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Review

Migrant Workers and Physical Health: an Umbrella Review

Nicola Mucci[1,*], Veronica Traversini[1], Gabriele Giorgi[2], Giacomo Garzaro[3], Javier Fiz-Perez[2], Marcello Campagna[4], Venerando Rapisarda[5], Eleonora Tommasi[1], Manfredi Montalti[1], Giulio Arcangeli[1]

[1] Department of Experimental and Clinical Medicine, University of Florence, 23 Largo Piero Palagi, I-50139 Florence, Italy; nicola.mucci@unifi.it (N.M.); veronica.traversini@unifi.it (V.T.); eleonora.tommasi@unifi.it (E.T.); giulio.arcangeli@unifi.it (G.A.)

[2] Department of Human Sciences, European University of Rome, 190 Via degli Aldobrandeschi , I-00163 Roma Rome, Italy; gabriele.giorgi@unier.it (Ga.Gi.); javier.fizperez@unier.it (J.F.P)

[3] Department of Public Health Sciences and Pediatrics, University of Turin, 94 Piazza Polonia, I-10126 Turin, Italy; giacomo.garzaro@unito.it (Gi.Ga.)

[4] Department of Medical Sciences and Public Health, University of Cagliari, SS 554 bivio Sestu, I-09042 Monserrato, Cagliari, Italy; mcampagna@unica.it (M.C.)

[5] Department of Clinical and Experimental Medicine, University of Catania, 89 Via Santa Sofia, I-95123 Catania, Italy; vrapisarda@unict.it (V.R.)

* Correspondence: nicola.mucci@unifi.it; Tel.: +39-055-417-769

Abstract: Migrants are mainly employed in "3D Jobs" dirty, dangerous, difficult, characterized by monotony, intense rhythms, in sectors at higher risk as construction, heavy industry, agriculture. Aim of this study is to elaborate a systematic review, in order to identify the main occupational risks and occupational diseases of this category. Research included articles published from 2013 to 2018 on the major online databases (PubMed, Cochrane Library and Scopus), using a combination of some keywords (migrant workers, expatriates, physical health, diseases, illnesses, travel, travelers, work and occupational). The online search indicated 1.109 references. We excluded 977 studies, because unrelated to physical health and 64 due to duplication. They were analyzed 68 articles, including 6 reviews and 62 original article. The main risk emerged are to developing infectious diseases, metabolic cardiovascular diseases and to manifesting a lower quality of life, in particular due to difficulties in accessing local health services. It will be crucial to implement the role of occupational medicine in order to introduce multilevel interventions designed to prevent work-related injuries and illnesses and to promote healthier working environments.

Keywords: migrant workers; expatriates; workplace; physical health; umbrella review; organizational psychology; occupational health

1. Introduction

The term "*expatriate*" derives from the Latin "*expatriare*", that is "leave your country". According to this definition, expatriates are people who leave their country of origin to live in another context. Often, the term expatriate can indicate all those people who do not intend to live abroad forever and wish to maintain their original nationality for practical reasons [1].

In this sense, an expatriate is different from an immigrant who settles permanently in the country in which he transfers and acquires a new nationality. Moreover, the term "expatriate" is used for workers from industrialized countries who move abroad for relatively short periods (for example, "business travel"). With the rise of globalization, the framework includes also the technical and manual employees who work for small businesses or for innovative sectors, not only the so-called "white collar workers".

The migration phenomenon is constantly growing; according to the latest United Nations' estimates, the number of migrants is almost doubled, passing from 173 million in 2000 to 258 million in 2017. Over 60% of the emigrants live on the Asian continent (about 80 million) and in Europe (about 78 million). As regards the origin, more than 100 million emigrate from Asia, in particular from India, followed by Europe (61 million), Latin America (38 million) and Africa (36 million). In 48% of cases they are female and 74% are between the ages of 20 and 64 [2].

According to a research carried out by the HSBC Expat Explorer in 2008, the opinion on a particular country changes using a subjective rather than objective judgment, such as the standard of living. The most positive impressions are thus recorded in Germany, followed by Canada and Spain. In these countries, expatriates are used to socializing with the local population and learning the language, joining groups or communities and even buying properties. Generally, in these countries it is quite easy to integrate, both for expatriates and for family members. Following the same criteria, China and the United Arab Emirates are the countries in which immigrants encounter many difficulties of integration and adaptation to culture [3]. Expatriates can become, if properly integrated, an important resource to promote the sustainable development of the country in which they move. The psychology of sustainability and sustainable development is an innovative field of research which, through the promotion of interpersonal and intrapersonal talents, aims to improve the general quality of life of the community [4].

With regard to employment, immigrants are mainly employed in heavy and risky jobs (the so-called "3D Jobs" - *dirty, dangerous, difficult*-), namely manual, tiring, dangerous activities, characterized by monotony and very intense rhythms. These are often low-income activities, concentrated in sectors traditionally at higher risk (such as the construction sector, heavy industry, transport, services, agriculture), activities that employ immigrants for a number of hours' higher work compared to native workers and often not corresponding to the actual professional profile of the immigrant [5].

The international community has adopted many legal instruments to protect expatriate populations; among these, the documents drawn up during the "*International Convention on the Protection of the Rights of All Migrant Workers and Members of their families*" held in New York in 1990 and the "*Protocol to prevent, suppress and punish trafficking in persons*" in New York in 2000 stand out for their importance. These tools, along with the rights of migrant workers adopted by the *International Labor Organization* (ILO), form the foundations of migrants' international legislations [2].

Italy has also expressed itself in this sense, essentially with the introduction of the Legislative decree no. 81/2008 and subsequent amendments, in which it appears a differentiated and functionalized protection system for this working category. Migrant worker is included in the "priority groups", through which specific strategies on health and safety at work are set up. The "special risks" must be assessed individually and in a reciprocal relationship with each other: in this case, the origin from other countries is frequently associated with the precariousness of work, the use of non-standard contractual forms, stressful situations caused by work context (role in the organization, interpersonal relationships, etc.) and work content (type of tasks, load, rhythms and working hours, etc.) and finally age and gender differences, given the high rates of youth and female immigrant employees [6]. The psychology of sustainability is another great opportunity for the protection and development of expatriates in the workplace. Their experience in the country of origin, re-elaborated according to a positive narrative, enriches the companies of the host country with a sustainable and multicultural development [7, 8].

The purpose of this study is to elaborate a systematic review of the scientific literature regarding the health status of migrant workers, in order to identify the main occupational risks and occupational diseases that these workers can encounter and highlight some suitable preventive strategies to apply in this area.

2. Materials and Methods

The presentation of this systematic review is in accordance with the PRISMA statement [9].

2.1. Literature research

The research included articles published in the last 5 years, from 2013 to 2018 on the major online databases (PubMed, Cochrane Library and Scopus). The search strategy used a combination of controlled vocabulary and free text terms based on the following keywords: migrant workers, expatriates, physical health, diseases, illnesses, travel, travelers, work and occupational medicine. All research fields were considered. Additionally, we practiced a hand search on reference lists of the selected articles and reviews to carry out a wider analysis.

