



Human health and ecological assessment programs for Hebei Spirit oil spill accident of 2007: Status, lessons, and future challenges



Dawoon Jung ^{a, b, c}, Jung-Ah Kim ^{a, d}, Myung-Sook Park ^d, Un Hyuk Yim ^e,
Kyungho Choi ^{a, b, *}

^a School of Public Health, Seoul National University, Seoul 08826, Republic of Korea

^b Institute of Health and Environment, School of Public Health, Seoul National University, Seoul 08826, Republic of Korea

^c Korea Environment Institute, Sejong 30147, Republic of Korea

^d Taean Environmental Health Center, Taean 32148, Republic of Korea

^e Oil and POPs Research Group, Korea Institute of Ocean Science and Technology, Geoje 53201, Republic of Korea

HIGHLIGHTS

- Hebei Spirit oil spill caused serious damages to ecosystem and human health.
- Follow-up ecosystem and human health investigations were carried out independently.
- Gaps and inefficiencies were identified between these two long-term investigations.
- Areas warranting collaboration between both investigations are suggested.

ARTICLE INFO

Article history:

Received 28 July 2016

Received in revised form

31 December 2016

Accepted 31 December 2016

Available online 2 January 2017

Handling Editor: Shane Snyder

Keywords:

Hebei Spirit oil spill

Human health assessment

Ecosystem health assessment

Long-term monitoring

ABSTRACT

Hebei Spirit oil spill (HSOS) of December 2007 is one of the worst oil spill accidents that occurred in Yellow Sea. The affected coastline along the west coast of Korean Peninsula hosts one of the largest tidal flats worldwide, and is home to tens of thousands of human residents. Based on nation-wide concerns on ecosystem damages and adverse human health effects, two separate surveillance programs on ecosystem and human health were initiated: a 10-year follow-up program by Ministry of Oceans and Fisheries to assess ecological impacts of the oil spill, and an exposure and health effect assessment program by Ministry of Environment for the residents of Taean and its vicinity. For the past eight years, extensive monitoring and surveillance data on ecosystem and humans have been accumulated through these programs. But these studies have been conducted mostly independently, and collaborations were seldom made between two programs. The lack of communication resulted in gaps and overlaps between the programs which led to loss of critical information and efficiency. As oil spill can affect both humans and ecosystem through various pathways, collaboration and communication between human and ecosystem health surveillance programs are necessary, and will synergize the success of both programs. Such concerted efforts will provide better platform for understanding the status of impact, and for developing approaches to address human and ecosystem health challenges that may be faced following environmental disasters like HSOS.

© 2017 Elsevier Ltd. All rights reserved.

1. Background

Oil spill in the sea can cause immediate and catastrophic consequences on the marine and coastal ecosystem, and also disrupt

* Corresponding author. School of Public Health, Seoul National University, Seoul 08826, Republic of Korea.

E-mail address: kyungho@snu.ac.kr (K. Choi).

the physical and mental health, and livelihood of humans that reside in the impacted area (Cline et al., 2014; Guimarães and Alves, 2014; Shultz et al., 2015). In recent decades, several massive oil spills, such as Exxon Valdez oil spill near Alaska, Deep Water Horizon wellhead blow out in the Gulf of Mexico, and the Prestige oil spill of Spain, have occurred, and affected the ecosystems and human lives around the affected area for a prolonged period of time (Albaigés et al., 2006; D'Andrea and Reddy, 2014).

Hebei Spirit oil spill (HSOS) incident is one of the most serious oil spill accidents that occurred in the Yellow Sea that lies between Korea and China (Yim et al., 2012). The accident occurred about 10 km off the coast of Taean on December 7th, 2007, when a crane barge (Samsung No. 1) struck the M/V *Hebei Spirit* tanker, and resulted in the release of approximately 10,900 tons of oil into the sea. The released oil contaminated roughly 375 km coastline of the Korean west coast and islands nearby.

The affected area hosts one of the largest tidal flats worldwide, and is home to diverse benthic organisms which comprise integral components in the marine and coastal ecosystem. In addition, the affected coast of Taean is home to Korea's only coastal National Park. As pollution by spilled oil severely damages the marine and coastal ecosystem (MLTMA, 2008), therefore, ecological consequences of HSOS became a great public concern.

HSOS incident is unique in that it affected not only the ecosystem, but also human health and the local economy. Residents of Taean along with up to 1.3 million volunteers (total person-days) across the country participated in the clean-up campaign that was carried out for several months. Because of lack of contingency planning for oil spill remediation, and unawareness of possible chemical exposure from the oil spill, most clean-up workers did not wear proper personal protection equipment. Throughout the remediation process, therefore, many residents and volunteers were exposed to various oil related compounds and experienced acute and chronic health consequences (Lee et al., 2009).

