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Roberto BARBUTI, Stefano CHESSA, Roberto FRESCO, Paolo MILAZZO

PREFACE

The technological innovation in biology and agriculture often leveraging on innovation in computer science and engineering, pushed forward the process of integration among these disciplines. In particular, information technology (IT) provides common methodologies and tools for the automatic acquisition and analysis of the data that concern the management and optimization of the natural and territorial resources.

In agriculture, applications of IT enable the integration of interventions concerning its sustainability and productivity, by offering methods and tools to monitor, control, analyse and optimize the production while keeping it respectful of the environment. Similarly, the best practices for bio sustainability, for the management of bio-diversity and for the bioremediation of the environment (including soil, water etc…) are also progressively adopting IT, which enable more focused (and thus more effective) applications.

In this context, the conference "Technologies and innovation for sustainable management of Agriculture, Environment and Biodiversity" (TI4AAB), was held in July 2016 at the Natural History Museum of the University of Pisa located in the Calci Charterhouse (Calci, province of Pisa) in order to encourage the sharing of emerging knowledge about the above topics.

In fact, the conference was dedicated to fostering innovative cross-disciplinary research and applications and to stimulating the exchange of strategies and experiences, among academic and company experts from different disciplines (agriculture, biology, computer science and engineering and environmental decision making), in order to encourage a common, interdisciplinary discussion about the adoption and perspectives of IT in modern agriculture, environmental management, biodiversity and bio-sustainability in general.

The conference was held under the auspices of the municipality of Calci, the University of Pisa and of the "Ordine dei Dottori Agronomi e Dottori Forestali". It was also attended and supported by some leading national and worlwide industries, like CAEN RFID, OSRAM, STMicroelectronics, EBV Elektronik, Qprel Srl, AEDIT Srl, EMipiace Srl, and Zefiro Ricerca & Innovazione Srl, and by the Italian National Forestry Authority.

This volume constitutes a selection of the contributions presented at the conference and cover the aspects of innovation in agriculture, biology, and applied information technology. In particular, concerning innovation in agriculture, the paper by Nin et al. studies new soilless cultivation systems for wild strawberry growing in the Tuscan Appennine mountains. The paper by Prisa describes experimental research concerning the use of zeolites in combination with effective microorganisms, in order to improve the quality of olive trees. Finally, the paper by Lombardo et al. describes collaborative approaches to innovation in agriculture (co-generation of technology).

Concerning innovation in biology, the paper by Baldacci et al. describes the results of the preliminary phases of the AIS-LIFE project, which aims at developing aerobiological information systems in order to improve pollen-related allergic respiratory disease management. Still concerning the AIS-LIFE project, the paper by Natali et al. aims to describe the strategy used in AIS-LIFE project, to evaluate daily pollen concentration in the atmosphere produced by many allergic plant species. The use of data and GIS system are shown as an approach to assess allergy risk maps.

Concerning innovation in computer science applied to agriculture and biology, two contributions focus on modeling approaches, and two contributions provide a survey of information technology applied to agriculture and biology. Specifically, the paper by Bodei et al. describes the application of the IOT-LYSA formal modelling framework to a possible scenario of grape cultivation, in order to assess water consumption, and the paper by Barbuti et al. proposes a mathematical model of artificial reefs, in order to study the dynamics of algal coverage and of populations of fish in some Italian

artificial reefs. Finally, the paper by Fresco et. al. explores the current challenges and IT solutions in order to realize a digital agriculture framework, intended as an evolution from Precision Farming to connected knowledge-based farm production systems, and the paper by Pucci et al. provides a survey on biologging methodologies for the collection of knowledge about animals' behaviour, making a review of some related common data analysis techniques.

All papers have been carefully reviewed by experts in the specific fields. Here is the list of the reviewers, that we thank for the collaboration.

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THE AIS LIFE PROJECT: THE ITALIAN ENROLLMENT PHASE RESULTS

ABSTRACT: S. BALDACCI, S. MAIO, A. ANGINO, P. SILVI, M. SIMONI, S. LA GRUTTA, G. VIEGI, F. RUGGIERO, G. BEDINI, F. NATALI, L. CECCHI, U. BERGER, M. PRENTOVIC, I. ANNESI MAESANO, A. MOUSTAFA, M. THIBAUDON, S. MONNIER, S. ORLANDINI, *The AIS LIFE project: the Italian enrollment phase results.*

The prevalence of allergic diseases and asthma are increasing worldwide, particularly in children and young adults.

Given the remarkable clinical impact of pollen allergy, the project "Aerobiological Information Systems and allergic respiratory disease management" AIS-LIFE has been developed in order to improve pollen-related allergic respiratory disease management in the general population, through the implementation and the permanent utilization of two different Aerobiological Information Systems in Italy, France and Austria.