Two independent reviewers read titles and abstracts of the reports identified by the search strategy. They selected relevant reports according to inclusion and exclusion criteria. Doubts or disagreements were solved by discussion with a third researcher. Finally, they independently screened the corresponding full text to decide on final eligibility.

2.2. Quality assessment

Three different reviewers assessed the methodological quality of the selected studies with specific rating tools. We used INSA method "International Narrative Systematic Assessment" [10] to judge the quality of narrative reviews, AMSTAR to evaluate systematic reviews and the Newcastle Ottawa Scale to evaluate cross-sectional, cohort studies and case control studies [11]; while the JADAD scale was applied for randomized clinical trials [12].

2.3. Eligibility and Inclusion Criteria

No restrictions were applied for language or publication type. The studies included in this review focus on the physical health of migrant workers and the main diseases found in this particular category of workers.

2.4. Exclusion Criteria

We have excluded reports not related to physical disturbances of migrant workers, articles not related to workers, articles related to mental or stress disorders, articles about children or children of migrants. We have also excluded reports of less academic significance, editorial articles, individual contributions, and purely descriptive studies published in scientific conferences without any quantitative and qualitative inferences.

3. Results

The online search indicated 1.109 references: PubMed (591), Scopus (489) and Cochrane Library (29). Of these, 977 were excluded because they were not relevant to the physical health of migrant workers. Of the remaining, 64 items were excluded because they were duplicates. Finally, 68 studies were included in this review (Figure 1).

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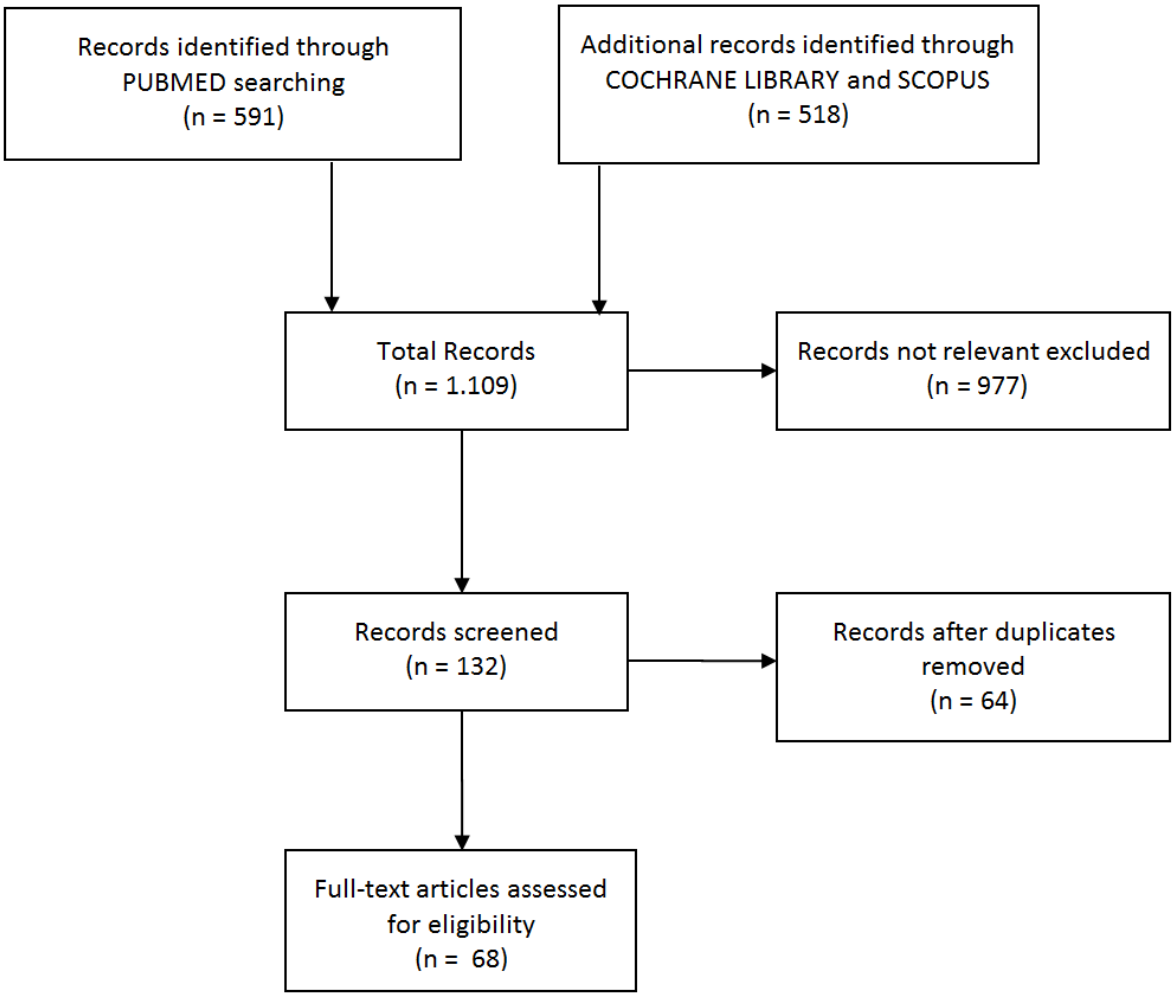

Figure 1. Flow-chart of the bibliographic research.

Of these, 6 are reviews and 62 are original articles. Among the original articles, 50 were cross-sectional studies, 5 were clinical trials, 3 cohort studies, 2 clinical cases and 2 cases (Table 1).

Table 1. Manuscripts included in the review with the related score.

Authors	Year of publication	Countries of publication	Types of study	Score
Al Hosani F. et al	2013	Arab Emirates	cross sectional	N.6
Al Rifai R. et al	2015	Japan	cross sectional	N. 8
Anjara SG. et al	2017	Malesia	cross sectional	N. 7
Arcury T. et al	2013	America	Review	I.4
Banerjee M. et al	2015	India	cross sectional	N. 6
Bener A.	2017	Arab Emirates	cross sectional	N.6
Bhandari P. et al	2016	Korea	cross sectional	N. 7
Bi Y. et al	2016	China	cross sectional	N. 7
Biering K. et al	2016	Denmark	cross sectional	N.6
Brumitt J. et al	2013	America	cross sectional	N. 6
Castaneda S. et al	2015	America	cross sectional	N.7
Chen H. et al	2016	China	cross sectional	N. 5
Chen W. et al	2016	China	trial	J.4

