO).

Psychosocial factors can play a crucial role in determining MSMW vulnerability, particularly in terms of risk behaviour, and for these reasons this sub-population can be identified as a priority population for targeted HIV and STI prevention interventions (9) (10).

In addition, and from a purely epidemiological perspective, arguably MSMW may also represent a critical priority group because of their potential “bridging role” for STIs and HIV; a view that has been expressed previously in a number of studies (11) (12) (13). A better understanding of the behavioural patterns of this population may therefore represent a key factor for reducing the potential transmission of HIV and other STIs within the target population and also to women, who are less likely to acquire STIs compared to MSMO (5).

In terms of behavioural risk patterns, some studies suggest that there is a lower prevalence of HIV infection amongst MSMW compared to those reporting only sex with men, on the basis that MSMW seem to be more likely to use a condom with male partners and less likely to engage in receptive anal sex compared to MSMO (14) (15) (16) (17). On the contrary however, other more recent studies have found that MSMW are more likely to be infected with HIV compared with both heterosexual men and MSMO (7). Furthermore, it has been reported that MSMW who are in a relationship with a female partner are more likely to have unprotected sex with male and female partners and consequently, are also more likely to acquire STIs (7) (18).

Due to such behavioural risk patterns, HIV testing practices represent a crucial factor for MSMW. Indeed, current evidence shows that MSMW are less likely to seek HIV testing compared to MSMO (19) (20). Further research is therefore needed to understand better and assess not only the patterns of attitudes concerning health seeking behaviours such as HIV testing, but also the entire risk-behaviour spectrum amongst this specific population.

Disclosure of sexual orientation may represent another potential risk factor for HIV-related behaviours with particular relevance to bisexual men, even compared to gay men (22). Non-disclosure of sexual orientation amongst MSMW has been attributed to high levels of perceived stigma, as well as certain legal, cultural, and social norms (22). Such barriers to disclosure have been argued to drive MSMW underground and place them out of reach of HIV-preventative services, knowledges, and behaviours, thereby increasing their risk for HIV infection (23) (24).



Despite a number of studies in the literature focusing on MSMW, this group nevertheless continues to represent a hard-to-reach and relatively unknown sub-population within the MSM community for two main reasons. First, the different categorisations of MSMW that have been proposed and adopted in previous studies, mean that it is difficult to gain reliable and valid surveillance data for this population. Second, the different sampling approaches that have been adopted to then enrol these MSMW (categorised in diverse ways) to epidemiological surveys means that data are not necessarily always comparable.

In terms of MSMW categorisation, public health research on HIV/STI and sexual health amongst bisexual men has relied traditionally on behavioural and identity-related definitions to assess this population. Yet, defining bisexuality purely on the basis of self-identity can lead to a misclassification if the actual behaviour is not considered (9). Furthermore, a definition of bisexuality based purely on actual behaviour can lead to an underestimation of those who self-identify as bisexual but who have not had sex with a male/female partner over the period of time investigated by a survey methodology. Therefore in some studies, a combination of the two definitions or categorisations (behavioural-based or identity-based) has been used (25).

Linked to MSMW categorisation, in terms of sampling approaches and subsequent recruitment, behaviourally bisexual men represent a difficult target population to reach because they might not necessarily identify as being members of the gay or

bisexual community and therefore may arguably be less likely to participate in research studies or surveys targeting MSM. Consequently, two sampling methodologies currently defined as the ‘gold-standard’ for conducting bio-behavioural surveys targeting hard-to-reach population such as MSM have been advocated including venue based methods such as Time and Location Sampling, (TLS), and network-based approaches such as Respondent-Driven Sampling (RDS). Indeed, previous studies have demonstrated that TLS and RDS are effective in recruiting diverse samples of MSM (sub)populations (4) (26). The strengths of these sampling methodologies lie in: (i) the possibility of recruiting participants who are present in the study area (whether they identify themselves as members of the gay or bisexual community or not) and; (ii) the possibility to enrol participants whom might not be in contact with health and/or other social care services, therefore providing researchers with a unique snapshot of the current community(ies) of MSM in the given study area relative to other sampling approaches.

## **Sialon II**

The Sialon II project co-funded by the European Commission under the Second Programme of Community Action in the Field of Health (2008-2013), was a multi-centre biological and behavioural cross-sectional survey carried out across 13 European cities including: Brussels (Belgium), Sofia (Bulgaria), Hamburg (Germany), Verona (Italy), Vilnius (Lithuania), Warsaw (Poland), Lisbon (Portugal), Bucharest (Romania), Bratislava (Slovakia), Ljubljana (Slovenia), Barcelona (Spain), Stockholm (Sweden), and Brighton (UK).

The project brought together governmental and non-governmental experiences and perspectives from groups ranging from the European Union, ECDC, the WHO, and UNAIDS to local public health institutions, universities, and gay associations. The project also built on the experiences gained through the previously conducted EU-funded Sialon I study (3). In Sialon II, the adoption of TLS and RDS meant that the project was able to recruit diverse sub-populations of MSM in the study cities including MSMW, but also MSM who inject drugs, MSM sex workers, MSM immigrants, and MSM tourists.

The purpose of this paper is to assess the relation between socio-demographic factors (such as area of residence, educational status), stigma (perceived stigma, level of 'outness'), sexual behavioural patterns (number and type of partners and sexual practice), health care service utilisation and test seeking behaviour, as well as sero-status amongst behaviourally identified MSMW, in order to be able to identify factors associated with being MSMW versus MSMO. The aim is to provide a better understanding of the factors associated with health-relevant behavioural patterns, with particular reference to HIV test-seeking behaviour amongst this specific sub-group. Based on previous research, we hypothesise that MSMW will be less open about their sexual orientation and will perceive higher levels of stigma compared to MSMO (24) (22). We assume that MSMW's sexual behavioural patterns will differ significantly from those of MSMO, including higher levels of non-steady male partners (27), lower levels of testing (19), and poorer knowledge of testing facilities compared to MSMO (19). We also assume that age may play a significant role in characterising MSMW compared to MSMO: the probability of having sex with men and women might

decrease with increasing age, probably due to a potential ‘stabilisation’ of sexual identity or sexual preferences (even if this phenomenon represents a controversial issue within the scientific community) (28).

