Mining in High Altitude: Chile – Challenges for health

Dr. Manuel Guerra Godoy

Dirección de Salud e Higiene Ocupacional - División Minería
Gerencia Zonal Norte
Mutual de Seguridad C. Ch. C.
AGENDA

• Chile:
  • Work Safety and Health in Chile
  • The role of Mutual de Seguridad CChC
  • Present and Future Challenges in Work Safety and Health in Chile
Chile

Length 4.329 Km
Average width 175 Km
AGENDA

• Chile: Demographics

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Mutual System (Non for Profit)

PROTECT: Health and Safety Insurance

PREVENT: Safety Consultancy Services

PROVIDE: Worker’s Compensation

PROVIDE: Health Care and Rehab Services
Number of Workers insured by all Mutuals

2.895.116

4.832.489
Labor accident rates

Accident rate per hundred workers
Fatal Accidents Rates 1997 - 2015

At work

Transit

Dead rate per thousand workers
Fatal accident rates by economic sector - 2015

<table>
<thead>
<tr>
<th>Economic Sector</th>
<th>Rate per 100,000 workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>14.6</td>
</tr>
<tr>
<td>Mining</td>
<td>9.6</td>
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<tr>
<td>Agriculture, Forestry and Fishing</td>
<td>6.8</td>
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<tr>
<td>Construction</td>
<td>6.7</td>
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<tr>
<td>Manufacturing</td>
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<tr>
<td>Trade</td>
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<tr>
<td>Services</td>
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<tr>
<td>Electricity, Gas and Water</td>
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</table>
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Mutual de Seguridad in Numbers

+ 95,000 Insured Companies

1.950,000 insured workers

4,300 employees throughout the country

National Coverage

North
14 Clinics

Center
18 Clinics

Metropolitan
10 Clinics

South
23 Clinics

1 Terciary Care
Trauma Hospital

More than 70 outpatient clinics
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Control of **fatal accidents**

Control of **Occupational Diseases**

**Aging Workforce**

**Migrant workers**

**Extreme Environment exposures**

(The case of working at High Altitude)
Mining is the strongest pillar of Chile’s economic and social development and is a world class industry.

25% of government revenues come from the Copper
Mining Activities in High Altitude in Chile

4,800 – Nevada
4,600 – Maricunga
4,500 – Collahuasi
4,200 – Quebrada Blanca
3,900 – El Abra / Litio SQM / Salar SQM
3,200 – Zaldivar / Los Pelambres / Los Bronces
3,100 – Andina Valparaíso
3,050 – Escondida Antofagasta
Working at High Altitude

Environment
- Atmospheric Pressure
- Temperature
- Wind
- UV radiation
- Geology

Workers
- Performance
- Health Risks
- Isolation
- Nutrition
- Off work time

Equipment
- Performance
- Storage
- Supplies
Types of Exposure to High Altitude

Permanent exposure: Residents or Natives

Recreational or Sports exposure

Occupational Exposure: Sporadic or chronic intermittent
Levels of human response against adverse environmental effects of hypobaria

**Cultural level:** using technical means to help mitigate the effects of hypobaria.

**Physiological level:** through compensatory responses of the body that allow settle and acclimatize to hypobaric environment. Instinctive appearance of adjustments in behavior, functional and structural modifications.

**Genetic level:** is evolutionary changes and implantation in the human genome.
Background

Chile for being a mountainous country, a lot work activities are carried out in places over 3000 m.a.s.l., specially in the field of mining.

They are not only mineworkers exposed to these conditions, but an increasing number of workers at altitude as military, transport and public officials. There are more than 50,000 workers exposed in Chile.