Dafalla A. et al	2017	Arab Emirates	cross sectional	N. 7
Dodd V. et al	2016	America	cross sectional	N. 5
Dodd W. et al	2017	South India	cross sectional	N.6
Earle-Richardson G. et al	2014	America	case control	N.6
Fan W. Et al	2017	America	cross sectional	N. 7
Fernandez B.	2018	Australia	review	I.5
Fitzgerald S. et al	2017	China	Review	A.7
Fonseca A. et al	2017	Portugal	cross sectional	N. 5
Gao XF. et al	2015	China	cross sectional	N.6
Goldenberg SM et al	2018	America	cross sectional	N. 5
Habib RR et al	2016	Lebanon	cross sectional	N. 6
Hsieh YC et al	2016	America	cross sectional	N. 7
Jensen MT. et al	2015	Norway	cross sectional	N. 6
Khongthanachayopit S. et al	2017	Thailand	cross sectional	N.7
Kumparatana P. et al	2017	America	cross sectional	N.7
Lee WS et al	2017	China	cross sectional	N.7
Lee H. et al	2017	Korea	trial	J.3
Leng A. et al	2016	China	cross sectional	N.5
Li W. et al	2016	China	trial	J.3
Li Y. et al	2013	China	case report	
Lu C. et al	2015	China	cross sectional	N.7
Lu C. et al	2014	China	cross sectional	N.7
Lu L. et al	2014	China	cross sectional	N.7
Mannocci A. et al	2016	Italy	Cohort study	N.7
Martin M. et al	2016	America	cross sectional	N.7
Mendelsohn J. et al	2015	China	trial	J.3
Modesti P. et al	2017	Italy	cross sectional	N.6
Ning C. et al	2013	China	Cohort study	N.8
Norris A. et al	2017	America	cross sectional	N.7
Perez- Carceles MD et al	2014	Spain	cross sectional	N.7
Pichardo-Geisinger R et al	2013	America	cross sectional	N. 7
Rodriguez G. et al	2016	America	cross sectional	N.5
Ronda E. et al	2015	Spain	cross sectional	N.3
Sabhlok A et al	2015	India	review	I.4
Sanchez J. et al	2013	America	trial	J.3
Sadarangani S. et al	2017	Malesia	Review	A.4
Salyer S.J. et al	2014	America	cross sectional	N.6
Shah S. et al	2017	Arab Emirates	cross sectional	N.7
Shah S. et al	2015	Arab Emirates	cross sectional	N.7
Shah S. et al	2015	Arab Emirates	cross sectional	N.7
Simkhada P.P. et al	2017	Uk	Review	I.7
Skogberg N. et al	2017	Finland	cross sectional	N.7
Taha H.A. et al	2013	Arab Emirates	cross sectional	N.6

Tam W. et al	2017	Malesia	cross sectional	N. 4
Thomas B. et al	2014	South India	cross sectional	N.7
Urmi AZ et al.	2015	Bangladesh	cross sectional	N.7
Varadharajan K. et al	2013	India	cross sectional	N.7
Vernier M. et al	2013	France	cohort study	N.5
Wang D et al	2015	China	case report	
Wang P. et al	2015	China	cross sectional	N.7
Wangroongsarb P. et al	2016	Thailand	cross sectional	N.7
Xing H. et al	2013	China	case control	N.6
Yan S. et al	2016	China	cross sectional	N.6
Yang H. et al	2015	China	cross sectional	N.7
Yang H. et al	2017	China	cross sectional	N.7

3.1. Reviews

As for the scores of the narrative reviews, the INSA score shows an average of 5, a median of 4.5 and a modal value of 4 (Table 2), thus indicating an intermediate quality of the studies. The most appropriate methodological narrative review was a study conducted by the United Kingdom in Nepal (INSA = 7). As for the reviews of the systematic reviews, the Amstar score shows an average and a median of 5.5.

Table 2. Review, trial, case-control, case-report, and cohort studies with the specific diseases and job categories.

Authors	Year	Type of study	Diseases	Workers' Categories	Score
Arcury T. et al	2013	Review	injury, illnesses, pesticides	Agriculture, Foresty and Fishing Sector	I.4
Fernandez B.	2018	Review	pregnancy, injuries, illnesses	Domestic Workers	I.5
Fitzgerald S. et al	2017	Review	Work Injuries	Construction, manual labour, employees	A.7
Sabhlok A et al	2015	Review	respiratory diseases, injuries	Road workers	I.4
Sadarangani S. et al	2017	Review	Infectious diseases	Employees and domestic workers	A.4
Simkhada P.P. et al	2017	Review	sexual risks, injuries, alcohol, drugs	Employees and agriculture workers	I.7
Chen W. et al	2016	Trial	organic solvent's exposure	Employees	J.4
Lee H. et al	2017	Trial	cardiovascular risk	Employees	J.3

Li W. et al	2016	Trial	Malaria	Staff members of company	J.3
Mendelsohn J. et al	2015	Trial	Sexual infections	Construction workers	J.3
Sanchez J. et al	2013	Trial	Sexual infections	Agriculture	J.3
Xing H. et al	2013	Case control	quality of life	Shoes factory, textile industry,domestic, construction, transport	N.6
Earle-Richardson G. et al	2014	Case control	eye irritations	Farmworkers	N.6
Li Y. et al	2013	Case report	Malaria	Not specified	not applicable
Wang D et al	2015	Case report	Infectious diseases	Not specified	not applicable
Vernier M. et al	2013	Cohort study	hepatitis	Employees	N.5
Ning C. et al	2013	Cohort study	Sexual infections	Construction and mining workers	N.8
Mannocci A. et al	2016	Cohort study	Cardiometabolic diseases	Oil And Gas Workers	N.7

The review written by Fitzgerald and colleagues takes into account health surveillance and the prevention of accidents at work among migrant workers in China. The literature review revealed inconsistent injury surveillance among such workers. Although limited, the data suggest that many migrants work in hazardous environments and injury rates are disproportionately high, with traumatism, especially in the manufacturing and construction sectors. The authors suggest ways of improving prevention, strengthening the national workplace safety system, improving workplace safety training and access to appropriate safety devices [13].

Sabhlok and colleagues also focus on the injuries in a particular category of migrant workers, i.e. road builders in the Himalayan territory: the authors point out how these workers, often exploited, develop symptoms of high-altitude work syndrome, as headache, asthenia, respiratory disorders (dyspnea, chest pain, pulmonary edema) and various diseases, such as pulmonary fibrosis, chronic bronchitis and lung cancer, due to exposure to environmental pollutants. These workers are subjected to high levels of stress, because they are separated from their families for months, working in inhospitable environments and in extreme physical conditions. All of this results in inappropriate lifestyles, such as alcohol abuse and gambling [14].

In the review by Saradangani and colleagues in 2017, significant percentages of malaria, enteric fevers, hepatitis and tuberculosis were found among expatriate workers in Singapore. The cases of hepatitis E remain low but migrant workers account are half the subjects involved. Migrants employed in the construction sector are more likely to contract infections, such as Dengue, Zika and Chikungunya. Probably migrant workers in South East Asia appear to be at higher risk than the native population, due to a complex interaction of several factors, including a greater prevalence of

the disease in their countries of origin, socio-economic factors, conditions of life and financial, linguistic and cultural barriers to access to the health care network. For this reason, receiving countries need reinforced surveillance, increasing preventive measures and reducing barriers to access to healthcare for migrant workers [15].