This paper aims at describing the results of the enrollment phase in Pisa, Italy. As a part of the AIS project, 618 Pisa allergic subjects were contacted by trained fieldworkers and invited to replay to a screening questionnaire in order to ascertain the inclusion criteria: spending most of the week living, studying, working in the study area, presence of seasonal nasal / ocular / bronchial symptoms in the last 12 months or use of preventive treatment, and absence of allergen-specific immunotherapy in the last 6 years. Participants were randomly assigned to three groups: A. using the Integrated Information System (IIS), B. using the Personalized Pollen Information system (PPI) and C. not using any system. Chi-square test and analysis of variance were performed to assess statistical differences of general characteristics and symptoms by screening results.

Out of 618 subjects, 39.6% had a positive screening and participated in the study, 3.6% had a positive screening but refused, 27.2% had a negative screening and 29.6% refused for lack of interest/health problems or were unreachable/died. Participants (mean age 48 years) were younger than eligible refusals (59 years) ($p<.001$); with a higher prevalence rate of seasonal nasal symptoms (87%) and a lower prevalence rate of use of preventive medicines for bronchial symptoms (33%) than refusals (68% and 55%, respectively; $p<.05$). Considering participants, group B subjects were significantly younger (40 years) than group A (48 years) and C (55 years) subjects ($p<.001$); prevalence rate of seasonal bronchial symptoms was significantly lower in group C subjects (25.0%) than in group A (44.3%) and B (52.6%) subjects; prevalence rate of use of preventive medicines for bronchial symptoms was borderline significantly lower in group C (23.9%) than in group A (34.2%) and group B (41%).

These preliminary results underline a few differences between eligible subjects participating and not participating in the study and among the study groups to be taken into account in the future analyses. Only the completion of the study will allow to fully evaluate the effectiveness of the two aerobiological information systems in improving allergic diseases management thus paving the way for new, permanent information systems and for a continuous innovation of the proposed model.

KEYWORDS: Pollen allergy, aerobiological information systems, education, respiratory symptoms.

RIASSUNTO: S. BALDACCI, S. MAIO, A. ANGINO, P. SILVI, M. SIMONI, S. LA GRUTTA, G. VIEGI, F. RUGGIERO, G. BEDINI, F. NATALI, L. CECCHI, U. BERGER, M. PRENTOVIC, I. ANNESI MAESANO, A. MOUSTAFA, M. THIBAUDON, S. MONNIER, S. ORLANDINI, *Progetto AIS LIFE: risultati della fase di arruolamento in Italia.*

La diffusione di disturbi allergici e asma sono in aumento a livello mondiale, in particolare nei bambini e negli adolescenti.

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Dato l'impatto clinico significativo delle allergie ai pollini, è stato realizzato il progetto "Aerobiological Information Systems and allergic respiratory disease management" AIS-LIFE al fine di migliorare la gestione dei disturbi respiratori legati a tali forme di allergia nella popolazione generale tramite l'implementazione e l'utilizzo costante di due diversi Sistemi Informativi Aerobiologici in Italia, Francia e Austria.

Questo articolo ha lo scopo di descrivere i risultati della fase di arruolamento a Pisa, in Italia. Nel contesto del progetto AIS, 618 soggetti allergici a Pisa sono stati contattati da intervistatori ed invitati a rispondere ad un questionario di Screening al fine di accertare i criteri di inclusione: passare la maggior parte della settimana risiedendo, studiando o lavorando nell'area oggetto di studio, presenza di sintomi nasali/oculari/bronchiali stagionali negli ultimi 12 mesi o uso di trattamenti preventivi, e assenza di immunoterapia allergene specifica negli ultimi 6 anni. I partecipanti sono stati casualmente suddivisi in tre gruppi: A. utilizzanti l'Integrated Information Systems (IIS), B. utilizzanti il Personalized Pollen Information system (PPI) e C. non utilizzanti alcun sistema informativo. Al fine di valutare le differenze statistiche riguardo le caratteristiche generali e i sintomi rilevati sono stati eseguiti il test Chi-quadrato e l'analisi della varianza sui dati di screening raccolti.

Su un campione di 618 soggetti, il 39.6% ha avuto uno screening positivo e ha partecipato allo studio, il 3,6% ha avuto uno screening positivo ma ha rifiutato, il 27.2% ha avuto uno screening negativo e il 29.6% ha rifiutato per mancanza di interesse/problemi di salute o irreperibilità/decesso. I partecipanti (età media 48 anni) erano più giovani degli elegibili che hanno rifiutato (59 anni) ($p<.001$); mostravano una maggiore prevalenza di sintomi nasali stagionali (87%) e una minore prevalenza di uso di farmaci per la prevenzione di sintomi bronchiali (33%) rispetto a coloro che hanno rifiutato (68% e 55% rispettivamente; $p<.05$). Tra i partecipanti, i soggetti del gruppo B erano significativamente più giovani (40 anni) di quelli del gruppo A (48 anni) e C (55 anni) ($p<.001$); il tasso di prevalenza di sintomi bronchiali stagionali era significativamente più basso nei soggetti del gruppo C (25.0%) che in quelli del gruppo A (44.3%) e B (52.6%); il tasso di prevalenza dell'uso di farmaci per la prevenzione di sintomi bronchiali era più basso, al limite della significatività, nel gruppo C (23.9%) che nel gruppo A (34.2%) e B (41%).