Due to the unique sample from which the present analysis are based upon, and because of the distinctive characteristics of the Sialon II survey (i.e. TLS and RDS methodologies, common protocols, and testing algorithms), results presented in this paper may offer unique insights for more effective prevention campaigns tailored to MSMW, with the aim of both tackling the HIV epidemic amongst male partners and reducing the potential for transmission to female partners (29) (30) (31).

## **METHODS**

### **Study design**

Sialon II was a multi-centre biological and behavioural cross-sectional survey carried out across 13 European cities. Detailed study procedures as well as bio-behavioural data collection and testing methodologies have been presented elsewhere (26).

### **Study population**

Participants were individuals present in the study cities at the moment of data collection who met the following inclusion criteria: having had any kind of sex with another man during the previous 12 months before the enrolment; agreeing to participate in the study, and; agreeing to donate either an oral fluid or blood specimen.

### **Enrolment**

Time-Location Sampling (TLS) and Respondent Driven Sampling (RDS) were used to recruit study participants. According to the methodology for carrying out surveys using these sampling approaches (32) (33), preliminary formative research was conducted in each survey site prior to data collection taking place. Formative research comprised activities to assess: (i) prevention needs of local MSM populations including an overview of local (e.g. NGO) experiences in prevention activities and behavioural and/or biological data collection in the study sites; (ii) age-groups to be considered in the survey implementation (using data and information from previous studies where possible); (iii) availability of commercial venues and/or cruising

settings in light of TLS survey implementation; (iv) social networks/seeds and appropriateness of incentive strategies in light of RDS survey implementation; (v) existence and levels of HIV testing services; (vi) levels of stigma and general data regarding the MSM population for the given study area (i.e. desk-based research using data and information from previous studies where possible).

The Sialon II survey was implemented using the same methodology (i.e. protocols, laboratory algorithms etc.) in each of the 13 study sites (26). A total of 5,200 participants (target number 400 per city) were planned to be enrolled in the survey.

## **Instruments**

### *Questionnaire*

A self-administered pen-and-paper questionnaire was used to collect behavioural data from respondents. The preliminary version of the questionnaire (designed by the Sialon II network in line with the GARPR indicators (1) and previous EC-funded European projects), was piloted amongst MSM in each study site. The English version of the questionnaire was then translated into the languages of the participating cities and back translated into English.

### *Laboratory testing of biological samples*

In cities where the TLS method was used, HIV antibodies were tested in oral fluid (OF) samples using GENSCREEN HIV 1/2 version 2, BIO-RAD. As a quality control for testing suitability of the samples, a total IgG antibodies ELISA test Human IgG ELISA Kit 1x96, Quantitative / Immunology Consultants Laboratory was used. All HIV-reactive samples were re-tested with Vironostika HIV Ag/Ab, Biomerieux. In cities where the RDS method was used, blood samples were collected and processed in a clinical setting (e.g. hospital, infectious disease department etc.) according to the local contextual procedures, and serum was extracted according to the local laboratory standard procedure(s). Serum samples were tested with a HIV 4<sup>th</sup> generation ELISA/CLIA test. Reactive results were confirmed with a Western Blot test. In line with the protocols, participants with HIV-positive results were provided with post-test counselling and referred subsequently to the local care systems for further management of their HIV status.

### **Ethics**

Prior to data collection, research protocols were submitted to, and approved by, an appropriate institutional ethical review board in each participating city, as well as by the WHO Research Project Review Panel (RP2) and the WHO Research Ethics Review Committee (ERC) during 2012-13. A dedicated bar-code system was adopted in order to link anonymously the different types of data collected from participants (i.e. behavioural data and biological samples) as well as guarantee the anonymity and confidentiality of the respondents' data. For the TLS survey, respondents who wanted

to collect their tests results could do so using their unique bar code ID. For the RDS survey where respondents were tested directly in a hospital/clinical setting, test results were available according to the local standards (including pre and post-test counselling).

## **Variables definition**

### *Dependent variable*

In this study, participants were identified as either behaviourally MSMW or MSMO based on their self-reported sexual behaviours during the last six months with male and/or female partners (steady and/or non-steady). Despite the limitations mentioned previously of a purely behaviourally based definition, this was the only possible way to define it with regards to the core survey questions common to both study arms (TLS-RDS).

### *Independent variables*

Independent variables in this study included: age (based on self-reported year of birth), educational status (secondary school or lower, high school or post-secondary, or university/higher), 'outness' (the extent to which participants reported being open about their sexual attraction towards men with others based on a five point item ranging from 1 "out to no-one" to 5 "out to all or almost all"; further categorised as "some, most or all" vs. "none or few"), origin (migrant/immigrant or visitor vs. native-born in the study country), type of partners (steady/non-steady), sexual practice



(based on the self-reported sexual behaviours in the last six months, no anal intercourse, anal intercourse, unprotected anal intercourse), testing facility knowledge (knowing where to go for HIV testing), HIV testing (lifetime and in the last 12 months), STI testing in the last 12 months, being reached by prevention programmes in the last 12 months (condom distribution), and HIV status based on laboratory testing. Finally, perceived stigma towards gay/bisexual people was assessed using a 5-point likert scale ranging from 1 (very negative) to 5 (very positive) regarding respondents' perceptions of homophobia, through the question "In your experience, what is most people's attitude towards gays or bisexuals in the following contexts?" across three domains: 1) work/school; 2) parents, and; 3) friends/acquaintances (Cronbach's alpha .73). The scale's range varied from a minimum of 3 to a maximum of 15 points (from negative to positive experiences). A reversed scoring system was used for a more intuitive interpretation.