From the Simkhada's article, some major risk factors have emerged involving the health of Nepalese workers who move to foreign countries, including sexual habits, type of work and lifestyles. Sexual behavior can be seen from a perspective of loneliness and desire when one is separated from partners for long periods, and then risky behavior is adopted, a condition called "situational disinhibition". In addition, Nepalese migrant workers often deal with dangerous jobs and degrading that local workers not want to do. The inherent risks expose migrant workers at greater risk of workplace accidents and diseases: the most common injuries are cuts, bone fractures and joint sprains. According to the authors, 82% of workers in the agricultural and construction sector reported injuries in the previous 12 months. Furthermore, in the agricultural sector, most of the Nepalese workers show a poor use of personal protective devices [16].

Eight specific professional exhibitions emerged from the Arcury's scientific review, which can influence the health status of immigrant workers employed in the agriculture, fisheries and forestry sectors. These risks include the working environment (microclimate, plants, animals), toxic biological substances (allergens and dust), transport, machinery, physical agents (vibrations, noise), chemicals (pesticides, solvents) and, finally, lack of access to medical care [17].

Fernandez et al. examined health needs through an analysis of Ethiopian migrant domestic workers who have access to health care in Lebanon. The needs of health care in Lebanon emerged from the study can be classified into four types of situations: minor illnesses that require only outpatient care; pregnancies, serious illnesses (such as cancer, tuberculosis or heart problems) and emergencies (due to accidents, assaults or suicide attempts). These inequalities in access to health care are intensified for international migrants as a socio-economic group with a less privileged status than citizens. Furthermore, migrants with precarious, temporary or irregular status are more vulnerable and marginalized than regular migrants, as they are often unable to make use of state health services. Health inequalities faced by migrants may be due to lack of rights based on their migrant status (migrants with temporary contracts, migrants with irregular or irregular status) and / or due to gender, class, race and ethnicity barriers [18].

3.2. Original Articles

The scores assigned to the transversal articles have an average value of 6.4, a median and a modal value of 7 (Table 3). This situation represents a good quality of studies; the studies conducted in Japan and in China obtained the highest values.

Table 3. Cross-sectional studies with the specific diseases and job categories.

Authors	Year	Type of study	Diseases	Job categories	Score
Al Hosani F. et al	2013	cross sectional	Tuberculosis	Office workers, drivers, domestic, food handlers, etc.	N.6
Al Rifai R. et al	2015	cross sectional	Sexual infections	Domestic Workers and Multinational workers	N. 8
Anjara SG. et al	2017	cross sectional	lower quality of life	Domestic Workers	N. 7
Banerjee M. et al	2015	cross sectional	Dermatologic and respiratory problems	Construction workers	N. 6

Bener A.	2017	cross sectional	BMI, smoke, pain, cardiovascular, gastrointestinal diseases	construction, agriculture, driver	N.6
Bhandari P. et al	2016	cross sectional	perceived health, physical activity	Manual laborers, domestic, construction, office, others	N. 7
Bi Y. et al	2016	cross sectional	Diabetes	manufacturing, construction, services, accommodation	N. 7
Biering K. et al	2016	cross sectional	Work Injuries	Employees	N.6
Brumitt J. et al	2013	cross sectional	Smoke tobacco/ Physical activity	Seasonal Farmworkers	N. 6
Castaneda S. et al	2015	cross sectional	Cardiovascular diseases	Seasonal Farmworkers	N.7
Chen H. et al	2016	cross sectional	quality of life	government, private enterprises, employees	N. 5
Dafalla A. et al	2017	cross sectional	infectious diseases	food handlers, babysitters, housemaids, drivers	N. 7
Dodd V. et al	2016	cross sectional	Oral cancer	Farmworkers	N. 5
Dodd W. et al	2017	cross sectional	musculoskeletal disorders, infective diseases, skin problems	construction, textile sector, manufacturing	N.6
Fan W. Et al	2017	cross sectional	lower quality of life	agriculture, textile, construction	N. 7
Fonseca A. et al	2017	cross sectional	Malaria, endocrine, metabolic, cardiovascular and respiratory	Directors, managers, specialist in scientific activities	N. 5
Gao XF. et al	2015	cross sectional	Tuberculosis	employees	N.6
Goldenberg SM et al	2018	cross sectional	Infectious diseases, alcohol abuse	migrant sex workers	N. 5
Habib RR et al	2016	cross sectional	respiratory, digestive, musculoskeletal disorders	farmworkers	N. 6
Hsieh YC et al	2016	cross	dermatologic,	housekeepers	N. 7

		sectional	musculoskeletal problems		
Jensen MT. et al	2015	cross sectional	muscle pain, gastric discomfort	Business Travellers	N. 6
Khongthanachayopit S. et al	2017	cross sectional	musculoskeletal disorders, diabetes, hypertension, allergy	Agriculture Sector, Employees in restaurant/factory	N.7
Kumparatana P. et al	2017	cross sectional	lower health, alcohol	employees	N.7
Lee WS et al	2017	cross sectional	BMI	agriculture	N.7
Leng A. et al	2016	cross sectional	Hepatitis B	Rural Workers	N.5
Lu C. et al	2015	cross sectional	chronic diseases	employees factory	N.7
Lu C. et al	2014	cross sectional	BMI	textile factory	N.7
Lu L. et al	2014	cross sectional	quality of life	employees factory	N.7
Martin M. et al	2016	cross sectional	Cardio-metabolic diseases	sales workers, agriculture, forestry, manufacturing, administrators	N.7
Modesti P. et al	2017	cross sectional	Diabetes 2	Textile employees, manager, student, house keepers	N.6
Norris A. et al	2017	cross sectional	HIV	Employees	N.7
Perez- Carceles MD et al	2014	cross sectional	Hazardous Drinking	Construction industry and agriculture	N.7
Pichardo-Geisinger R et al	2013	cross sectional	Dermatologic problems	manual and poultry workers	N. 7
Rodriguez G. et al	2016	cross sectional	Pain, stress, blood pressure	Employees in service, in production and office support	N.5
Ronda E. et al	2015	cross sectional	muscle pain, headache, gastric discomfort	Employees, domestic, construction	N.3
Salyer S.J. et al	2014	cross sectional	Infectious diseases	Non-governmental organization workers	N.6
Shah S. et al	2017	cross sectional	Diabetes	employees	N.7