Questi risultati preliminari sottolineano alcune differenze tra i soggetti elegibili partecipanti e non allo studio e tra i gruppi costituiti da tenere in considerazione nelle analisi future. Solo il completamento dello studio consentirà di valutare completamente l'efficacia dei due sistemi informativi aerobiologici nel migliorare la gestione dei disturbi allergici aprendo la strada per nuovi sistemi informativi permanenti e per una continua innovazione del modello proposto.

Parole chiave: Allergia ai pollini, sistemi informativi aerobiologici, educazione, sintomi respiratori.

INTRODUCTION

The prevalence of asthma and allergies has increased during the past decades, particularly in westernized countries. The reasons of this increase are still unclear, but life style, environmental factors and the synergy between pollens and pollutants may play a relevant role (1).

Pollen is one of the most common triggers of seasonal allergies. Climate changes tend to prolong pollination period, moving up the growth period and increasing intensity and allergenicity of pollens across the year (2). Combined pollens-pollutants exposures are a common cause of asthma exacerbations (3) and onset or worsening of rhinitis (4). This has lead to increased health costs and reduced quality of life and productivity of those who are affected (5).

Nowadays, about 30-40% of the world population is affected by one or more allergic conditions (6). As regards pollen allergy, Poaceae cause allergic responses in 35% of the European population (6).

In Italy the prevalence rate of allergic rhinitis is estimated to be about 26% in the general population (7) and grass pollen allergy represents more than 50% of all pollinosis (8). Allergic rhinitis and asthma have a significant impact on patients, their families and, more generally, on society. An European survey reports that 80% of allergic people complain about daily activity limitations with school/work absenteeism or reduced productivity (9).

In Tuscany, a recent study conducted on a Pisa general population sample reported that allergic rhinitis symptoms/disease more than doubled in the last 25 years moving from 16.2 to 37.4% (10).

Allergy treatment is based on prevention of exposure, suppression of symptoms through the use of specific medication, and specific immunotherapy (11).

In the proper management of respiratory allergic diseases, a key aspect is represented by the patient education: how to prevent exacerbations, recognize and avoid exposure to possible risk factors. In the case of allergies to pollens and fungal spores, the "allergen avoidance" strategies include knowledge of pollen calendars, avoidance of places or activities in areas with high pollen loads (e.g. outdoor sports), preventive treatment intake and use of personal protective equipment (e.g. masks). Some studies suggest that information about aeroallergens (e.g. allergenic airborne pollen grains and fungal spores) may play an important role in the timing of prophylactic medication as well as in maintaining treatment compliance among the sensitized population. Thus, this kind of information may lead to a reduction in asthma/rhinitis exacerbations (12).

Aerobiological monitoring systems are available in many countries, but few studies have been performed to assess their effect as a preventative tool.

To bridge this gap, the effectiveness of two different implemented Aerobiological Information Systems (AIS) are being assessed and validated through a field survey on general population samples affected by allergies in Italy (Pisa), France (Paris) and Austria (Vienna) within the AIS LIFE project framework started in 2014 and now in progress (http://www.ais-life.eu/).

In particular, the usefulness of using the two different AIS for respiratory allergic diseases outcomes improvement (symptoms, drugs consumptions, quality of life etc.) will be assessed and both systems, one of them or neither may prove effective. The research hypothesis is that subjects using the AIS, with respect to subjects not using them, modify their behavior, increasing awareness towards allergies and reducing/avoiding exposure to pollens, using personal protective equipments or adjusting the level of drug therapy; all these actions are expected to improve the diseases control and quality of life. The aim of this paper is to describe the results of the enrollment phase in Pisa, Italy.

METHODS

The study has a prospective observational design including two observational phases one year apart on sub-

jects suffering from pollen allergy. Pre-existent databases and web/media campaigns were utilized in order to enrol an expected number of 250 subjects suffering from pollen allergy. Each subject completed the Screening questionnaire through a telephone interview in order to ascertain that the inclusion criteria were met:

- suffering from pollen allergy and reporting seasonal symptoms (last 12 months) or use of preventive treatment for allergic symptoms,
- ≥ 18 years of either sex,
- spending most of the week (at least 5 days/week) living, studying, working in the study area,
- absence of allergen-specific immunotherapy in the last 6 years.