## **Data analysis**

### *Descriptive and bivariate analysis*

For quantitative variables, mean, median, standard deviation, Wilcoxon–Mann–Whitney test and Kruskal–Wallis test by ranks were used. For nominal variables, percentages and Fisher's exact test were used. Bivariate analyses were carried out using a multivariate logistic model with  $p < .05$  as the threshold for variable inclusion.

### *Multi-level Modelling*

In order to account for the hierarchical structure of the data collected by city and the consequent clustering of observations within a city, a multivariable multi-level logistic random-intercept model was estimated (34). The multi-level analysis was conducted to identify factors associated with being MSMW versus MSMO as defined by self-reported behaviours. Predictors associated with the outcome variable with a probability  $<0.05$  were considered significant. STATA Version 14.1 was used for all analyses (College Station, TX: StataCorp LP).

## **RESULTS**

### **Sialon II study sample**

A total of 4,901 MSM were enrolled across the 13 study sites. TLS was used in Brussels, Sofia, Hamburg, Warsaw, Lisbon, Ljubljana, Barcelona, Stockholm, and Brighton, whilst RDS was used in Bratislava, Bucharest, Verona, and Vilnius. Table 1 presents the number of participants enrolled in the study by city, the number of valid questionnaires, and the number of oral fluid samples collected and tested. In countries where TLS was used, 3,596 participants were enrolled, whilst in countries where RDS was used 1,305 were enrolled. A comprehensive description of the study sample is available in the Sialon II bio-behavioural survey technical report (4).

### **Characteristics of the MSMW sample**

Participants were categorised as behaviourally bisexual men (MSMW) in 589 cases (12.64% of the total sample). The mean age for this sub-population was not statistically different from the MSMO sub-sample (Table 2).

In terms of residence area, similar patterns were recorded both for MSMW and MSMO, whilst when considering education MSMW were significantly less likely to hold a university degree or higher (47.44%), compared to MSMO (56.79%) ( $p < 0.05$ ),

In terms of 'outness', that is the extent to which participants are open about their sexual attraction to men with others, there was a substantial difference between the two groups ( $p < .05$ ). MSMW reported being significantly less 'out' (39.46 % for the category "some, most or all") compared to MSMO (75.08 %).

In terms of origin, the number of survey participants who reported having been born in the city in which they were recruited was significantly lower amongst MSMW compared to MSMO ( $p < 0.05$ ).

When considering the type of sexual partners, MSMW reported a relatively higher number of non-steady sexual partners ( $p = 0.05$ ) and occasions in which they had had unprotected anal intercourse in the last six months compared to MSMO ( $p < 0.05$ ).

Knowledge of testing facilities showed a significant variation between those classified as MSMW (87.89%) compared to MSMO (94.74%) ( $p < 0.05$ ). A similar pattern was also apparent for lifetime HIV testing ( $p < 0.05$ ).

In terms of prevention programmes (i.e. being reached by prevention programmes such as free condom distribution in the last 12 months), parallel patterns were recorded for the two groups. MSMW indicated that they were reached by prevention programmes in 58.80% of cases, whilst 63.55% of MSMO reported this ( $p = 0.4$ ).

However, MSMW were less likely than MSMO to report testing for STIs (other than HIV) in the last 12 months ( $p < 0.05$ ). A similar pattern was also observed when considering HIV testing over the last 12 months. 50.97% of MSMW were tested for HIV in the previous 12 months compared to 57.96% of MSMO ( $p < 0.05$ ).

Regarding biologically-measured HIV sero-status, there was no significant difference regarding odds of infection between the two groups ( $p = 0.14$ ): MSMW 8.92% versus MSMO (10.86%). Finally, in terms of respondents' perceived stigma towards gay/bisexual people, MSMW reported a significantly higher perception of stigma than MSMO.

### **Characterising MSMW (multilevel multivariate model)**

Results from the multivariate model are shown in Table 3. Not all predictors initially identified through the bivariate analyses and included in the model were significantly associated with the dependent variable, namely being MSMW. The final estimated model based on a random intercept at city level, resulted as the best possible one. In fact, the inclusion of random slopes for other predictors did not provide any additional improvement of the model.

Area of residence did not play a significant role in differentiating MSMW from MSMO nor did participants' education or origin (being a migrant, immigrant or visitor vs. being native-born in the study country) ( $p > 0.05$ ). In addition, being reached by prevention programmes and testing behaviours in the last 12 months (HIV and STI testing), as well as HIV status based on laboratory testing – which were statistically significant ( $p < 0.05$ ) when considered separately – were not significantly associated with the dependent variable once included in the model.

In contrast, being 'out' regarding sexual attraction to other men represented a significant factor in differentiating between the two groups. Participants who only reported being 'out' with "none or few" people, were nearly four times as likely to report having practised sex with both women and men (OR = 3.60;  $p < 0.05$ ) compared to those who reported being 'out' to "most or all". This indicates that MSMW were less open about their own sexual orientation compared to MSMO.

In terms of sexual partners, MSMW were also more likely to report sexual relations with non-steady partners in the last six months (OR = 1.65;  $p < 0.05$ ). Considering the type of sexual practice adopted in the six months before the enrolment period,

MSMW were more likely to report UAI with men (OR = 0.44;  $p < 0.05$ ) compared to MSMO.

Being knowledgeable about testing facilities was significantly associated with a reduced odds of being MSMW (OR = 0.63;  $p < 0.05$ ), suggesting that MSMO were better informed regarding services providing voluntary counselling and testing (VCT) compared to MSMW.