Shah S. et al	2015	cross sectional	obesity and cardiovascular risk	employees	N.7
Shah S. et al	2015	cross sectional	Hypertension	Drivers, costruction agriculture, salesman, office, tailor, cook keeper	N.7
Skogberg N. et al	2017	cross sectional	Metabolic syndrome	employees	N.7
Taha H.A. et al	2013	cross sectional	Infectious diseases	farmer, food handlers, shepherds, drivers, housemaids	N.6
Tam W. et al	2017	cross sectional	influenza, gastritis, cancer, accidents	manual workers	N. 4
Thomas B. et al	2014	cross sectional	Chest symptoms	brick kiln workers	N.7
Urmi AZ et al.	2015	cross sectional	Sexual infections	Employees	N.7
Varadharajan K. et al	2013	cross sectional	Obesity	Professional, Technical & Managerial, sales, services, manual labour	N.7
Wang P. et al	2015	cross sectional	Lifestyle behaviors	service sector, construction, manager	N.7
Wangroongsarb P. et al	2016	cross sectional	Malaria	agriculture, domestic, factory, fishery	N.7
Yan S. et al	2016	cross sectional	Diabetes	not specified	N.6
Yang H. et al	2015	cross sectional	BMI	manufacturing, construction, hospitality, domestic, small business,recreation	N.7
Yang H. et al	2017	cross sectional	Lifestyle behaviors	Manufacturing, construction, hospitality, domestic, small business, recreation	N.7

The most represented labor categories in transversal studies are farmers (15 studies; 29.4%), construction and construction workers (12 studies; 23.5%) and domestic workers (8 studies; 15.6%).

In these studies, the risk of contracting infectious diseases (12 studies; 23.5%) and of developing metabolic diseases (11 studies; 19.6%) are examined above all; 8 studies (15.6%) highlight the quality

of life of migrant workers in a foreign country, 6 studies (11.7%) investigate cardiovascular diseases while about 10 articles (19.6%) deal with different pathologies (muscular disorders, dermatological disorders, gastrointestinal and tumor affections).

3.2.1. Infectious diseases

In the study by Dafalla and colleagues, a large sample of expatriates in the United Arab Emirates is examined. The authors found intestinal parasitic infections in 3.3% of the sample and, among these, 96% were positive for a single parasite, such as Giardia (36%) and Entamoeba histolytica (31%). Infections were positively correlated with gender (male workers) and with the occupational category (mostly workers in the food and agriculture industries) [19]. Percentages of higher intestinal infections among migrant workers were also found in the study of Taha and colleagues, with higher infections among farmers (20.6%) followed by food handlers (18.8%), shepherds (17.8%), drivers (13.4%) and domestic (13.3%). The type of infections is slightly influenced by employment: Trichura was the most common parasite among household workers (28.8%), Giardia Lamblia was more frequent among drivers (30.3%) and farmers (24.2%). %), finally the Entamoeba histolytica / Escherichia Coli was the most represented among pastors (41.2%) and food handlers (66.6%) [20].

Tuberculosis is a global public health problem. The results of the Al Hosani's study confirm this aspect: the prevalence of active TB between expatriate adult expatriates in the United Arab Emirates (about 39 per 100,000) is about 14 times higher than the estimated prevalence of tuberculosis in the native population [21]. According to the study by Gao and colleagues, China and in particular the Sichuan Province is one of the countries with the highest prevalence of tuberculosis, settling on 459 cases out of 100,000. For this reason, the authors investigated the quality of life in migrants suffering from tuberculosis; the results of QOL (Quality of Life) were significantly lower compared to the indigenous Chinese population, especially in physical, psychological and environmental domains (with scores of 12.1, 12.9, 11.7, respectively). Subjects over 50 reported worse scores, such as those with poorer levels of education [22].

In some European countries, such as Portugal, there is a growing wave of expatriation and emigration that mainly includes sub-Saharan African destinations, such as Angola and Mozambique [23]. This aspect involves an increasing number of hospitalizations for the diagnosis of imported malaria. The study by Fonseca and colleagues aims to understand the morbidity of Portuguese expatriates in Africa and the preventive measures applied to malaria, through questionnaires administered to 352 workers. The main occupations were executive managers (n = 77; 21.9%) and specialists in intellectual and scientific activities. 74 people (21%) reported at least one new health problem in the previous 3 months; the most common diseases reported were infections, including pneumonia (15 cases), malaria (12), intestinal infections (8), typhoid fever (5) and a case of tuberculosis. Because of these, 39 individuals (11.1%) reported temporary sick leave, 72 (20.5%) required medical assistance and 17 (4.8%) were hospitalized. In 64% of cases (n = 226) psychological disorders were reported, such as fatigue, stress and longing. About 87% of people used personal anti-mosquito protection measures, namely repellents (54.8%), mosquito nets (24.7%), air conditioning (76.4%), domestic insecticides (52.6%), covering arms and legs in the evening (24.1%). With regard to chemoprophylaxis, 133 individuals (37.8%) reported not having taken it, 6 (1.7%) took mefloquine or atavaquone / proguanil and 213 (60.5%) reported having taken it only initially [24].

3.2.2. Cardiovascular and metabolic diseases

Overweight and obesity are more common among male migrant workers than the native male population. Cardio-metabolic risk profiles for migrant workers are often not optimal. In the Bi's study, about 50,000 Chinese migrant workers aged between 18 and 59, the prevalence estimates were 26.8% for overweight, 4.7% for obesity, 29.4% for central obesity, 30.5 % for prediabetes, 5.1% for free diabetes, 16.3% for hypertension, 34.5% for dyslipidemia and 18.6% for metabolic syndrome [25].

The study by Varandharajan notes that some specific aspects of migration are associated with overweight / obesity. In this study, migrant women in rural areas reported a lower frequency of consumption of fruit, eggs and fish (44%, 30% and 23% respectively) compared to the natives (61%, 44% and 36% respectively). About 15% of women and 11% of men were overweight or obese. Factors such as the level of education, the type of employment and the economic status of workers are directly related to the prevalence of overweight / obesity. We have seen that gender differences play a fundamental role in moderating the risk of overweight / obesity among migrants, perhaps attributable to the different levels of knowledge and information on health, greater access to treatment and physical activity [26]. Further confirmations are obtained from Yang H. and colleagues, with 9.9% of the sample, consisting of migrant workers in China, hypertensive and 27% overweight or obese. The authors point out that workers employed in the manufacturing sector reported a less unhealthy lifestyle than those employed in the service sector. Worst life styles were mostly associated with workplaces in confined and confined spaces, with shifts of 8-11 hours a day [27].

The study by Shah and colleagues determined the prevalence, associated factors, awareness, treatment, control of hypertension among 1375 male immigrants from India, Pakistan, Bangladesh, residing in the United Arab Emirates. The average age of the participants was 34 years and the overall prevalence of hypertension is 30.5%; 76% of the sample classified as hypertensive was not aware of its conditions. 48% of the sample who knew about it reported having used the drugs and only 8% kept the blood pressure under control. Participants were more likely to be overweight or obese and practiced poor physical activity, less than 30 minutes a day [28].