Each subject willing to participate in the study provided in advance his/her signed consent form.

Participants were randomly assigned to one of the three groups: A) using the Integrated Information System (IIS); B) using the Personalized Pollen Information system (PPI); C) not using any information system (controls).

In fact, the AIS LIFE project is implementing two different Aerobiological Information Systems based on the weekly forecasts of the pollens:

- the integrated information system (IIS) providing weekly pollen count, chemical air pollutants concentration data, tendency for the next week, aerobiologic analysis and clinical recommendations, delivered to group A subjects via email;
- the personalized pollen information (PPI) providing the personal symptom load based on the combination of daily pollens count and forecasts, and recent symptoms data from the patient's hay fever diary, delivered to group B subjects via a mobile pollen application (fig. 1).

Each enrolled subject filled in the Health questionnaire about the health status and quality of life associated with allergic diseases in the previous 12 months (1st observational phase) to be newly administered after a 12 months follow-up (2nd observational phase). Figure 2 shows the flow chart of the study in the three countries.

Then, all subjects were exposed to an educational intervention about promotion of life styles, medical recommendations to prevent exacerbations of respiratory allergic diseases and, only for group A and B subjects, instructions about use and conditions of access to the AIS. From here onwards, the Implementation phase has started, i.e. weekly access to the IIS or PPI (via internet or mobile devices) during a period of 12 months for each subject of the groups A-B is expected; while controls are expected to behave in the same way they used to do.

Finally, after the 2nd observational phase, the Satisfaction questionnaire about access difficulty/usefulness/use of the IIS and PPI will be administered to subjects of groups A and B.

Statistical Package for Social Sciences (SPSS), rel. 16.0, was applied; chi-square test and analysis of variance were performed to assess statistical differences of general characteristics and symptoms by screening results. P-values less than 5% were considered statistically significant.

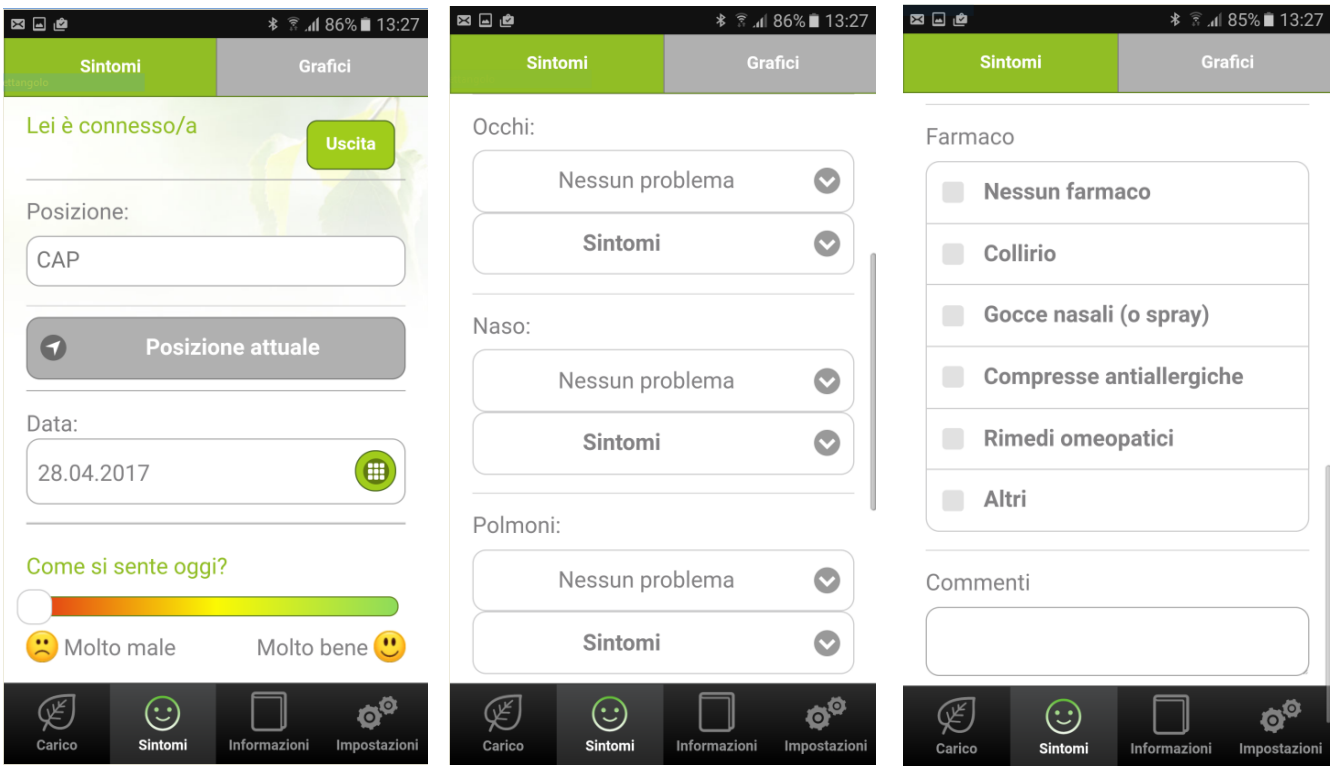

Fig. 1 - Screenshots from the PPI application (Italian version) used by group B.