The multilevel multivariate model showed lower odds of being MSMW when predicting from “at least once lifetime HIV testing” versus never having been tested (OR = 0.69;  $p < 0.05$ ). This suggests that MSMW were less likely than MSMO to have tested for HIV when considering lifetime HIV testing history.

Participants perceiving a friendlier environment (less stigma) for gay and bisexual people were more likely to be MSMO than MSMW. The score of people’s attitude on the gay/bisexual scale was positively associated with being MSMW with an OR of 1.11 ( $p < 0.05$ ) showing that the higher the negative perception the higher the odds of having sex with both men and women. The predicted probability of reporting sex with both men and women increased as perceived stigma increased; however, when we combined the effect of the perceived stigma and ‘outness’, the model predicted different marginal probabilities as shown in Figure 1. The predicted probability of having sex with both men and women, increases independently with an increase in negative attitude perception; however when the variable of being ‘out’ or not is included, the increase in the number of men declaring MSMW increases steeply.

Finally, with regards to age, the model showed a decrease in the odds of being MSMW (OR = 0.99;  $p < 0.05$ ) as age increased, meaning that MSMW were more likely to be younger than MSMO.

## DISCUSSION

This study offers a valuable characterisation of MSMW which can usefully inform preventative actions targeting this relatively sizeable sub-group of the sexual minority population (Schrimshaw, 2016; Pachankis, Cochran, and Mays, 2015). Furthermore, the use of up-to-date sampling methodologies for bio-behavioural surveys (TLS-RDS) provides further strength to the study results in reaching the MSM population subgroups (particularly with RDS), therefore overcoming some of the most relevant limitations in previous studies targeting this specific group.

According to our findings, MSMW appear to be characterised by a low level of ‘outness’, that is, they tend to be less open with family, friends, and co-workers about their own sexual attraction compared to MSMO. Although this finding has been reported in other studies, it should be noted that such studies were in some cases targeting MSMW from specific ethnic minority groups, such as bisexual black men in the US (35) (7) (36), whereas data on MSMW from a large multi-site bio-behavioural survey implemented in European sites are lacking.

Considering information on testing facilities, MSMW report less knowledge of HIV testing services compared to MSMO (37). This result is in line with recent research which documents that MSMW have an increased vulnerability that can potentially lead to a higher risk of infection (29). This could partially be related to the ‘stigma’ perceived by MSMW who do not consider themselves part of gay or bisexual communities, and which may therefore not only reduce the likelihood of such MSMW from being exposed to information on testing facilities (thus reducing HIV/STI testing uptake) but may also lead to MSMW to perceive themselves as being at a lower risk of acquiring HIV/STIs compared to MSMO (38).



In terms of testing, the model shows that participants who tested at least once for HIV in their lifetime were less likely to be MSMW than MSMO. Linking to the previous point of MSMW possibly not perceiving themselves as being ‘at-risk, this result is in line with the findings from previous studies (29) (9) and may have potential critical impacts in terms of HIV positivity knowledge and a resulting bridging effect. Results on types of sexual partners seem to confirm this risk, also taking into account the fact that MSMW are more prone to report sexual encounters with non-steady partners compared to MSMO: this association has been confirmed in the present analysis as well as in other publications (25).

When considering sexual practices, our findings indicate that MSMW are less likely to engage in UAI compared to MSMO. This finding represents the core output of this analysis, considering the current debate on this matter. In fact, some studies confirm the relatively low level of UAI amongst the MSMW compared to MSMO (39) (14) (15) (16) (17), where they are reported as engaging in less risky behaviour (7) (18). In addition, the model clearly indicates a decrease in the odds of practicing sex with both men and women with an increase in age that can perhaps partially be related to the ‘stabilisation’ of sexual preferences.

Taking into account the associations with perceived stigma towards gay/bisexual individuals, MSMW in the present sample seem to perceive a more stigmatising environment, which might increase reluctance to disclose sexual orientation and thus impact on access to testing facilities (19).

The results of the present study have important implications for MSMWs’ health and prevention actions as they show the importance of stigma as negative factor for disclosing sexual orientation and/or sexual identity; a key factor for communicating

with both types of partners (male/female) such as assessing risk and, discussing possible risk-reduction strategies. Indeed these findings are in line with the broader research evidence which suggests disclosure of sexual orientation by MSMW to their male and female partners may facilitate negotiations concerning risk-reduction (27). Specific programmes tailored to MSMW promoting HIV prevention and encouraging regular HIV testing amongst this target group, may therefore be necessary in contributing to the reduction of HIV acquisition and onward transmission. Particularly when delivering sexuality-related counselling, as one of the critical interventions to promote well-being through increasing self-esteem, self-regulation and self-efficacy (40) (41) (42), these factors should be considered carefully. In the case of counselling offered to MSMW, particular attention should be paid to multiple partnerships and related communication/disclosures.

Bearing in mind that the social environment contributes greatly to shaping individual behaviours, an additional implication relates to the so-called macro level, that is, a 'double-stigma' from both gay and heterosexual communities (43). The fact that MSMW seem to be less open regarding their sexual orientation compared to MSMO could potentially be due to and/or lead to such possible 'double-stigma' (9).

Consequently, a high level of experienced psychosocial vulnerability (e.g. lower levels of perceived social support from both members of the gay and heterosexual communities in general) could also be expected in this specific population (9).

Therefore it seems extremely important to identify specific contextual actions that ultimately can lead to the promotion of better social contexts for MSM in general and MSMW in particular. This might represent a crucial factor when considering the global health of MSMW, as low levels of perceived social support from family and

friends generally lead to negative effects on physical and mental health (44). This lack of perceived support from a community or a social group might be particularly relevant for MSMW, as they may not identify themselves as members of either heterosexual or gay communities (45). Therefore, promoting settings and socio-cultural environments that are not only gay-friendly, but also open to a multifaceted range of sexual identities and orientations might be a key factor in promoting well-being and sexual health also amongst MSMW.