Following the accident, people subsequently recognized seriousness of human health and ecological consequences of the oil spill. Therefore, Korean government initiated long-term monitoring programs for both human and ecosystem health: Ministry of Environment established Taean Environmental Health Center (TEHC) and began to investigate long-term health effects of residents. Ministry of Oceans and Fisheries along with Korea Institute of Ocean Science and Technology (KIOST) started a 10-year long project on ecological impact assessment and restoration. The goals of these efforts were to understand the human health and ecological impacts of the oil spill, and to develop appropriate management measures for HSOS and similar accidents in the future.

In this study, we reviewed the history and progresses of the human health and ecosystem assessment programs, and identified the areas that warrant communication and collaborative efforts between these two follow-up programs. The results of this study can be applied to future oil spill accidents to develop a public health management framework through collaboration between human health and ecosystem assessment programs.

2. After HSOS: status and progresses

2.1. Immediate responses: the first month

2.1.1. Clean-up activities and governmental responses

Immediate responses to the oil spill had started with the arrival of clean-up vessels at the site two hours after the accident. Four days after the accident, the government declared the six districts within the region as Special Disaster District, and three months later, "Special act on assistance to residents suffering damage from the *Hebei Spirit* oil spill accident and restoration of the marine environment" was enacted for the remediation of contaminated environment and for compensation for the damages residents experienced (Fig. 1).

The clean-up processes have taken place both on water and on shore, and were most rigorously carried out during the first month after the accident. Later on January 8th, 2008, Korean government declared conclusion of the clean-up in the sea (Yim et al., 2012). In

the clean-up operation in the sea, relatively fewer civilians were involved. In contrast, clean-up activities on the beaches and along the shorelines which took longer time, were mostly conducted by local residents and volunteers (TEHC, 2011). Across the country, over 1.3 million volunteers (total person-days) came and participated in the clean-up until the end of May 2008, but for relatively short period of time. The local residents, however, participated in the clean-up for longer period of time. As fisheries and tourism were not possible after the accident, many local residents participated in clean-up activities and received payments for their work. Clean-up activities on the shore involved direct contacts with crude oil through activities such as wiping, skimming, and scooping oil off the surfaces. Due to limited awareness on the health effects of oil exposure, the clean-up workers and volunteers mostly worked without proper personal protection equipment (PPEs). The government and media began to release advisories to wear PPEs one week after the accident. However, actual precautionary measures, such as safety guidelines, were not implemented until one month after the spill (TEHC, 2011).

2.1.2. Acute human health issues – first month

Immediately following the oil spill, volatile organic compounds (VOCs) and lighter weight polycyclic aromatic hydrocarbons (PAHs) can be released from the affected area. Appropriate protection measures against such exposure, however, were not taken, on one hand due to the lack of awareness of potential health damages, and on the other hand due to the government's priority on containment of oil and minimization of ecological and economic damages. For example, the Emergency Responses Center established shortly after HSOS did not include any representatives from the Ministry of Environment or Ministry of Health and Welfare. Representatives from Ministry of Health and Welfare were stationed on site, but were mostly involved in emergency medical support for symptoms such as headache, nausea, etc. Exposure to oil related chemicals and associated health consequences were not considered then by the Ministry.

Independent researchers from academia and non-governmental organizations (NGOs) collected urine samples from residents and volunteer clean-up workers, as early as December 14th, one week after the accident, and measured VOCs, PAH metabolites, and heavy metals. Metabolites of oil components in urine, e.g., t,t-muconic acid, mandelic acid, 1-hydroxypyrene (OHP), increased among the volunteers after clean-up activity (Ha et al., 2012). Urinary levels of two oxidative stress markers, thiobarbituric acid reactive substances (TBARS) and 8-hydroxydeoxyguanosine (8-OHdG), were also elevated (Lee et al., 2010b). They also investigated symptoms of visual disturbance, nasal and bronchus irritation, headaches, heart palpitations, fatigue and fever, memory and cognitive disturbance, and abdominal pain among the subjects. The intensity of physical symptoms was elevated among the subjects who participated in the clean-up activities (Sim et al., 2010), and was also positively correlated with the duration of clean-up (Cheong et al., 2011; Ha et al., 2012). In addition, lack of PPE was associated with higher levels of fatigue and fever, and higher concentrations of urinary mercury (Lee et al., 2009). Several other studies have shown the association between acute exposure to oil spill and physical symptoms among the clean-up workers and local residents during the first few weeks (Table 1). Among military personnel participating in the clean-up, the duration of clean-up was also significantly associated with the intensity of physical symptoms, whereas the use of PPEs correlated negatively (Gwack et al., 2012). All studies involving human subjects were reviewed for ethics by the Institutional Review Board of Dankook University Hospital (Cheonan, Korea). A summary of research findings is listed in Table 1.

Download English Version:

<https://daneshyari.com/en/article/5747440>

Download Persian Version:

<https://daneshyari.com/article/5747440>

[Daneshyari.com](https://daneshyari.com)