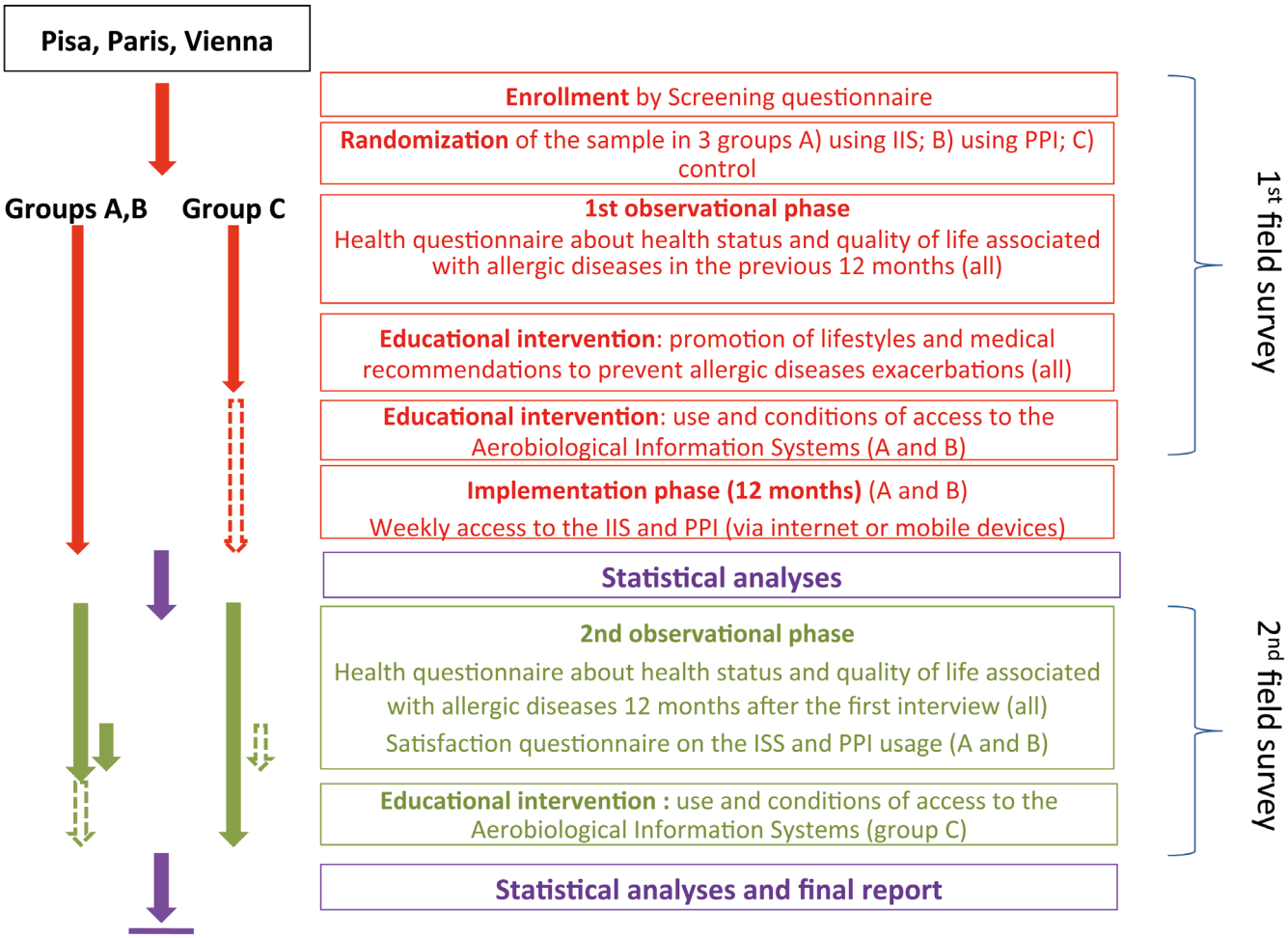

Fig. 2 - Flow chart of the prospective observational AIS study.

RESULTS

Out of 618 allergic subjects contacted by trained field-workers, 39.6% were eligible according to the Screening questionnaire and agreed to participate in the study, 3.6% were eligible but refused, 27.2% were not eligible and 29.6% refused for lack of interest/health problems without assaying eligibility or were unreachable/died (fig. 3).