Notwithstanding the strengths of the Sialon II survey, namely the use of the gold-standard methodologies for bio-behavioural data collection amongst hard to reach populations and the characteristics of the overall survey sample, results must be interpreted in light of certain limitations.

Excluding the data related to laboratory testing and that obtained through automated procedures, information collected via self-administered pen-and-paper questionnaires is subject to recall bias, especially for recall of specific sexual practices.

In terms of sampling methodology, despite the fact that both TLS and RDS represent the current state-of-the-art approaches to implementing bio-behavioural studies targeting hard-to-reach populations such as MSM, the sampling methods adopted could have had an impact on the representativeness of the sample in the study sites. Moreover, web-based recruitment methods have not been taken into account, with the potential underrepresentation of a sub-population of MSM relying only on web and mobile phone 'Apps' for sexual encounters.

The generalisability of the findings may be limited by contextual factors (such as legislation/local policy, social norms) not included or measured in this survey, which characterise the gay communities in the selected study sites.

In addition, participants were identified as behaviourally MSMW or MSMO using their self-reported sexual behaviour during the last six months with male or female partners (steady and/or non-steady), rather than referring to the self-reported sexual identity or sexual orientation.

An additional limitation could be the lack of sexual identity/sexual orientation items investigated in the survey. Sexual self-identity can be extremely informative (23), as it might be influenced by contextual factors (e.g. stigma, self-disclosure) (13) and therefore provide indirect information of unobserved factors influencing individual behaviour.

The results presented in this article can not only inform actions and prevention campaigns in the surveyed cities, but considering the different geographical areas of Europe, they may also be useful for the broader European context. To our knowledge, Sialon II is the only multi-site integrated bio-behavioural survey of its kind to have been implemented in the EU, and the results presented here therefore can add to an increasing body of research focusing on MSMW, especially for the European area.

## CONCLUSIONS

Over the years, a sometimes limited focus on MSMW characterisation has been reported in epidemiological research. This lacuna could be due partially to the fact that the bisexuality definition and psycho-social and behavioural implications seem to represent a critical issue from a theoretical viewpoint (46), and also because of a greater emphasis on analysing the potential bridging effect rather than on profiling the MSMW population in itself with its specific health needs (25).

These survey results corroborate insights from other studies (9) (7), highlighting the elevated vulnerability of MSMW and the wide spectrum of potentially risky behavioural and psycho-social patterns, particularly in terms of HIV testing, 'outness', and perceived stigma.

Addressing the distinctive spectrum of MSMW's sexual health needs and characteristics appears to be both quite challenging and urgent from a public health perspective. Promoting sexual health and preventing risky behaviours, such as low levels of HIV testing, with purposefully designed campaigns might prevent severe consequences both for the MSMW group in itself and for other sub-populations, such as female partners of MSMW (7).

Further research is needed to understand better the behavioural patterns and prevention needs of this specific population, as well as disclosure dynamics, clarifying in particular (i) the behavioural and psychological patterns which characterise MSMW, (ii) the unique mental concerns reported by MSMW compared to MSMO, and (ii) the relation between mental health and stigmatising contexts at the

macro level as well as personal determinants of risk including sexual behaviour and test seeking.

## **COMPLIANCE WITH ETHICAL STANDARDS**

**Funding:** this manuscript is based on data from the Sialon II project, co-funded under the Second Programme of Community Action in the field of Health (2008-2013) (Work Plan 2010) (Grant Agreement Number: 2010 12 11). The sole responsibility lies with the authors of this manuscript and the Commission is not responsible for any use that may be made of the information contained therein.

**Conflicts of interest:** the authors declare that they have no competing interests.

**Ethical approval:** all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Prior to data collection, research protocols were submitted to, and approved by, an appropriate institutional ethical review board in each participating city, as well as by the WHO Research Project Review Panel (RP2) and the WHO Research Ethics Review Committee (ERC) during 2012-13.

**Informed consent:** according to the study protocol procedures, informed consent was obtained from all individual participants included in the study.

## REFERENCES

1. **UNAIDS, Joint United Nations Programme on HIV/AIDS.** *Global AIDS response progress reporting 2014: construction of core indicators for monitoring the 2011 UN political declaration on HIV/AIDS.* Geneva : Joint United Nations Programme on HIV/AIDS (UNAIDS), WHO Library Cataloguing-in-Publication Data, 2014. ISBN 978 92 4 150.
2. *The global response to HIV in men who have sex with men.* **Beyrer, C., Baral, S.D., Collins, C., Richardson, E.T., Sullivan, P.S., Sanchez, J., Trapence, G., Katabira, E., Kazatchkine, M., Ryan, O., Wirtz, A.L., Mayer, K.H.** s.l. : Lancet, 2016, Vols. 2016 Jul 9;388(10040):198-206.
3. *HIV bio-behavioural survey among men who have sex with men in Barcelona, Bratislava, Bucharest, Ljubljana, Prague and Verona, 2008-2009.* **Mirandola, M., Folch, C., Krampac, I., Nita, I., Stanekova, D., Stehlikova, D., Toskin, I., Gios, L., Foschia, J.P., Breveglieri, M., Furegato, M., Castellani, E., Bonavina, M.G., SIALON network.** s.l. : Euro Surveill, 2009, Vol. 2009 Dec 3;14(48). pii: 19427.
4. **Mirandola, M., Gios, L., Sherriff, N., Toskin, I., Marcus, U., Schink, S., Suligoi, B., Folch, C., Rosińska, M. (Editors).** *The Sialon II Project. Report on a Bio-behavioural Survey among MSM in 13 European cities.* s.l. : ISBN 978-88-98768-55-4 Cierre Grafica, 2016.
5. **ECDC, European Centre for Disease Prevention and Control.** *Thematic Report. Men who have sex with men. Monitoring implementation of the Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia: 2014 progress report.* Stockholm : ECDC, 2015.