Important results were obtained by Castaneda and colleagues, who reported some parameters associated with cardiovascular risk (blood pressure, obesity, diabetes, smoking and cholesterolemia) among a group of Latino migrants employed in agriculture compared to US seasonal workers: the results they showed a greater probability of developing obesity in migrant subjects (OR 2.15), especially in female subjects (OR 3.29), which are more affected by diabetes (OR 4.74) [29].

The aim of the Skokberg research was to compare the prevalence of the metabolic syndrome between migrants and Finnish citizens and evaluate any associated factors; the authors showed higher blood sugar levels, with lower HDL levels, among Russian, Somali and Kurdish migrant. Furthermore, female migrants have greater abdominal circumference values. The metabolic syndrome was associated with lower levels of education, low physical activity, low fruit and vegetable intake and unemployment state [30].

Diabetes is a serious public health problem among migrants, particularly in Southeast Asia [31]. The high prevalence of Type 2 Diabetes (T2DM) among first generation immigrants in Europe underlines the need for specific health programs for the early diagnosis, treatment and prevention of this disease [32]. In the study by Modesti and colleagues, of 1608 Chinese participants, 177 subjects presented T2DM (11%), 119 with a new diagnosis (7.4%). Among those with diabetes, 58 cases (32.8%) were aware of the disease and 46 (79%) were treated with hypoglycemic drugs. Other important data confirming has also been obtained from the study by Shah et al, in which among the HbA1C levels of the test sample, 18.6% had prediabetes and 10.7% had type 2 diabetes. The prevalence of prediabetes was 8.5% for Filipinos, 16.7% for Arabs and 30.3% for South Asians. Similarly, the prevalence of T2DM was 1.7% for Filipinos, 12.2% for Arabs and 16.7% for South Asians [31]. The study by Yan et al. reports a prevalence of diabetes of 11.6% on a sample of 1150 migrants transferred from rural to urban areas of China. The risk increases significantly with age, income, obesity and hypertension. Based on the SF36 scores, residents aged> 60 years with diabetes reported greater physical and emotional limitations, more physical pain and worse physical health than those without diabetes [33].

3.2.3. Quality of life

In the study by Ronda, the pressure and anguish experienced by immigrants due to the precariousness of working conditions are perceived as having an impact on their state of health and report symptoms such as widespread pain, especially muscular pains, headaches and gastric

disorders. Often the use of hypnoinductive drugs is a common mechanism to cope with such inconveniences. The worsening of eating habits, in term of food's quality and quantity, due to a reduced income, is frequent among immigrant workers [34].

Anjara and colleagues found a good quality of life among the study participants. However, more than half of the participants reported feeling stressed and almost 20% of the participants experienced isolation; both factors are associated with a worse quality of life [35].

Migrants from rural to urban areas, particularly employees in small and medium-sized enterprises, are more vulnerable to health risks and report lower Health Related Quality of Life (HRQOL) score levels [36]. Often this type of companies fails to provide adequate health protection to their migrant workers, due to insufficient funds, management problems and supervision. The studies of Lu et al confirmed this trend, in which workers with fixed working hours and higher salaries had higher HRQOL scores. Negative events such as a disease in the last two weeks and the need for access to treatment have negatively impacted the HRQOL score (β = -0.78), while a work contract, insurance, income, training, access to health care (weekly physical exercise, health check-up and use of protective devices) have led to an improvement in HRQOL (β = -0.20) [37].

Thai researchers [38] analyzed a sample of 600 migrant workers in Thailand to analyze access and quality of health services, a possible index of discrimination for the non-indigenous population. 63% of the subjects were female, in 80% employed in the catering sector and in 37%, they had contracted a disease in the previous 12 months. Of this 37%, only 14% were able to access local health services (in particular for economic difficulties, knowledge on health care systems and distance of hospitals compared to residence). About healthcare, 25 expatriate workers in Singapore, interviewed by Tam et colleagues, reported negative experiences, as like perceived collusion between doctors and employers, with holding of medical documentation, insufficient hospitalization or medical leave, and lack of discharge care. Difficulties with reporting work injury resulted in a loss of medical leave wages, an unduly long wait to receiving fair medical assessment and compensation, and the mental stress of waiting to be repatriated [39].

A cross-sectional study of over 400 food suppliers, immigrated to Kazakhstan, showed a low overall health status of 46%. Of these, a doctor does not follow less than 3% regularly and around 10% have a high consumption of alcohol. Among the female subjects, 30% reported mistreatment and 19% sexual assaults [40].

The cross-sectional study carried out by the Yang H. team on over 5,000 migrants, employed in Shanghai in the last 6 months, showed significant emerging problems regarding their quality of life; 21% reported mental disorders, such as obsessive-compulsive disorders, anxiety and hostility, and 63% unhealthy lifestyle habits. In comparison with the participants, men are more likely to be smokers, to consume more alcohol and less fruit and vegetables [41].

At last, using the HPM (Health Promoting Behavior) as a theoretical framework, the aim of Bhandari's study was to describe the HPB and identify the predictors of HPB in Nepalese adults working in South Korea. The most frequently practiced health behavior was spiritual growth, followed by interpersonal relationships, nutrition, health responsibility and stress management. Physical activity was the least practiced health behavior in foreign workers, although most participants were men [42].

3.2.4. Various diseases

In the study by Banerejee et al, on a sample of 340 masons, 33.2% of workers suffered from one or more types of respiratory symptoms, of which 107 (94.6%) workers reported that respiratory disorders began after the start of construction work. Forty-eight (14.1%) suffered from multiple respiratory symptoms while productive cough and dry cough were the two common symptoms, present in 27 (7.9%) and 19 (5.9%) patients respectively. 36.2% of workers suffered from dermatological problems, of which 116 (94.3%) workers said that the demonstrations began after the start of the job. Rashes (9.7%), redness (16.2%) and skin rash with pruritus (30.9%) were the most common dermatological symptoms [43].

The objectives of the study by Perez-Carceles et al. they were instead to identify workers with dangerous alcohol consumption, through AUDIT questionnaires and the "Carbohydrate-deficient transferrin" (CDT) biomarker and ascertain the associated risk factors. The results show that 13% of 385 migrant workers were positive with AUDIT> 8 and / or CDT> 2.6. Male sex, work in construction or agriculture, being resident in Spain for 7 years and sharing a home with friends are the most associated risk factors for increased alcohol consumption [44].

The most common pathologies in the Pichardo's cross sectional study were the dermatological diseases, present in 52.3% of the workers in the sample. Inflammatory skin diseases were present in 28.2% and pigment diseases in 21.8% of workers. The most common skin conditions were tinea pedis (37.6%), fungal infections (31.9%), scars (13.7%), acne (11.8%) and melasma (9.3 %). Age, sex and work (poultry farms) contribute in part to the prevalence of these diseases [45].