Considering only 267 eligible subjects, both participants and refusals spent most of the week (at least 5 days/week) living, studying or working in the study area and were not treated with allergen-specific immunotherapy in the last 6 years.

Table 1 shows that participants were significantly younger than eligible refusals: mean age 47.6±14.2 years versus 59.3±13.3 years ($p<.001$); with a higher prevalence rate of seasonal nasal symptoms (86.5%) and a lower prevalence rate of use of preventive medicines for bronchial symptoms (32.7%) than refusals (68.2% and 54.5%, respectively; $p<.05$). Conversely, prevalence rates of gender, overall nasal symptoms, ocular symptoms and bronchial symptoms in the last 12 months, use of preventive medicines for seasonal nasal and ocular symptoms, seasonal ocular and bronchial symptoms did not significantly differ between participants and refusals. Seasonal nasal symptoms were the most prevalent pollen allergy symptoms in participants (86.5%) while seasonal ocular symptoms were in refusals (76.2%). Both participants and refusals used preventive medicines mainly for seasonal nasal symptoms (49.4% and 54.5%, respectively) and, only refusals, also for seasonal bronchial symptoms (54.5%) (tab. 1).

Out of 245 participants, 32% subjects were assigned to group A, 32% to group B and 36% to group C. Table 2 shows that group B subjects were significantly younger (39.5±11.3) than group A (47.8 ±12.9) and C (54.8±13.8) subjects ($p<.001$). Prevalence rates of overall and seasonal bronchial symptoms were significantly lower in group C subjects (37.5 and 25.0%, respectively) than in group A (58.2 and 44.3%, respectively) and B (60.3 and 52.6%, respectively) subjects. In addition prevalence rate of use of preventive medicines for bronchial symptoms was borderline significantly lower in group C (23.9%) than in group A

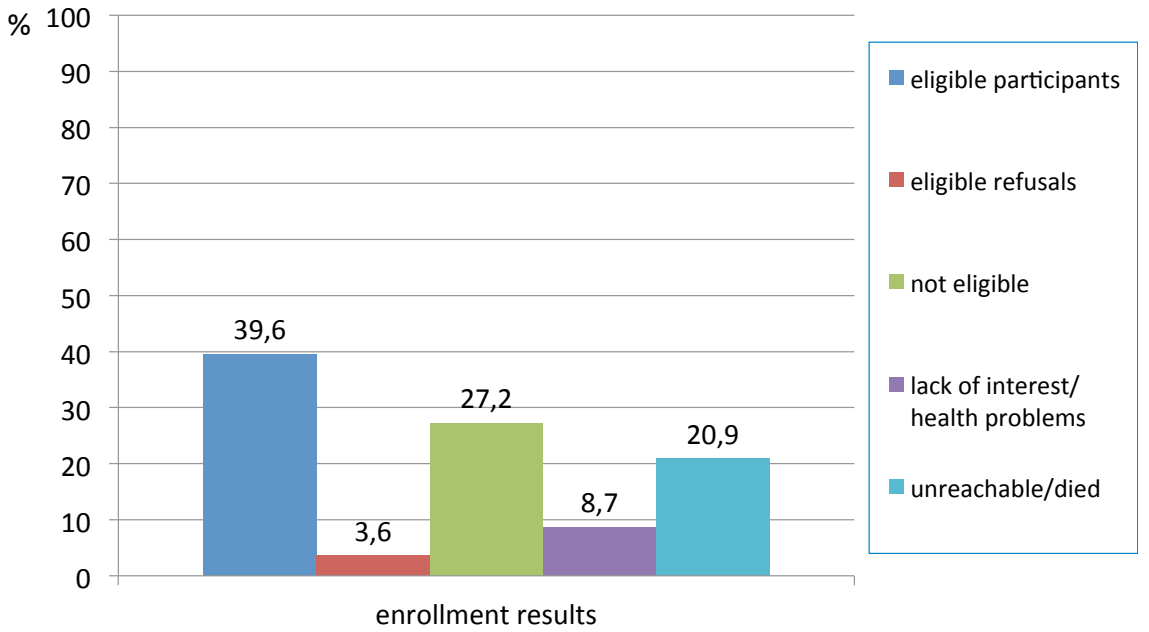

Fig. 3 - PISA sample stratified by enrollment results (N=618).

Table 1 - Prevalence rates and mean values of demographic characteristics, allergic symptoms and use of preventive medicines in the last 12 months by participation/refusal in the Pisa eligible sample.