6. **The EMIS Network.** *EMIS 2010. The European Men-Who-Have-Sex-With-Men Internet Survey. Findings from 38 countries* . Stockholm : European Centre for Disease Prevention and Control, 2013.
7. *Beyond the bisexual bridge: sexual health among U.S. men who have sex with men and women.* **Jeffries, W.L.** s.l. : Am J Prev Med, 2014, Vols. 2014 Sep;47(3):320-9.
8. *Bisexual Behaviors, HIV Knowledge, and Stigmatizing/Discriminatory Attitudes among Men Who Have Sex with Men.* **Liao, M., Wang, M., Shen, X., Huang, P., Yang, X., Hao, L., et al.** s.l. : PLoS One, 2015, PLoS ONE, Vol. 2015 Jun 29;10(6):e0130866, p. 10(6): e0130866. doi:10.1371/journal.pone.0130866.
9. *Psychosocial vulnerability and HIV-related sexual risk among men who have sex with men and women in the United States.* **Dyer, T.P., Regan, R., Pacek, L.R., Acheampong, A., Khan, M.R.** s.l. : Arch Sex Behav, 2015, Vols. 2015 Feb;44(2):429-41.
10. **ECDC, European Centre for Disease Prevention and Control.** *ECDC, A comprehensive approach to HIV/STI prevention in the context of sexual health in the EU/EEA.* Stockholm : ECDC, 2013.
11. *Prevalence of bisexual behaviour among bridge population of men who have sex with men in China: a meta-analysis of observational studies* . **Yun K, Xu JJ, Reilly KH, Zhang J, Jiang YJ, Wang N, Shang H.** s.l. : Sex Transm Infect, 2011 , Vols. Dec;87(7):563-70.
12. *Bridging sexual boundaries: men who have sex with men and women in a street-based sample in Los Angeles.* **Gorbach PM, Murphy R, Weiss RE, Hucks-Ortiz C, Shoptaw S.** 2009, J Urban Health, pp. Jul;86 Suppl 1:63-76.
13. *Predictors of bisexual behaviour among MSM attending Intervention sites may help in prevention interventions for the bridge to the heterosexual epidemic in India:*

- Data from HIV sentinel surveillance.* **Godbole, S., Sane, S., Kamble, P., Raj, Y., Dulhani, N.** s.l. : PLoS ONE, 2014, Vol. 9(9): e107439.
14. *Global epidemiology of HIV infection in men who have sex with men.* **Beyrer, C., Baral, S.D., van Griensven, F., et al.** s.l. : Lancet, 2012, Vols. 380(9839):367–77.
15. *HIV-1 infection in high risk men who have sex with men in Mombasa, Kenya.* **Sanders, E.J., Graham, S.M., Okuku, H.S., van der Elst, E.M., Muhaari, A., Davies A, Peshu N, Price M, McClelland RS, Smith, A.D.** s.l. : AIDS, 2007, Vols. 2007 Nov 30;21(18):2513-20.
16. *Epidemiology of male same-sex behaviour and associated sexual health indicators in low- and middle-income countries: 2003-2007 estimates.* **Cáceres, C.F., Konda, K., Segura, E.R., Lyerla, R.** s.l. : Sex Transm Infect, 2008, Vol. 2008 Aug;84 Suppl 1.
17. *HIV infection and sexual risk among men who have sex with men and women (MSMW): a systematic review and meta-analysis.* **Friedman, M.R., Wei, C., Klem, M.L., Silvestre, A.J., Markovic, N., Stall, R.** s.l. : PLoS One, 2014, Vol. 2014 Jan 30;9(1):e87139.
18. *HIV risk among men who have sex with men only (MSMO) and men who have sex with men and women (MSMW) in Baltimore.* **Maulsby, C., Sifakis, F., German, D., Flynn, C.P., Holtgrave, D.** s.l. : J Homosex, 2013, Vols. 2013;60(1):51-68.
19. *Socio-demographic factors predicting HIV test seeking behaviour among MSM in 6 EU cities.* **Mirandola, M., Gios, L., Davis, R.J., Furegato, M., Breveglieri, M., Folch, C., Stanekova, D., Nita, I., Stehlíková, D.** s.l. : European Journal of Public Health, 2016, Vol. doi:10.1093/eurpub/ckw144.

20. *Potential impact on HIV incidence of higher HIV testing rates and earlier antiretroviral therapy initiation in MSM.* **Phillips, A.N., et al.**, 2015, AIDS, pp. 29:1855–1862.
21. **WHO, World Health Organisation, Department of Reproductive Health and Research.** *Emergence of multi-drug resistant Neisseria gonorrhoeae – Threat of global rise in untreatable sexually transmitted infections.* s.l. : World Health Organisation, 2011.
22. *Reasons for Non-Disclosure of Sexual Orientation Among Behaviorally Bisexual Men: Non-Disclosure as Stigma Management.* **Schrimshaw, E.W., Downing, M.J., Cohn, D.J.** DOI:10.1007/s10508-016-0762-y, s.l. : Arch Sex Behav, 2016, Vol. 2016 Jun 8.
23. *Hidden from health: structural stigma, sexual orientation concealment, and HIV across 38 countries in the European MSM Internet Survey.* **Pachankis, J. E., Hatzenbuehler, M. L., Hickson, F., Weatherburn, P., Berg, R. C., Marcus, U., & Schmidt, A. J.** s.l. : AIDS, 2015, Vols. 29(10), 1239–1246.
24. *The Geography of Sexual Orientation: Structural Stigma and Sexual Attraction, Behavior, and Identity Among Men Who Have Sex with Men Across 38 European Countries.* **Pachankis, J.E., Hatzenbuehler, M.L., Mirandola, M., Weatherburn, P., Berg, R.C., Marcus, U., Schmidt, A.J.** s.l. : Arch Sex Behav, 2016, Vols. DOI 10.1007/s10508-016-0819-y.
25. *Sexual behaviors and experiences among behaviorally bisexual men in the midwestern United States.* **Dodge, B., Schnarrs, P.W., Reece, M., Martinez, O., Goncalves, G., Malebranche, D., Fortenberry, J.D.** s.l. : Archives of sexual behavior, 2013, Vols. 2013; 42(2):247–256.