Migrant workers in Latin countries may suffer from serious health disparities, including poor oral health. The purpose of research by Dodd and colleagues was to assess risk awareness in this job category, including levels of personal care. Researchers gave specific questionnaires to farm workers in Hillsborough County, Florida. 53.7% of the respondents were female; the average age for males and females was 38.7 and 39.2 respectively. 6.7 % had never attended school; the knowledge of risk factors, signs and symptoms of oral cancer were low, with a lack of attention to prevention [46].

Agricultural workers involved in the study by Brumitt et al. completed a questionnaire on health and levels of physical activity. 58.2% of the subjects reported doing exercises during the week; 16% reported physical activity for 3 hours or more a week, 17% reported smoking and 10% reported chewing tobacco. Tobacco use is higher among individuals who do not practice sport [47].

3.3. Trial

With regard to the selected trials, the methodological quality was fair, having obtained a score greater than three in all the studies. Two of these experimental studies dealt with the prevalence of the risks of sexually transmitted diseases and risky behaviors among expatriate workers.

In the first study [48], the experimenters designed a three-phase trial: in Phase 1, data from a survey given to the workers of 18 building sites and the results of tests on HIV and sexually transmitted diseases were collected transmitted; in Phase 2, three educational interventions were implemented on the community (the first intervention consisted in the distribution of educational leaflets; in the second intervention, educational posters and a series of instructional videos were added, in the third consultancy with group and individual counseling sessions); finally, in Phase 3, 3 and 6 month follow-up interviews were conducted to evaluate the impact of interventions on risky behavior. Among the results obtained, men were twice as likely to participate in intervention activities (OR = 2.2; p = 0.036). There were no differences in participation among younger workers (<30 years) and older workers (OR = 1.1; p = 0.766). More educated workers had higher participation rates than less educated workers (OR = 1.9; p = 0.01).

In the second trial concerning sexually transmitted diseases [49], a community-based participatory research project, the "Project Salud", was presented with the aim of involving the Latin American community in Florida for the prevention of HIV. The main objective of the "Salud Project" is to compare and evaluate the effectiveness of 2 different methods: the so-called "Adapted Stage-Enhanced Motivational Interviewing (A-SEMI), divided into 4 group sessions to prevent HIV and encourage safe sexual behavior, and the "Health Promotion Condition" (HPC), aimed at promoting public health strategies, such as hygiene and first aid. The 278 participants were randomly assigned to A-SEMI or HPC. Both interventions consisted of four interactive sessions of approximately 2 hours, structurally equivalent, with the administration of questionnaires and followed by a follow-up of 3 - 9 months. The A-SEMI participants have a greater knowledge of HIV (p = 0.009), they perceive fewer obstacles to condom use (p <.001), which they use more consistently (p <.001).

Chen W. and colleagues, however, have emphasized that migrant workers are at greater risk of developing occupational health risks due to incorrect behavior, such as the low use of personal protective equipment (PPE). For this reason, they proposed a protocol of an experimental study to be

carried out on migrant workers in 60 small-medium enterprises in China. The subjects will be divided into 2 groups, intervention and control, and the results analyzed at 0-3-6 months, in order to verify the use of PPE and expand the knowledge of workers on specific risks [50].

Purpose of the experimentation of Lee H. et al. was to examine the effects of a standardized walking program (ST) compared to an enhanced ambulation program (ET) with reference to the main cardiovascular parameters, among 132 Chinese migrant workers in Korea, without contraindications to physical activity. Both groups had to reach monthly goals; the ET group received text messages to encourage walking and movement. After 12-24 weeks, there was a significant decrease in risk at 10 years for cardiovascular disease (CVD), blood pressure, fasting glucose, BMI and abdominal circumference in both groups [51].

Li and colleagues tried to implement the knowledge on the risk of contracting malaria among 1441 Chinese workers migrated to Niger for work, through the use of chat and social networks. The participants initially completed a questionnaire on the knowledge of the disease, then were randomly divided into an experimental group or controls; the first group were constantly sent specific messages regarding the prevention and therapy against malaria, while the second group gave more general information. After 4 months, the participants again completed the questionnaire. In the first questionnaire the percentages on experience and knowledge stood at 58-60%, after 4 months they passed to 70%; the improvement was mainly found in the experimental group, compared to controls ($p < 0.01$) and a decrease in malaria diagnoses was recorded, going from 23.72% to 15.40% during the experimentation period [52].

4. Discussion

The issue of attention to the protection of health and safety in the workplace of migrant workers is very relevant, especially for the occupational physician. In fact, it is important to underline the importance of ethical, professional, scientific and legislative motivations that require the occupational physician to protect the most vulnerable worker, for possible social and health consequences.

Our review highlighted some specific risk factors present in this area, deserving of adequate consideration, in particular for the prevention of some repercussions on work activity.

Among these, infectious diseases are strongly responsible in the etiology of the main disorders of migrant workers. Infections are one of the major causes of mortality and morbidity for public health, particularly in developing countries [20, 53]. Most migrant workers such as farmers, drivers, waiters come from regions endemic to intestinal infections, characterized by modest socioeconomic levels and poor access to care [54]. The spread of pathogens has closely linked to educational, environmental, health conditions, socio-economic status and access to medical care. Some categories of workers are considered to be most at risk, such as cooks, waiters and agricultural producers, poor hygiene conditions and inadequate knowledge about food storage can be source of pathogens and be involved in the transmission of infections to local communities and consequently to business travelers or tourism [55].

Infections such as tuberculosis and malaria are still global public health problems [20, 56]; according to the latest WHO estimates, tuberculosis is the ninth-leading cause of death in all manner with 1.3 million TB deaths in 2016 and 10.4 million people infected, of whom 65% are male and 56% of cases from countries such as China, Philippines and Pakistan [57].

Despite significant efforts and resources dedicated to the control of these diseases remains a difficult challenge to face, due to the increase in mobility between countries, to the difficulties of access to treatment for some populations and for cases resistant to treatment [58; 59].

Emerging infections, such as pathologies not present in a territory but of import due to migrations and the higher mobility among workers, for example cases of Dengue and Zika from the South America or Avian Influenza from China, must be taken into account for the purposes of proper health surveillance [60, 61].

Moreover, migrant workers exhibit demographic characteristics that would put them at high risk for heterosexual HIV transmission, such as unstable family and work situations, ease of access to high-risk (including commercial) sex and lack of access to HIV treatment and prevention programs [62,63,64]. Rural residence, longer duration of migrant work to be independently, physical isolation, alcohol use, human rights violations are associated with testing positive; female gender, higher level of education, policy reforms and workplace interventions to be negatively associated [65,66].

Many studies report a higher prevalence of obesity and cardiovascular diseases associated with migrants, due to environmental factors and changes in lifestyles [67,68]. One of the possible explanations for the greater prevalence of the metabolic syndrome among migrants is the rapid transition from developing countries to Western countries; rapid changes in environmental factors and changes in lifestyles, with greater sedentary and greater consumption of energy foods, worsen the cardiovascular profiles of migrants [69,70]. Migration from rural areas to urban areas, in fact, has been associated with incorrect lifestyles and behavior patterns, with an increase in the consumption of polyunsaturated fats and a reduction of saturated fats, complex carbohydrates and fibers, as well as a poor physical activity [27,71]. Also important is the role of particularly stressful jobs carried out by expatriate workers, with long shifts and night shifts that can alter biological cycles, such as glucose and lipid metabolism [72].