	Participants		Refusals		
	N	(n=245)	N	(n=22)	p
Gender: Females (%)	156	63.7	13	59.1	n.s.
Age : Means ± SD (years)	245	47.6 ±14.2	22	59.3±13.3	<.001
Overall nasal symptoms: Yes (%)	228	93.1	19	86.4	n.s.
Seasonal nasal symptoms: Yes (%)	212	86.5	15	68.2	.021
Preventive medicines for nasal symptoms: Yes (%)	121	49.4	12	54.5	n.s.
Overall ocular symptoms: Yes (%)	193	78.8	16	76.2	n.s.
Seasonal ocular symptoms: Yes (%)	178	72.7	16	76.2	n.s.
Preventive medicines for ocular symptoms: Yes (%)	42	17.1	5	23.8	n.s.
Overall bronchial symptoms: Yes (%)	126	51.4	14	63.6	n.s.
Seasonal bronchial symptoms: Yes (%)	98	40.0	9	40.9	n.s.
Preventive medicines for bronchial symptoms: Yes (%)	80	32.7	12	54.5	.038

Table 2 - Prevalence rates and mean values of demographic characteristics, allergic symptoms and use of preventive medicines in the last 12 months by study group in the Pisa enrolled sample.

	Group A (n=79)		Group B (n=78)		Group C (n=88)		
	N		N		N		p
Gender: Females (%)	54	68.4	44	56.4	58	65.9	n.s.
Age: Means ± SD (years)	79	47.8 ±12.9	78	39.5±11.3	88	54.8±13.8	<.001
Overall nasal symptoms: Yes (%)	74	93.7	73	93.6	81	92.0	n.s.
Seasonal nasal symptoms: Yes (%)	72	91.1	69	88.5	71	80.7	n.s.
Preventive medicines for nasal symptoms: Yes (%)	39	49.4	44	56.4	38	43.2	n.s.
Overall ocular symptoms: Yes (%)	66	83.5	62	79.5	65	73.9	n.s.
Seasonal ocular symptoms: Yes (%)	62	78.5	58	74.4	58	65.9	n.s.
Preventive medicines for ocular symptoms: Yes (%)	12	15.2	14	17.9	16	18.2	n.s.
Overall bronchial symptoms: Yes (%)	46	58.2	47	60.3	33	37.5	.005
Seasonal bronchial symptoms: Yes (%)	35	44.3	41	52.6	22	25.0	.001
Preventive medicines for bronchial symptoms: Yes (%)	27	34.2	32	41.0	21	23.9	.059

(34.2%) and group B (41%). Conversely, prevalence rates of the other characteristics and symptoms did not significantly differ among the three study groups. Seasonal nasal symptoms were the most prevalent pollen allergy symptoms in group A (91.1%), B (88.5%) and C (80.7%), followed by seasonal ocular symptoms with a prevalence rate of 78.5% in group A, 74.4% in group B and 65.9% in group C.

All three study groups showed a low intake of preventive medicines; they were mainly used for seasonal nasal symptoms: 49.4% in group A, 56.4% in group B and 43.2% in group C (tab. 2).

DISCUSSION

An observational survey on 618 allergic subjects selected from pre-existing data sets was carried out in Pisa, Central Italy. The overall participation rate was 50.1% (245 participants/489 contacted subjects), but considering the expected target of 250 subjects the participation rate increases to 98% thus allowing to produce results with a sufficient statistical power and to reasonably obtain a population-representative sample.

Actually, participation rates for epidemiological surveys have been declining during the past decades throughout the world (13). Two examples are the Behavioral Risk Factor Surveillance Survey, conducted by the Centers for Disease Control and Prevention (CDC) since 1984, which reported a median participation rate of 71.4% in 1993, 48.9% in 2000, and 51.1% in 2005 (13) and the Framingham Heart Study, whose participation rate in the original study started in 1948 was 69% while the participation rate for the Multi-Ethnic Study of Atherosclerosis started in 2000 was 59.8% (13).

In the AIS study, the planned time frame for enrollment was prolonged mainly because of the high rate of subjects reporting at least one exclusion criterion in the Screening questionnaire such as transfer outside the study area and the unexpectedly large use of immunotherapy; untraceableness of the selected subjects for the massive transition from landline to mobile phone in the last decades; a high rate of refusals due to lack of time, a pressing problem of modern societies which is heavily affecting research projects depending on real life. Indeed, the changes in society and work have led not only to changed demands, but also to a generally undisputed increase in

heterogenic psychomental and psychosocial stress due to pressure of time, overtime and shift work, as well as mobbing, economic pressures, and multiple tasks such as job, family and leisure activities (14). However, a very common strategy for considering the potential bias introduced by study nonparticipation is the collection of minimal data on nonrespondents for comparisons with respondents. These preliminary results underline a few differences between eligible subjects participating and not participating in the study in relation to mean age, prevalence rate of seasonal nasal symptoms and prevalence rate of use of preventive medicines for bronchial symptoms to be taken into account in the future analyses. Furthermore, statistical methods for adjustment of potential bias introduced by differences among the three study groups in relation to age, prevalence rate of seasonal bronchial symptoms and use of preventive medicines for bronchial symptoms will be applied. Only the completion of the study expected by the end of 2017 will allow to fully evaluate the effectiveness of the two AIS in improving allergic diseases management thus paving the way for new, permanent information systems and for a continuous innovation of the proposed model. In addition, in order to raise general public's willingness to accept this kind of intervention, advocacy work needs to be supported.