26. *Bio-behavioural HIV and STI surveillance among men who have sex with men in Europe: the Sialon II protocols.* **Gios, L., Mirandola, M., Toskin, I., Marcus, U., et al.**, s.l. : BMC Public Health, 2016, Vol. 2016 Mar 2;16(1):212.
27. *HIV Serosorting, Status Disclosure, and Strategic Positioning Among Highly Sexually Active Gay and Bisexual Men.* **Grov, C., Rendina, H.J., Moody, R.L., Ventuneac, A., Parsons, J.T.** s.l. : AIDS Patient Care STDS, 2015, Vols. 2015 Oct;29(10):559-68.
28. *Variations in Sexual Identity Milestones Among Lesbians, Gay Men, and Bisexuals.* **Martos, A.J., Nezhad, S., Meyer, I.H.** s.l. : Sexuality Research and Social Policy, 2014, Vols. March 2015, Volume 12, Issue 1, pp 24–33.
29. *HIV and Sexual Risk Among Men Who Have Sex With Men and Women in Asia: A Systematic Review and Meta-Analysis.* **Bowring, A.L., Veronese, V., Doyle, J.S., Stooze, M., Hellard, M.** s.l. : AIDS Behav, 2016, Vol. 2016 Jan 18.
30. *Bisexual behavior among Chinese young migrant men who have sex with men: Implications for HIV prevention and intervention.* **Guo, Y., Li, X., Song, Y., Liu, Y.** 2012, AIDS Care.
31. *Young, Online and in the Dark: Scaling Up HIV Testing among MSM in ASEAN.* **Guadamuz, T.E., Cheung, D.H., Wei, C., Koe, S., Lim, S.H.** 2015, PLoS One, p. 2015 May 14;10(5).
32. *Surveillance of HIV risk and prevention behaviors of men who have sex with men – A national application of venue-based, time-space sampling.* **MacKellar, D., Gallagher, K., Sanchez, T., Lansky, A., Sullivan, P.** s.l. : Public Health Rep, 2007, Vols. 122(Suppl 1): 39–47.
33. *Formative research to optimize respondent-driven sampling surveys among hard-to-reach populations in HIV behavioral and biological surveillance: lessons learned*

*from four case studies.* **Johnston, L.G., Whitehead, S., Simic-Lawson, M., Kendall, C.** s.l. : AIDS Care, 2010, Vols. 2010 Jun;22(6):784-92.

34. **Rabe-Hesketh S, Skrondal A.** *Multilevel and longitudinal modeling using Stata* . s.l. : College Station: Stata Press, 2008.

35. *Perspectives on substance use and disclosure among behaviorally bisexual Black men with female primary partners.* **Benoit, E., Koken, J.A.** s.l. : Journal of ethnicity in substance abuse, 2012, Vols. 2012;11(4):294-317.

36. *Stuck in the middle: longitudinal HIV-related health disparities among men who have sex with men and women (MSMW).* **Friedman, M.R., Stall, R., Silvestre, A.J., et al.,** s.l. : Journal of acquired immune deficiency syndromes, 2014, Vols. (1999). 2014;66(2):213-220.

37. *Differences and Similarities in HIV Testing Among Men Who have Sex with Men and Women (MSMW) and Men Who Have Sex with Men Only (MSMO).* **Maulsby, C., Sifakis, F., German, D., Flynn, C.P., Holtgrave, D.** s.l. : Open AIDS J, 2012, Vols. 2012;6:53-9.

38. *HIV testing and risk behaviors among gay, bisexual, and other men who have sex with men - United States.* **CDC, Centers for Disease Control and Prevention.** s.l. : MMWR Morb Mortal Wkly Rep, 2013, Vols. 2013 Nov 29;62(47):958-62.

39. *Behaviorally Bisexual Men and their Risk Behaviors with Men and Women.* **Zule, W.A., Bobashev, G.V., Wechsberg, W.M., Costenbader, E.C., Coomes, C.M.** s.l. : J Urban Health, 2009, Vols. Jul;86 Suppl 1:48-62.

40. *WHO guideline for brief sexuality-related communication: implications for STI/HIV policy and practice.* **Toskin, I., Cooper, B., Troussier, T., Klugman, B., Kulier, R., Chandra-Mouli, V., Temmerman, M.** s.l. : Reprod Health Matters, 2015, Vols. 2015 Nov;23(46):177-84.