Considering this trend, the effects of altitude are now relevant to consider in occupational health aspect.
Main conditions in high altitude

- Environmental dryness
- Oxygen Shortage
- Isolation
- UV radiation
- Extreme temperatures
Dryness
UV radiation
Lack of oxygen
Extreme temperatures
Isolation
Shiftwork system

Physical discomforts
Psychological disorders
 Decompensated chronic diseases
Sleep disturbances
Accidents
Decreased productivity
<table>
<thead>
<tr>
<th>Altitud (m)</th>
<th>Bar</th>
<th>Tor (mm Hg)</th>
<th>pI O2 (mm Hg)</th>
<th>pA O2 (mm Hg)</th>
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Own conditions of labor

Shiftwork system.

Physical and mental overload.
acknowledges that between 20 and 30% of traffic accidents are caused by fatigue
Every human work, including:

MAINTENANCE
REPARATION
REPRODUCTION

It requires ENERGY
What is fatigue?

Adenosine Triphosphate (ATP) = combustible cell
Lack of oxygen = Lack of ATP

Lack of ATP → Fatigue events

ATP underproduction → Fatigue events
ATP overconsumption → Fatigue events
### Factors

<table>
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<tr>
<th>Personal</th>
<th>Psychosocial</th>
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<tr>
<td>Medical, physical and mental condition</td>
<td>Alternative work during breaks</td>
</tr>
<tr>
<td>Individual susceptibility</td>
<td>Family crisis (finance, addictions, health, etc.)</td>
</tr>
<tr>
<td>Sleep habits, eating and exercise</td>
<td>Lack of knowledge of the family group of F &amp; S</td>
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</table>

<table>
<thead>
<tr>
<th>Environment</th>
<th>Company</th>
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<tbody>
<tr>
<td>Geographic location</td>
<td>System and shift schedule</td>
</tr>
<tr>
<td>High altitude</td>
<td>Monotony of labor</td>
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<tr>
<td>Weather conditions</td>
<td>production requirements</td>
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<tr>
<td></td>
<td>Comfort in the bedrooms</td>
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<td>Feeding</td>
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Chile, 2013: Modification to S.D. 594

“The companies or locations that have workers exposed to chronic intermittent hypobaria by high altitude (> 3000 meters above sea level), should make risk prevention by taking the following measures:

Inform risks to workers.

Risk Management (Incorporating risk management system).

Preventive written program (updated annually).

Occupational Surveillance Program.

Annual theoretical and practical training (3 hours) provides by trained professional of health).

Annual Preventive medical check (private health system)”
Intermittent Chronic hypobaria (ICH) exposure:

“Discontinuous exposure of workers to high altitude for work for more than 6 months, with a minimum stay of 30% of this time in rotating shifts systems at high altitude and low altitude rest.”
Challenges for health in Chile

Application of preventive measures, evaluation, control and monitoring of those exposed to CIH must be addressed as a social and ethical responsibility to care for the health and quality of life of workers.

Training of professionals and technicians in Occupational Health, Mountain Medicine, Medical emergencies, Physiology and High Altitude Medicine. Currently there are not enough doctors and professionals trained to address the problems of health of workers exposed to hypobaria environment.

Application of knowledge and scientific evidence in the evaluation, control and monitoring of workers exposed to CIH.
Challenges for health in Chile

Establish partnerships with academic institutions, to carry out research projects that contribute to knowledge of human physiology and high altitude medicine in hypobaria environment and exposed workers. Exposure to chronic intermittent hypobaria hypoxia is a biological, epidemiological and occupational phenomenon that needs to be studied in Chile.

Identify workers who have poor tolerance to hypobaria hypoxia, see the possibility to train in simulated conditions, treat and reintegrate them in their work environment.

Redesign jobs and shift systems (Ergonomics).
Challenges for health in Chile

Companies with workers exposed to CIH should implement measures to mitigate the effects of hypobaria, both during working hours and during the period of sleep in camps, especially in workers who fail to acclimatize by oxygenation during sleep especially.

Including Fatigue in the matrices of occupational risks, implementing a risk management program.

Prevention of occupational diseases: Acute Mountain Sickness, erythrocytosis, Sleep Central Apnea, Chronic Pulmonary Hypertension, Right Heart Failure, etc.
Thank You