These studies support what the "*Healthy Migrant Effect*" reported in 2009, which highlighted how migrants have a decay of their health status, proportional to the length of their stay in Western States [73]; the longer duration of stay has been associated with an increase in cardiovascular risks, including overweight, obesity and hypertension [74]. This effect has related proportionally with the country of origin, the reasons for the transfer to another country, the lifestyles adopted and the determinants examined, such as the relationship between ischemic diseases, diabetes and years of stay of migrants in Denmark [73,75].

The work conditions, climate, the plans and personal expectations of each individual, together with a host of other factors, combine to form a model of alcohol consumption that may reflect the habits of the country of origin, or even involve increased drinking. The relation between substance abuse and migration is complex. There seems to be a multifactorial relation in which biological, psychological, cultural and social factors intervene. Some authors have associated hazardous alcohol consumption with the type of work [76,77]. Construction and agriculture, both open to the inclement weather, traditionally offer hard work conditions, and ingestion of alcohol before beginning work is a common habit [44]. Occupational health services are one of the pillars for conducting early interventions; for prevention in fact, work is the ideal place for the homogeneity of the population concerned, the free access to all employees and the possibility of follow-up activity.

According to the Italian Workers Compensation Authority (INAIL) sources, in 2016 work accidents in Italy involving foreign workers amounted to 61 thousand (15% of the total), of which 45 thousand occurred to non-EU citizens and about 16 thousand to EU citizens; events occurring in the industrial sector in 87% of cases, 6% in agriculture and 29% in female subjects [78].

The data available to us through this review of the literature confirm this trend, as many studies highlight the greater risk of incurring accidents for migrant workers, as they often work in hazardous environments without safety devices available, especially in the productive sectors and building [79]. Construction workers are among the categories most exposed to various risks at the workplace, physical, chemical, biological and ergonomic [44,77]. This category of work is more likely to incur trauma, even fatal, and to develop respiratory diseases, such as chronic obstructive pulmonary disease, asthma, silicosis, and dermatological diseases [80]. The authors of the studies suggest some preventive strategies that can be applied, in order to prevent and reduce even fatal accidents: for example, it is necessary to identify areas with higher risk (construction, manufacturing, mines), to improve the training of personnel in the field of safety, strengthen the use of adequate equipment often not used and establish or strengthen national surveillance systems.

From our review, another particularly risky sector has turned out to be agriculture. Migrant farmers are among the most marginalized job classes, often very poor, without legal protection and

residing in inadequate facilities [81]. Workers employed in the seasonal migrant agricultural sector are exposed to climatic conditions with high temperatures, chemicals and pesticides that can lead to dermatological diseases and respiratory diseases, to incongruous postures and repetitive movements resulting in musculoskeletal disorders, to sometimes fatal traumatic injuries [82, 83, 84]. Housing conditions in poorly ventilated housing, poor hygienic conditions, with humidity and mildew, favor the onset of respiratory diseases, such as pneumonia and asthma, and infectious diseases [81, 85].

Furthermore, the lack of knowledge on occupational diseases combined with the poor use of safety devices expose these workers to a greater risk of developing accidents and occupational diseases, mainly allergic symptoms [86].

Through our review, we have highlighted that the quality of life of migrant workers is lower than that of the natives. Migrant workers are a vulnerable population group in urban areas [87, 88]. These people have, in most cases, lower education levels, lower income, heavier workloads, longer working hours, and live in more crowded housing compared to local residents [89]. Health-related quality of life (HRQOL) has become an important target in the medical area, including treatment outcome assessment, health economics evaluation, and assessing the effects of health education. HRQOL has been widely applied in epidemiological studies. However, this methodological approach is being used rarely among migrant workers without specific illnesses. New-generation migrant workers have significant impairment in HRQOL compared with urban workers in the psychological and environmental domains and general health. The lower HRQOL in migrant workers may be explained by poor social support, living and work conditions [90]. Foreign workers may experience difficulty adapting to their new position; they might experience more work-related stress such as inadequate rest due to overtime work and inadequate medical and social security coverage provided by the employers [91]. Social relationships and networks that exist in the countryside are difficult to achieve in urban areas because of the distances and surroundings, leading to ever-decreasing social support [92,93]. To reduce work-related stress and foster interpersonal relationships in migrants, the psychology of sustainable development promotes greater connection with nature and empathy. Expats who settle in the new social and work environment become an irreplaceable resource for the entire community [94].

Through this work, it is clear how the occupational physician has before him the commitment to protect the health of the immigrant worker, a person with specific needs but who must be guaranteed levels of protection similar to the native workers.

The physician will have to identify the worker's origin and his personal history, in order to identify socio-cultural differences, difficulties in linguistic comprehension and compliance with prevention interventions. Health surveillance will therefore be essential, through a careful medical history (physiological, pathological, working history) and a precise objective examination, correlated by laboratory and diagnostic examinations, targeted on a case-by-case basis. The information-training courses for workers will be fundamental for prevention purposes; in the Italian Law their content is understandable and occurs verifying the comprehension of the language (Article 36 and 37 of Legislative Decree no. 106/09), to avoid security issues, management of emergencies and understanding of procedures.

Our scientific review and included studies have some limitations as a whole. First, most of the studies are cross-sectional, not intervention or efficacy evaluation, which would be of particular interest to the physician, in order to understand the determinants of occupational diseases and to set up appropriate interventions. We have included articles published in the last 5 years, from 2013 to 2018, as previous studies were not very relevant to our research field. In fact, in recent years we have observed a greater interest and attention on the part of researchers in this issue, directly proportional to the exponential growth of migratory flows worldwide.

Studies are often being conducted outside the European context, on small specific communities, with difficulties of extrapolation to our context; in most cases, the results on migrant workers have been compared with the data of the natives, not allowing to adequately characterizing the risk.

Overall, the quality of the studies was of average value, also due to the frequent use of subjective assessment tools, such as questionnaires administered to the sample not always standardized.

Finally, it was very complex to compare very different studies, by type of sector of work of the samples in question (from the "business traveler" to the domestic or farmers), for gender differences, that also affect the type of work, and environmental contexts totally different for culture, religion and legislation (for example, differences between South America, United Arab Emirates and South East Asia).

5. Conclusions

In the light of the trend of the increase in migratory flows and the increase in the prevalence of accidents and illnesses at work in foreign workers, caused by unfavorable working conditions, health professionals must direct their attention and their commitment to the protection of this category. The data in the literature and the technical-legislative tools to deal with the topic are well available today; through these data and through appropriate preventive interventions, physicians can guarantee a targeted management of this vulnerable population, especially in the most dangerous sectors.

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