41. *Brief sexuality communication--a behavioural intervention to advance sexually transmitted infection/HIV prevention: a systematic review.* **Cooper, B., Toskin, I., Kulier, R., Allen, T., Hawkes, S.** s.l. : BJOG, 2014, Vols. 2014 Oct;121 Suppl 5:92-103.
42. **World Health Organization.** *Brief sexuality-related communication: recommendations for a public health approach.* s.l. : World Health Organization, 2015. Vol. ISBN 978 92 4 154900 4.
43. *Combination HIV prevention: significance, challenges, and opportunities.* **Kurth, A.E., Celum, C., Baeten, J.M., Vermund, S.H., Wasserheit, J.N.** s.l. : Current HIV/AIDS Reports, 8(1), 62-72, 2011.
44. *Occupations, social vulnerability and HIV/STI risk: The case of bisexual Latino men in the New York City metropolitan area.* **Muñoz-Laboy, M., Severson, N., & Bannan, S.,** s.l. : Global Public Health, 2014, Vols. 9(10), 1167–1183.
45. *HIV-Related Behaviors, Social Support and Health-Related Quality of Life among Men Who Have Sex with Men and Women (MSMW): A Cross-Sectional Study in Chongqing, China.* **Chen, J.P., Han, M.M., Liao, Z.J., Dai, Z.Z.** s.l. : PLoS ONE, 2015, Vol. 10(2): e0118651. doi:10.1371/journal.pone.0118651.
46. *Playing with Butler and Foucault: Bisexuality and Queer Theory.* **Callis, A.S.** s.l. : Journal of Bisexuality, 2009, Vols. 9:3-4, 213-233.
47. *Comparison of Sexual Risk, HIV/STI Prevalence and Intervention Exposure Among Men Who Have Sex with Men and Women (MSMW) and Men Who Have Sex with Men Only (MSMO) in India: Implications for HIV Prevention.* **Ramakrishnan, L., Ramanathan, S., Chakrapani, V., Goswami, P., Deshpande, S., Yadav, D., Sen, S., George, B., Paranjape, R.** s.l. : AIDS Behav, 2015, Vols. 2015 Dec;19(12):2255-69.

## **TABLES AND FIGURES**

**Table 1. Number of valid and invalid questionnaires and valid samples collected in the Sialon II survey**

	Questionnaires collected	Valid questionnaires	% invalid questionnaires	Valid samples collected
Barcelona	408	402	1.5	400
Bratislava	400	400	0	400
Brighton	418	411	1.7	402
Brussels	406	391	3.7	379
Bucharest	183	183	0	183
Hamburg	408	407	0.2	390
Lisbon	409	408	0.2	371
Ljubljana	416	394	5.3	347
Sofia	411	411	0	361
Stockholm	377	366	2.9	356
Verona	400	400	0	400
Vilnius	322	322	0	322
Warsaw	408	406	0.5	405



**Table 2. Percent of MSM with various characteristics, by sexual identification (bivariate analysis)**

Characteristic	MSMW ( <i>n</i> = 589)		MSMO ( <i>n</i> = 4,069)		<i>P</i> value
Age					0.11
Mean	32.55		34.44		
Median	31		32		
St. Dev.	10.72		11.11		
Area of residence					0.10
Outside the study city	164	28.23 %	1,104	27.37 %	
In the study city	417	71.77 %	2,929	72.63 %	
Educational status					0.00
High school or lower	298	52.56 %	1,724	43.21 %	
Degree or higher	269	47.44 %	2,266	56.79 %	
Out-ness					0.00
Some, most or all	219	39.46 %	2,968	75.08 %	
None or few	336	60.54 %	985	24.92 %	
Origin					0.01
Foreigner	107	18.23 %	686	16.91 %	
Native-born	480	81.77 %	3,371	83.09 %	
Non-steady partners	452	88.45 %	3,126	84.46 %	0.05
Sexual practice					
No Anal Intercourse	157	26.66 %	594	14.60 %	
Anal Intercourse	134	22.75 %	988	24.28 %	0.00
Unprotected Anal Intercourse	298	50.59 %	2,487	61.12 %	0.00
Testing facilities knowledge	501	87.89 %	3,745	94.74 %	0.00
HIV testing (lifetime)	351	65.36 %	2,941	79.06 %	0.00
Being reached by prevention programmes (condom distribution) in the last 12 months	334	58.80 %	2,516	63.55 %	0.40
STI testing in the last 12 months	254	43.87 %	2,010	50.81 %	0.03
HIV test in the last 12 months	288	50.97 %	2,258	57.96 %	0.01
HIV status (lab based)	51	8.92 %	425	10.86 %	0.14
LGB stigma perception					0.00
Mean	8.99		7.63		
Median	9		8		
St. Dev.	2.62		2.49		

**Table 3. Multilevel Multivariate Model**

Dependent variable: being MSMW versus MSMO		OR	95% CI	<i>P</i>
<b>Fixed part</b>				
Area of residence	Out-side the study city	1		
	Study city	0.90	0.70 1.16	0.43
Educational status	Secondary school (high school) or lower	1		
	University or higher	0.80	0.63 1.03	0.08
Out-ness	Some, most or all	1		
	None or few	3.60	2.79 4.65	0.00
Origin	Emigrant/immigrant or visitor	1		
	Native-born	0.80	0.58 1.10	0.17
Non-steady partner	No	1		
	Yes	1.65	1.14 2.38	0.01
Sexual practice	No Anal Intercourse	1		
	Anal Intercourse	0.51	0.36 0.73	0.00
	Unprotected Anal Intercourse	0.44	0.32 0.60	0.00
Testing facility knowledge	No	1		
	Yes	0.63	0.43 0.93	0.02
HIV Testing (lifetime)	Never tested	1		
	Tested at least once	0.69	0.49 0.97	0.04
Being reached by prevention programmes (condom distribution) in the last 12 months	No	1		
	Yes	1.07	0.83 1.37	0.60
STI testing in the last 12 months	No	1		
	Yes	0.94	0.67 1.32	0.71

HIV testing in the last 12 months	No	1			
	Yes	1.29	0.88	1.89	0.19
HIV status (lab based)	Non-reactive	1			
	Reactive	1.00	0.66	1.50	0.99
LGB stigma perception		1.11	1.05	1.16	0.00
Age		0.99	0.98	1.00	0.04
Const.		0.15	0.07	0.35	0.00
<b>Random part</b>					
City					
	$\sigma^2$	0.08	0.02	0.31	
LR test = 6.80		Prob > = 0.05			

Figure 1: Plots of marginal predicted probabilities of MSMW and perceived attitudes towards gay/bisexual men scale by out-ness and city