CONCLUSIONS AND FUTURE PERSPECTIVES

These preliminary results underline a few differences between eligible subjects participating and not participating in the study and among the study groups to be taken into account in data analysis of the completed study. In Italy the majority of patients with pollens-induced allergy experienced nasal and ocular symptoms throughout the year with, on the contrary, a still suboptimal use of preventive medicine. In the current context of climate change, an effort to reduce the combined effects of pollen and pollutants on the population affected by allergic respiratory diseases is urgently needed. Thus, educational strategies and comprehensive information systems like those implemented in the AIS project should be developed, set up and disseminated across the EU, in order to reduce the effects of environmental factors on onset and exacerbation of allergic asthma and rhinitis.

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REFERENCES

Baldacci S., Maio S., Cerrai S., Sarno G., Baïz N., Simoni M., Annesi-Maesano I. & Viegi G.; HEALS Study, 2015 Allergy and asthma: Effects of the exposure to particulate matter and biological allergens. *Respiratory Medicine* 109(9):1089-104.

Cecchi L., D'Amato G., Ayres J.G., Galan C., Forastiere F., Forsberg B., Gerritsen J., Nunes C., Behrendt H., Akdis C. & Dahl R., Annesi-Maesano I., 2010 Projections of the effects of climate change on allergic asthma: the contribution of aerobiology. *Allergy* 65(9):1073-81.

Singh A.M. & Busse W.W., 2006 Asthma exacerbations. 2: aetiology. *Thorax* 61(9):809-16.

Levetin E. & Van de Water P., 2001 Environmental contributions to allergic disease. *Current Allergy and Asthma Reports* 1(6):506-14.

Walter H., Sadeque-Iqbal F., Ulysse R., Castillo D., Fitzpatrick A. & Singleton J., 2015 The effectiveness of school-based family asthma educational programs on the quality of life and number of asthma exacerbations of children aged five to 18 years diagnosed with asthma: a systematic review protocol. *JBI Database of Systematic Reviews and Implementation Reports* 13(10):69-81.

Pawankar R., Canonica G.W., Holgate S.T. & Lockey R.F., 2012 White book on allergy 2011-2012: executive summary. WAO – World Health Organization, Geneva.

De Marco R., Cappa V., Accordini S., Rava M., Antonicelli L., Bortolami O., Braggion M., Bugiani M., Casali L., Cazzoletti L., Cerveri I., Fois A.G., Girardi P., Locatelli F., Marcon A., Marinoni A., Panico M.G., Pirina P., Villani S., Zanolin M.E. & Verlato G.; GEIRD Study Group., 2012 Trends in the prevalence of asthma and allergic rhinitis in Italy between 1991 and 2010. *European Respiratory Journal* 3(9):883-892.

Ghitarrini S., Tedeschini E., Timorato V. & Frenguelli G., 2017 *Climate change: consequences on the pollination of grasses in Perugia (Central Italy). A 33-year-long study. International Journal of Biometeorology* 61(1):149-158.

Bousquet J., Neukirch F., Bousquet P.J., Gehano P., Klossek J.M., Le Gal M. & Allaf B., 2006 Severity and impairment of allergic rhinitis in patients consulting in primary care. *Journal of Allergy and Clinical Immunology* 117:158-162.

Maio S., Baldacci S., Carrozzi L., Pistelli F., Angino A., Simoni M., Sarno G., Cerrai S., Martini F., Fresta M., Silvi P., Di Pede F., Guerriero M. & Viegi G., 2016 Respiratory symptoms/diseases prevalence is still increasing: a 25-yr population study. *Respiratory Medicine* 110:58-65.

Schmid-Grendelmeier P., 2012 Pollen allergy and immunotherapy. *Ther Umsch* 69:239-248.

Bousquet J., Khaltaev N., Cruz A.A., *et al.*; World Health Organization.; GA(2)LEN.; AllerGen, 2008 Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). *Allergy* 63(86):8-160.

Galea S. & Tracy M., 2007 Participation rates in epidemiologic studies. *Annals of epidemiology* 17(9):643-53.

Weber A. & Jaekel-Reinhard A., 2000 Burnout syndrome: a disease of modern societies? *Occupational Medicine* 50(7):512-517.

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